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May 17, 2023

Ms. Sheila Abraham
Ohio Environmental Protection Agency
Division of Emergency Response and Revitalization
Northeast District Office
2110 East Aurora Road
Twinsburg, OH 44087

Subject: Submittal of Final Feasibility Study
Inland Corporation and BP Pipelines (North America) Inc.
Weaver Woodlands, New Franklin, Summit County, Ohio
Ohio EPA Project ID number, 277001207005

Dear Ms. Abraham:

On behalf of Remediation Management Services Company (RMSC), the enclosed Final Feasibility Study (FS) for the Weaver Woodlands Allotment Site (the Site) in New Franklin, Summit County, Ohio is being submitted to Ohio EPA. RMSC is managing the environmental issues associated with the Site for Inland Corporation and BP Pipelines (North America) Inc. to fulfill requirements of the Ohio EPA Director's Amended Final Findings and Orders (2007 Orders).

A draft final FS was submitted to Ohio EPA electronically on September 22, 2022. On October 19, 2022, an email was received from Ohio EPA requesting revision of the FS to include estimated costs for the five remedial alternatives evaluated in the FS. A draft remedial alternatives cost comparison was submitted to Ohio EPA on December 6, 2022. Ohio EPA responded by email with questions and comments on December 20, 2022. A response to comments and a revised remedial alternatives cost comparison were submitted to Ohio EPA on March 6, 2023. Ohio EPA responded by email with additional questions and comments on April 6, 2023. A response to comments and revisions were submitted to Ohio EPA by email on May 12, 2023. On May 16, 2023, an email was received from Ohio EPA indicating that the proposed revisions to the FS were approved, subject to one additional comment/question, and requesting that the FS be finalized.

The enclosed Final FS incorporates the proposed revisions to the draft FS that were approved by Ohio EPA on May 16, 2023.

Should you have any questions, please contact me at 330-421-1100.

Sincerely,

Greg Frisch
Liability Manager
Remediation Management Services Company, a BP-affiliated company

cc: Mark Schmidt, Antea Group-Verdantas
WR Barth, Sunoco Pipeline L.P.

FINAL

FEASIBILITY STUDY
WEAVER WOODLANDS ALLOTMENT
NEW FRANKLIN
SUMMIT COUNTY, OHIO

PREPARED FOR:
BP PIPELINES (NORTH AMERICA) INC. / INLAND CORPORATION

PREPARED BY:
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MAY 2023

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ACRONYMS AND ABBREVIATIONS

AC	Area of Concern
ARARs	Applicable or Relevant and Appropriate Requirements
AS	Air Sparging
bgs	Below Ground Surface
BTEX	Benzene, Toluene, Ethylbenzene, and Xylenes
BUSTR	Bureau of Underground Storage Tank Regulations
CAP	Corrective Action Plan
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COC	Chemical of Concern
CSEM	Conceptual Site Exposure Model
DERR	Division of Environmental Response and Revitalization
DPE	Dual Phase Extraction
EU	Exposure Unit
FS	Feasibility Study
gpm	Gallons Per Minute
HSU	Hydrostratigraphic Unit
LNAPL	Light Non-Aqueous Phase Liquid
MCL	Maximum Contaminant Level
MNA	Monitored Natural Attenuation
msl	mean sea level
NSZD	Natural Source Zone Depletion
OAC	Ohio Administrative Code
ORC	Ohio Revised Code
ODNR	Ohio Department of Natural Resources
Ohio EPA	Ohio Environmental Protection Agency
PDI	Pre-Design Investigation
PER	Pre-Investigation Evaluation Report
PHC	Petroleum Hydrocarbon Compound
POE	Point of Exposure
PVI	Petroleum Vapor Intrusion
RAO	Remedial Action Objective
RD/RA	Remedial Design and Remedial Action

LIST OF ACRONYMS AND ABBREVIATIONS CONT'D

RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
RL	Remedial Level
RMSC	Remediation Management Services Company
RSL	Regional Screening Level
SCM	Site Conceptual Model
SVE	Soil Vapor Extraction
TPH	Total Petroleum Hydrocarbons
U.S. EPA	U.S. Environmental Protection Agency
VISL	Vapor Intrusion Screening Level

1.0 INTRODUCTION

This Feasibility Study (FS) Report has been prepared on behalf of Remediation Management Services Company (RMSC), a BP affiliated Company. RMSC is managing the environmental issues associated with the Weaver Woodlands Allotment (the Site), located in New Franklin, Summit County, Ohio for Inland Corporation and BP Pipelines (North America) Inc. A Site Location Map is provided in Figure 1-1. This FS Report is being submitted on behalf of Inland Corporation and BP Pipelines (North America) Inc. (BP) in fulfillment of Section VI, paragraph 10(g) of the Director's Amended Final Findings and Orders ("2007 Orders") for the Site.

This FS is a follow-up to the August 2019 Final Remedial Investigation Report, submitted by RMSC. Based on information collected during the RI, 38 properties/exposure units (EUs) in New Franklin, Summit County, Ohio were designated to be carried forward for evaluation in the FS to address petroleum hydrocarbon impacts in proximity to an abandoned underground petroleum pipeline. Documentation of Ohio EPA's approval of the RI was provided in the November 25, 2019, letter Report for Weaver Woodlands Allotment, New Franklin Remedial Investigation/Feasibility Study – Next Steps. A copy of the letter, including associated tables identifying the properties/EUs to be evaluated, is presented in Appendix A.

Ohio EPA approves the FS prior to drafting a Preferred Plan for public comment. The Agency considers public comments before finalizing the remedy in a Decision Document.

The FS generally follows the process of the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA) for developing and evaluating alternative remedial responses. Following approval of the FS, the Ohio EPA will draft a Preferred Plan for public comment. The Ohio EPA will consider public comments before finalizing the remedy in a Decision Document.

1.1 Purpose and Organization of Report

1.1.1 Purpose

The purpose of the FS is to evaluate and select remedial alternatives that ensure compliance standards are met at the identified Points of Exposure (POEs) to ensure current and future receptors are protected across a site that has varying geology, land use and impact magnitudes. The FS defines a performance-based remediation approach, which employs a range of technologies appropriate to the conditions. Individual technologies have a limited range of efficacy, therefore a given area may transition between remediation technologies to achieve the project goal as conditions change and impacts are reduced.

1.1.2 Organization

The FS is organized into the section listed below:

- Section 1 presents background information, including Site description, Site history, site geology and hydrogeology, summarized from the August 2019 RI Report; a summary of activities performed since completion of the RI; a description of the nature and extent of contamination; a summary of the risk assessment, and a summary of the potential exposures at the EUs.
- Section 2 presents remedial action objectives and applicable or relevant and appropriate requirements (ARARs).
- Section 3 presents the screening of potentially applicable remedial technologies.
- Section 4 presents a description and evaluation of remedial alternatives and a description of the recommended alternative.
- Section 5 presents a description of the process of implementation of the recommended alternative.
- Section 6 presents references cited.

Tables, figures, and appendices follow the text of this report.

1.2 Background Information

This section presents a description of the Site and summarizes the history (including the RI), post-RI activities, and current conditions for development of the FS.

1.2.1 Site Description

The Site is located in the city of New Franklin, Summit County, Ohio. A portion of the United States Geological Survey Canal Fulton, Ohio 7.5-minute topographical quadrangle map, showing the subject property, is provided as Figure 1-1. The Site is located in a mixed rural and residential setting southwest of Akron, Ohio. The topography of the Site generally slopes from southwest to northeast

A 12-inch buried petroleum pipeline traverses the Site from west to east. The 12-inch pipeline was installed in 1970, to replace a buried 6-inch petroleum pipeline that was abandoned at that time. The Site is the location of impacts from petroleum hydrocarbon compounds (PHCs) that are attributed to releases from the abandoned 6-inch pipeline. As discussed in Section 1.0, the Site consists of 38 properties/EUs that have been retained for evaluation in the FS. The EUs are grouped into three remedial response areas: the Western Area, the Central Area, and the Eastern Area, which are illustrated on Figure 1-2. BP owns 13 vacant homes and several undeveloped parcels in the area, which are identified on Figure 1-2.

1.2.2 Site History

1.2.2.1 Release Discovery and Initial Investigation

During the mid-1940s, a 6-inch diameter buried petroleum pipeline was installed at the Site for transportation of refined petroleum products. The 6-inch line had several documented product releases during its operational period. In 1970, the 6-inch pipeline was abandoned and replaced by a 12-inch pipeline.

Beginning in the 1950s, residential homes were constructed in proximity to the buried petroleum pipeline. The primary drinking water source for these homes is groundwater from the Massillon Sandstone aquifer, as well as from local glacial till deposits.

In January and February 1990, several water wells at houses located in the area on Maywood Drive, Kaylin Drive, Fairwood Road, and Dailey Road were identified as having PHCs in their potable water supply. The Ohio EPA Division of Emergency Response and Remediation (DERR) was one of several government agencies that responded to the incident. Thirteen homes were eventually found to have detectable concentrations of benzene, toluene, ethylbenzene, and xylenes (BTEX) in their water supply wells.

In January 1991, Inland Corporation and BP agreed to Ohio EPA's 1991 Findings and Orders for conducting only investigations (B&N, 1995). As a result, Phase I and Phase II Hydrogeologic Investigations were completed between 1991 and 1994. The Phase I and Phase II investigations identified six areas of concern (ACs), designated AC-1 through AC-6. As an outcome of the RI, these designations have been replaced by the remedial response areas, which generally encompass the former ACs: the Western Area generally includes AC-1, AC-2, and AC-3, the Central Area generally includes AC-4; and the Eastern Area generally includes AC-5 and AC-6.

The chemicals of concern (COCs) were initially established based on the knowledge of the historical contents of the pipelines crossing the Site. Several documented releases of PHCs, predominantly gasoline, occurred along the 6-inch pipeline during the period it operated. The chemicals of potential concern at this Site were therefore established as PHC compounds. The Phase I and Phase II investigations identified the BTEX compounds and naphthalene as the primary COCs.

1.2.2.2 Source Reduction Remediation

Based on results of the Phase I and Phase II investigations and a subsequent remedial design study, BP elected to perform source reduction remediation on an interim and voluntary basis in 5 locations (2 in the Western Area, 1 in the Central Area, and 2 in the Eastern Area). Remediation systems were installed between 1998 and 1999 and generally operated until 2004. Descriptions of the remedial systems and their performance were presented in the URS 2008 Pre-Investigation Evaluation Report (PER) and are summarized below.

1.2.2.2.1 Western Area

In the Western Area (former AC-1), a Geoprobe™ investigation conducted between July and September 1997 concluded that PHC-impacted soils were generally limited to the backyard of a residence located at 604 Fairwood Drive. Results of the soil sampling were presented in the 1997 Modified Corrective Action Plan for Area of Concern AC-1. Due to the presence of PHC impacted soils that were generally limited to the backyard of a residence located at 604 Fairwood Drive, and the absence of shallow groundwater in the glacial soils in that area, BP elected to install a soil vapor extraction (SVE) system at 604 Fairwood Drive. A figure showing the layout of the system is included in Appendix B. The remedial system operated between January 1999 and May 2004. In May 2004, the system was shut down, as influent total petroleum hydrocarbon (TPH) concentrations were consistently below the laboratory detection limit. Contaminant removal can be summarized as follows:

Contaminant Removal Description	
Approximate TPH Vapor Phase Mass Removed (lbs)	13,267
Approximate PHC Aqueous Phase Mass Removed (lbs)	0.4
Approximate Total PHC Mass Removed (lbs)	13,485
Approximate Total Equivalent Gallons of PHC Removed	2,119

In June 2004, 40 soil samples were collected from 20 Geoprobe® soil borings (GP-100 through GP-119) advanced at 604 Fairwood. Based on a comparison of the June 2004 soil data to historical soil data (i.e., 1997 investigation), the data indicate that BTEX concentrations, especially benzene, decreased significantly in the unconsolidated soils at 604 Fairwood as a result of operation of the SVE system.

BP also performed voluntary source reduction remediation in the former AC-3 in the Western Area at 542 Center Road (southeast corner of the Renninger and Center Roads). PHCs were detected in soil and groundwater samples collected in unconsolidated soils on two properties in this area. At this location, a dual phase extraction (DPE) system was installed. A figure showing the layout of the system is included in Appendix B. The DPE system operated between April 1998 and May 2004. In

May 2004, the system was shut down because concentrations of extracted vapor phase and liquid PHCs were generally below laboratory detection limits. Contaminant removal can be summarized as follows:

Contaminant Removal Description	
Approximate PHC Vapor Phase Mass Removed (lbs)	2,477
Approximate PHC Aqueous Phase Mass Removed (lbs)	19
Approximate Total PHC Mass Removed (lbs)	2,496
Approximate Total Equivalent Gallons of Product Removed	399

In June 2004, 7 soil samples were collected from 4 Geoprobe® soil borings (GP-120 through GP-123) advanced in proximity to the DPE system. Analytical results showed BTEX concentrations in soil were approaching or below the analytical detection limits. Continued operation was no longer required for source reduction or receptor protection.

1.2.2.2.2 Central Area

BP also performed voluntary source reduction remediation in the Central Area (former AC-4) at 5255 Kaylin Drive. PHCs were detected in soil and groundwater samples collected in unconsolidated soils in this area. At this location, a DPE system was installed. A figure showing the layout of the system is included in Appendix B. The DPE system operated between April 1998 and May 2004. In May 2004, the system was shut down because concentrations of extracted vapor phase and liquid PHCs reached asymptotic levels. Contaminant removal can be summarized as follows:

Contaminant Removal Description	
Approximate PHC Vapor Phase Mass Removed (lbs)	3,416
Approximate PHC Aqueous Phase Mass Removed (lbs)	4
Approximate Total PHC Mass Removed (lbs)	3,420
Approximate Total Equivalent Gallons of Product Removed	547

1.2.2.2.3 Eastern Area

In the Eastern Area, BP elected to perform source reduction remediation at two locations: 5206 Dailey Road and at 5229/5233 Dailey Road (duplex) and 5239/5247 Dailey Road (duplex). At both of these locations, DPE systems were installed.

At 5206 Dailey Road, the system was operated between April 1998 and May 2004. The system was shut down because concentrations of extracted PHCs appeared to have reached asymptotic levels. Contaminant removal can be summarized as follows:

Contaminant Removal Description	
Approximate PHC Vapor Phase Mass Removed (lbs)	4,224
Approximate PHC Aqueous Phase Mass Removed (lbs)	15
Approximate Total PHC Mass Removed (lbs)	4,239
Approximate Total Equivalent Gallons of Product Removed	678

In June 2005, the DPE system at 5206 Dailey Road was restarted. The system operated until 2010. During that time, concentrations of extracted PHCs were low to below the analytical detection limits.

At 5229/5233 Dailey Road (duplex) and 5239/5247 Dailey Road (duplex), the system was operated between April 1998 and May 2004. The system was shut down because concentrations of extracted PHCs appeared to have reached asymptotic levels. Contaminant removal can be summarized as follows:

Contaminant Removal Description	
Approximate PHC Vapor Phase Mass Removed (lbs)	4,973
Approximate PHC Aqueous Phase Mass Removed (lbs)	228
Approximate Total PHC Mass Removed (lbs)	5,201
Approximate Total Equivalent Gallons of Product Removed	831

1.2.2.3 Remedial Investigation

In 2007, the Ohio EPA Director's Amended Findings and Orders were developed by RMSC and the Inland Corporation with the Ohio EPA. The 2007 Findings and Orders provide a path forward to project completion within the Ohio EPA regulatory framework.

Subsequently, several phases of investigation were performed to complete additional characterization and delineation that included installation of soil borings, monitoring wells, soil vapor points and subslab sampling points, and sampling of soil, surface water, groundwater, and soil and subslab vapor. Details of the investigations were presented in the 2019 RI Report. Twenty-nine (29) residential wells were sampled quarterly from the mid-1990s through 2016, and approximately 69 to 93 residential wells have been sampled annually through 2020.

The Site geologic and hydrogeologic conditions were evaluated and a Site Conceptual Model (SCM) was developed and presented in the 2019 RI Report. The conclusions of the RI Report included the following:

- The geologic conditions consist of unconsolidated glacial deposits overlying sedimentary sandstone and shale bedrock.
- The first encountered groundwater zone is encountered in the glacial deposits and weathered/fractured bedrock. This groundwater zone has been impacted by petroleum hydrocarbons in three Areas of the Site. The vertical and horizontal extent of COCs has been adequately delineated in groundwater in all three Areas. Groundwater encountered in the competent sandstone and shale bedrock and buried valley deposits is not impacted by petroleum hydrocarbons. These deeper groundwater aquifers are used as a potable water supply for all residences.
- The groundwater impacts have been grouped into three Areas (Western, Central, and Eastern). Thirty-eight (38) properties/EUs in the three Areas were identified in the RI Report to be carried forward into the FS for further evaluation of remedial alternatives to address groundwater impacts of petroleum hydrocarbon COCs, which include dissolved phase constituents and historical intermittent occurrences of light non-aqueous phase liquid (LNAPL) in three monitoring wells.
- Groundwater monitoring well results indicated that there were potentially unacceptable risks from petroleum vapor intrusion (PVI) at one occupied EU in the Western Area (569 Fairwood) and three occupied EUs in the Eastern Area (5229/5233 Dailey Road, 5239/5247 Dailey Road, and 5249/5253 Dailey Road) that required additional soil vapor, subslab, and/or or indoor air sampling to evaluate risks at these EUs.
- Soil vapor and/or subslab vapor sampling results indicated there are potentially unacceptable risks at two unoccupied BP-owned EUs in the Western Area (594 Fairwood and 605 Fairwood) and one occupied EU in the Central Area (359 Maywood) that required further soil vapor, subslab and/or indoor air sampling to evaluate risks at these EUs.

Following submittal of the RI Report in August 2019, additional data collection and interim response activities were performed that are discussed below in Section 1.2.4.

1.2.2.4 Drinking Water Well Replacement

Between 1991 and 1998, BP replaced approximately 40 residential drinking water wells in the area with double-cased steel wells designed to isolate potential petroleum impacts. The outer casing of the original double-cased well design was typically installed to the top of bedrock and therefore above the impacted shallow groundwater in and around the western portion of the Site. During subsequent investigations, two failure mechanisms with the replacement well design were identified:

1) grout loss along the annual space allowing a completed path from the contaminated shallow groundwater to the lower groundwater-bearing zone, and 2) corrosion of the steel well casing, which allowed contaminated shallow groundwater to connect to the inside well casing. In 2013, a new replacement drinking water well design was developed and approved by Ohio EPA (Ohio EPA, 2013) that addresses failures in the grout sealing and steel casings in the original design The new design consists of a double-cased well-constructed with a PVC outer and a PVC inner casing utilizing a modified Portland cement annual seal with Baroid additives. In the new design, a 10-inch diameter PVC outer casing extends at least 50 feet below the zone of groundwater contamination and a 5-inch diameter PVC inner casing extends into the deeper sandstone aquifer, with the remainder of the well completed as an open borehole. The new design was utilized to replace drinking water wells at 607 Highland Park, and 578, 585, 586, and 614 Fairwood between 2012 and 2018.

1.2.3 Site Geology & Hydrogeology

This section presents a summary of the geology and hydrogeology of the Site that was discussed in more detail in the 2019 RI Report. The majority of the Site is covered by glacial till deposited as ground moraine, end moraine, and hummocky moraine over a predominantly sandstone bedrock. The till deposits consist of two gradational units identified as the Kent Till, generally encountered at the surface, and the underlying Mogadore Till, which extends to bedrock. These units are of Wisconsinan age and are comprised of predominantly clay and silt with thin, discontinuous sand lenses, and sandstone, coal, and shale rock fragments. The thickness of these deposits averages approximately 30 feet but ranges from less than 1 foot to more than 100 feet. Glacial outwash deposits are found along a regional buried valley in the eastern portion of the Site (i.e., along Center and Dailey Road to the east) at varying thicknesses. The unconsolidated deposits at the Site have been designated hydrostratigraphic unit 4 (HSU-4).

The bedrock units underlying the glacial deposits consist of the members of the Pottsville Formation (in the order they are typically encountered), the Homewood Sandstone member (70 - 75 feet in thickness), designated HSU-1; the Mercer Shale/Sandstone member (50 – 65 feet in thickness), designated HSU-2; and the Massillon Sandstone member (greater than 60 feet in thickness), designated HSU-3. This group is typical of Pennsylvanian-age sediment deposits within a shallow marine/deltaic depositional environment. The lithology consists of alternating groups of sandstone, shale, limestone, coal, and under clays. Many of the beds within this group are not uniform in shape and exhibit abrupt lateral and vertical facies changes. Individual units are rarely consistent over large lateral distances, making lateral correlation of specific units particularly difficult.

Groundwater is typically encountered in both the unconsolidated glacial deposits and bedrock formation hydrostratigraphic units depending on location within the Site. Groundwater is typically first encountered within the upper weathered bedrock on the western portion of the Site and within the unconsolidated glacial deposits in the central and eastern portions of the Site. A deeper groundwater zone is typically encountered within the sandstone bedrock over the majority of the Site with the exception of the Eastern Area, where it is observed in buried unconsolidated glacial valley fill deposits. The deeper groundwater (i.e., greater than 60 feet below ground surface [bgs]) is the principal aquifer used as a drinking water supply. Both the groundwater zones have flow directions that are generally to the northeast. Further details regarding the geologic and hydrogeologic conditions in each Area are provided below.

1.2.3.1 Geologic and Hydrogeologic Conditions in the Western Area

The upper unconsolidated soil (HSU-4) encountered in the Western Area generally consists of brown clayey silt to sandy silt with gravel and cobbles. The unconsolidated soil in this area ranges from 1 to approximately 18.5 feet bgs, overlaying sandstone or interbedded sandstone and shale bedrock. The surface of the bedrock generally mimics the surface topography, which slopes to the northeast. The Homewood Sandstone (HSU-1) encountered beneath the surficial soils is typically weathered, gray to brown, and fractured. The Homewood Sandstone (HSU-1) becomes more competent with depth and grades to brown in color and in some instances iron oxide staining and vertical fractures are observed. Shale is usually weathered near the bedrock/soil interface but becomes more competent with depth.

The Homewood Sandstone (HSU-1) has several shale zones that are typically gray to dark gray, weak, and usually interbedded within fine to medium gray sandstone. In locations where shale deposits were noted, shale was recorded at depths of approximately 18 to 66 feet bgs with a maximum thickness of approximately 23 feet.

Other deposits noted within bedrock were coal laminae and calcium deposits at various depths. In some instances, coal layers approximately 2 feet in thickness (logged by cuttings) were encountered as shallow as 31 feet bgs and as deep as 98 feet bgs into the Mercer Shale/Sandstone unit (HSU-2).

Generally, groundwater is not encountered within the unconsolidated glacial deposits in the Western Area. The "shallow" groundwater monitoring wells in the Western Area are generally installed in the weathered/fractured portion of the Homewood Sandstone (HSU-1). The "deep" groundwater monitoring wells in the Western Area are installed in the competent portion of HSU-1 and into the Mercer Shale/Sandstone (HSU-2). The groundwater in the weathered/fractured portion of HSU-1 is encountered from approximately 0.3 to 37 feet bgs. The groundwater in the deeper/competent portion of HSU-1 and HSU-2 is encountered from approximately 10 to 55 feet bgs across the entire area. Groundwater is typically deeper in the southwest portion of the Western Area (near Highland

Park Drive) and is encountered at shallower depths in the eastern portion of the Western Area (at the corner of Center and Renninger Roads).

Groundwater in HSU-1 generally flows to the northeast. Horizontal hydraulic conductivities for HSU-1 range from 7.73E-04 centimeters per second (cm/sec.) to 1.38E-05 cm/sec. Groundwater in the deeper/competent portion of HSU-1 and HSU-2 also flows to the northeast.

Residential wells installed in this Area are completed at various depths (60-200 feet) in several of the bedrock hydrostratigraphic units, depending on the date of installation. In particular, recent residential wells installed by BP, due to casing failures, have been installed at depths greater than 140 feet bgs in the Massillon Sandstone (HSU-3). Older residential wells are completed in both the Homewood Sandstone (HSU 1) and the Mercer Shale/Sandstone (HSU-2).

1.2.3.2 Geologic and Hydrogeologic Conditions in the Central Area

The unconsolidated glacial deposits (HSU-4) encountered above the Homewood Sandstone (HSU-1) within the Central Area generally consist of brown silt and clay with sand, gravel, and cobbles. The unconsolidated soil ranges from approximately 0 to 34 feet bgs overlying mainly shale bedrock. Most of the materials are loose sand and gravel, some silts and clays are commonly observed. Thin layers of gray glacial till are occasionally encountered at 0.5 to 2 feet above bedrock. Sandstone or interbedded sandstone and shale are typically encountered beneath the glacial deposits from 12.5 to 20 feet bgs to at least 40 feet bgs.

The bedrock interface generally follows surface topography and dips slightly to the northeast and east towards a glacial buried valley. In the northeast portion of the Central Area (near the corner of Center and Dailey Roads), bedrock steeply drops off.

In the Central Area, the first groundwater zone is encountered in the unconsolidated glacial deposit hydrostratigraphic unit (HSU-4). Groundwater in HSU-4 is encountered within the unconsolidated glacial soils approximately 2 to 21 feet bgs. The groundwater in HSU-1 is encountered approximately 15 feet to 40 feet bgs.

Groundwater in HSU-4 generally flows to the northeast. The groundwater flow is below the stream surface elevation of approximately 1046 feet msl. Groundwater flow and the intermittent stream do not appear to be hydraulically connected. Horizontal hydraulic conductivity for HSU-4 ranges from 6.39E-04 cm/sec to 1.86E-05 cm/sec. Groundwater in HSU-1 generally flows to the north and east. The estimated horizontal hydraulic conductivity for HSU-1 ranges from 2.51E-04 cm/sec to 3.35E-05 cm/sec.

Residential wells installed in this Area are completed at various depths in several of the bedrock hydrostratigraphic units at depths greater than 200 feet deep, depending on age of installation. In particular, recent residential wells installed by BP, due to casing failures, have been installed at depths ranging from 100 to 240 feet bgs, in the Mercer Shale/Sandstone (HSU-2) and Massillon Sandstone (HSU-3).

1.2.3.3 Geologic and Hydrogeologic Conditions in the Eastern Area

Unlike the Western and Central Areas where the ground surface is relatively flat, in the Eastern Area ground surface topography varies considerably. The highest point in this area is approximately 1045 feet msl, near the high voltage power line tower and the intersection of a farm field and the grassy natural gas pipeline easement east of Dailey Road. The farm field to the south of RI MW 6-9 is relatively flat and at the same approximate elevation as the top of the pipeline easement and ground surface beneath the high voltage tower (1045 feet msl). The ground surface slopes away from this high point to the north and east. The eastern most portion of the Eastern Area slopes toward a wetland area that is approximately 998 feet msl in elevation.

The majority of this area that is east of Dailey Road is located within a glacial buried valley and the subsurface material consists of unconsolidated graded sands and gravels with silt and clay (HSU-4). However, highly weathered Homewood Sandstone (HSU-1) was encountered in several monitoring wells in the western portion of the Eastern Area along Dailey Road at approximately 5.5 feet bgs. Also, previous investigations (Burgess & Niple Phase II) noted bedrock encountered from approximately 7 to 13 feet bgs near Dailey Road sloping northeast to east toward the glacial buried valley.

The shallow groundwater in this portion of the Eastern Area correlates with the shallow groundwater encountered in the unconsolidated materials encountered in the Central Area (HSU 4). Perched groundwater is sporadically observed in the Eastern Area but appears to drain due to the sandy nature of the subsurface materials. Groundwater in HSU-4 is encountered within the unconsolidated soils approximately 0 to 41.9 feet bgs. Groundwater in HSU-4 generally flows to the east towards a wetland area that has a surface water elevation of approximately 998 feet msl. The horizontal hydraulic conductivity for HSU-4 groundwater in this Area ranges from 9.38E-03 cm/sec to 3.13E-04 cm/sec.

Along Daily Road, residential wells are installed in the competent portions of the Mercer Shale/Sandstone (HSU-2) and Massillon Sandstone (HSU-3). Further east in this Area, the bedrock surface has been extensively eroded by glacial activities to depths greater than 250 feet deep, in the form of a glacial buried valley deposit. Residential wells installed in this Area are completed at depths 65 to 101 feet bgs in the deeper portions unconsolidated buried valley, glacial deposits (HSU-4).

1.2.4 Post-RI Activities

Following submittal of the RI Report in August 2019, additional data collection and interim response activities were performed that consisted of drinking water testing, activities to evaluate and address vapor intrusion, groundwater monitoring, and investigation of the abandoned 6-inch diameter buried petroleum pipeline, which are discussed below.

1.2.4.1 Drinking Water Testing

Following submittal of the August 2019 RI Report, BP continued the annual residential well sampling program. Ninety-eight (98) residences were scheduled to be sampled; however, some homeowners declined the sampling or could not be contacted. Drinking water testing was performed at 90 residences during the 2019 annual sampling that was postponed from 2019 until February-March 2020, and 88 residences during the 2020 annual sampling that was performed in November-December 2020. Samples were not collected from the BP-owned residences, which are vacant. Starting in 2021, drinking water samples were only collected from residences located within, and immediately adjacent to, the remedial response areas. During the 2021 annual sampling event, which was performed primarily in November 2021, samples were collected from 42 residences, including 3 BP-owned residences. During the 2022 sampling event, which was performed in November 2022, samples were collected from 51 residences, including 11 BP-owned residences. (Two BP-owned residences located within the remedial areas no longer have a drinking water well.) Results were provided to the homeowners and were presented to Ohio EPA in separate annual reports (Antea Group-Hull, 2020, Antea Group-Hull, 2021, Antea Group-Verdantas, 2022, and Antea-Group-Verdantas, 2023). COCs were not detected in any of the samples, with the exception of the samples collected from the vacant BP-owned property at 536 Center in November 2022, in which ethylbenzene was detected at low concentrations below the MCL. The well was re-sampled on March 21, 2023, and no COCs were detected. Results of the re-sampling provided to Ohio EPA in a letter, dated April 25, 2023 (RMSC, 2023). It was determined that the ethylbenzene detections in the November 2022 samples may have been related to the replacement of the well pump two days prior to the sampling. A figure identifying the residences that were sampled during the most recent (November 2021) event is presented as Figure 1-3.

1.2.4.2 Vapor Intrusion Activities

As a follow-up to the RI Report, BP pursued investigation of the vapor intrusion pathway at the non-BP-owned residences that were identified for further evaluation in the 2019 RI Report: 569 Fairwood in the Western Area; 359 Maywood in the Central Area; and 5229/5233 Dailey Road, 5239/5247 Dailey Road, and 5249/5253 Dailey Road in the Eastern Area. Additional investigation was not pursued at the two vacant, BP-owned residences identified for further evaluation in the Western Area (594 Fairwood and 605 Fairwood).

At 359 Maywood, access was denied by the property owner. At 5249/5253 Dailey Road, a rental property, no response was received from the property owner to multiple written requests for access and voice mail messages from BP and Ohio EPA (Ohio EPA, 2020).

At 569 Fairwood, 5229/5233 Dailey Road, and 5239/5247 Dailey Road, access was obtained from the property owners to investigate the vapor intrusion pathway. Three subslab vapor sampling points were installed in the basement of each of these homes using Calvin Cox Vapor Pins and a subslab vapor sample was collected from each subslab vapor sampling point following the procedures described in the 2019 RI Report. Samples were collected using laboratory provided 6-liter Summa® canisters. The Summa® canisters were equipped with flow controllers that enabled each sample to be drawn from beneath the concrete slab for approximately one hour. The samples were analyzed for benzene, ethylbenzene, toluene, naphthalene, m&p-xylenes, and o-xylene.

Samples were collected from 569 Fairwood and 5239/5247 Dailey Road in April 2019, and from 5229/5233 Dailey Road in August 2019. Results were provided to the property owners and to Ohio EPA. Historical soil vapor and subslab vapor analytical results for all three Areas are summarized in Table 1-1 through Table 1-3. Consistent with the procedures presented in the 2019 RI Report, subslab vapor analytical results were compared to soil Vapor Intrusion Screening Levels (VISLs) for residential land use that were calculated using U.S. EPA's VISL Calculator. Results for samples collected from 569 Fairwood and 5229/5233 Dailey Road were below the VISLs. The use of VISLs to identify locations with potential PVI concerns is very conservative because VISLs don't account for the demonstrated tendency for petroleum vapors to bioattenuate in the subsurface (U.S. EPA, 2015). Bioattenuation often "cuts off" the pathway in the subsurface, eliminating the concern (ITRC, 2014). As discussed in Appendix C, Ohio EPA guidance recommends a stepwise approach to evaluate the significance of vapor intrusion, using multiple lines of evidence (Ohio EPA, 2020).

April 2019 subslab soil vapor sampling results for 5239/5247 Dailey Road exceeded the soil vapor VISLs for benzene, ethylbenzene, and naphthalene for the sample collected from subslab soil vapor sampling point RI-SUB-6-5. As a result, in May 2019, an indoor air sample (RI-IA-6-1) was collected from that area of the basement and a subslab soil vapor sample was collected from one subslab vapor sampling point (RI-SUB-6-3) that was not accessible during the April 2019 sampling event. The indoor air sample was collected using a laboratory provided 6-liter Summa® cannister equipped with a flow controller that enabled the sample to be drawn for approximately twenty-four hours. The subslab soil vapor sample was collected following the same procedures used for the previous subslab sampling events. The samples were analyzed for benzene, ethylbenzene, toluene, naphthalene, m&p-xylenes, and o-xylene. The indoor analytical results were compared to VISL target indoor air concentrations for residential land use that were calculated using the U.S. EPA online VISL calculator and are summarized in Table 1-4. The subslab vapor analytical results were compared to the calculated residential soil vapor VISLs and are summarized in Table 1-3. Results for the indoor air sample exceeded the VISL target indoor air concentration for benzene. Naphthalene was not detected at a concentration above the laboratory detection limit in the indoor air sample; however, the detection limit exceeded the residential target indoor air concentration VISL. Results for the subslab sample were below the residential VISLs.

Based on the results of the May 2019 sampling, another round of sampling was performed at 5239/5247 Dailey Road in August 2019 that consisted of collecting subslab soil vapor samples from the three subslab soil vapor sampling points and collecting an indoor air sample from the same location sampled previously (RI-IA-6-1) following the procedures used during the previous sampling event. Results are presented in Table 1-3 and Table 1-4 and showed that subslab results were below the residential VISLs, but indoor air results exceeded the residential target indoor air concentration VISLs for ethylbenzene and m&p-xylenes. Naphthalene was not detected at a concentration above the laboratory detection limit in the indoor air sample; however, the detection limit exceeded the residential target indoor air concentration VISL.

To mitigate the VISL target indoor air concentration exceedances at 5239/5247 Dailey Road documented by the May and August 2019 indoor air sample analytical results, a temporary vapor mitigation system was installed on September 25 and 26, 2019. The system consists of a semi-sealed cover installed over the basement sump and an active negative pressure fan and associated plumbing that ventilates the sump and discharges the vapors outside the residence. Operation of the temporary vapor mitigation system began on September 26, 2019.

On October 9 and 10, 2019, approximately 2-weeks after initiating operation of the sump vapor mitigation system, a follow-up indoor air sample was collected at 5239/5247 Dailey Road following the same procedures used previously. Laboratory analytical results were below the VISL target indoor air concentrations, with the exception of naphthalene, which was reported at a concentration exceeding the VISL target indoor air concentration. Results are presented in Table 1-4.

Based on the analytical results, it appeared that the temporary sump vapor mitigation system had reduced indoor air concentrations of the Site-related COCs; however, naphthalene was reported above acceptable levels. During the October indoor air sampling, a number of household products that may contain Site-related COCs were observed within the basement at 5239/5247 Dailey Road, including aerosol paints, oil-based paints and stains, paint thinners and solvents, and penetrating oils. These products were removed from the basement and approximately one week later, on December 12, 2019, a follow-up in indoor air sample was collected at 5239/5247 Dailey Road following the same procedures used previously. Sample RI-IA-6-1 was collected from the same location as the previous indoor air samples. Sample RI-IA-6-2 was collected from within a largely enclosed laundry room that had been constructed following the October 2019 sampling event. Laboratory analytical results for both indoor air samples were below the VISL target indoor air concentrations.

Follow-up in indoor air sampling was performed at 5239/5247 Dailey Road in August and October 2020, and March and November 2021, following the same procedures used previously, with samples being collected from both locations in the basement during each event. Laboratory analytical results for the indoor air sampling events were below the VISL target indoor air concentrations, with the exception that for the August 2020 event, naphthalene was not detected at a concentration above the laboratory detection limit; however, the detection limits exceeded the residential target indoor air concentration VISL. In March 2022, an additional round of indoor air sampling was performed at 5239/5247 Dailey Road, following the same procedures used previously, with samples being collected from both locations in the basement. Laboratory analytical results for the indoor air sampling event exceeded the VISL target indoor air concentration for benzene. It was subsequently discovered that the sump pump had been replaced prior to the March 2022 sample collection and it was suspected that opening of the sump cover may have allowed COCs to enter the basement air. Follow-up indoor air sampling was performed at 5239/5247 Dailey Road in July 2022, November 2022, and March 2023, following the same procedures used previously, with samples being collected from both locations in the basement. Laboratory analytical results for these indoor air sampling events were below the VISL target indoor air concentrations for all COCs.

Analytical results for indoor air sampling at 5239/5247 Dailey Road are presented in Table 1-4. The indoor air sampling results suggest that operation of the temporary sump vapor mitigation system, in combination with the removal of consumer products potentially containing COCs, is successfully preventing unacceptable indoor air exposure from Site-related COCs.

A high-water table and surface water drainage issues are thought to be contributing factors to the PVI issues at 5239/5247 Dailey Road. Groundwater levels at monitoring wells RI-MW-6-7 and RI-MW-6-20, located in front of this house, are typically less than 2 feet bgs of the ground surface. An area of collapse is present along the storm sewer that runs in a buried culvert from Dailey Road to Center Road and crosses the property on the west side of the house, which suggests that flow through the storm sewer has been compromised (refer to Figure 1-10). In addition, the owner of the property at 5239/5247 Dailey Road has stated that following work performed on the underground natural gas pipelines behind (east of) the house in 2013, the sump in the basement has been operating at a much higher rate, indicating that there has been an increase in the amount of water that accumulates around the foundation of the house. The property owner believes that drainage lines around the house at 5239/5247 Dailey Road were disrupted by the natural gas company during the construction activity on their underground pipeline in about 2013. Further evaluation of these issues may be needed to address the PVI issues at this EU.

1.2.4.3 Pipeline Investigation

Following completion of the 2019 RI Report, it was decided to perform further investigation of the abandoned 6-inch petroleum pipeline prior to preparation of the FS, in order to determine whether residual petroleum was present in the pipeline or whether significant areas of soil impacts were present in the vicinity of the pipeline that would need to be addressed in the FS. Work was performed within the pipeline right-of-way in two phases in October 2020 and February 2021. Details of the investigation and results were submitted to Ohio EPA in a June 23, 2021, report titled Abandoned 6-inch Easton-Mogadore Pipeline Investigation Summary, Weaver Woodlands Allotment, New Franklin, Summit County, Ohio. A summary is presented below.

During the initial investigation in October 2020, at five locations within the Remedial Areas, the pipeline was exposed by excavating the overlying soil, a section of the pipeline was removed, and excavation soil samples were collected to evaluate potential impacts to surrounding soils. The interior of the pipeline was inspected with a camera at each of the five locations to assess the integrity and internal contents of the pipeline. Selected excavation soil samples were analyzed for BTEX by U.S. EPA Method 8260 and naphthalene by U.S. EPA Method 8270 (SIM). Residual petroleum was not encountered within the pipeline and only limited impacts were identified in the excavation soil samples.

During the follow-up investigation in February 2021, 19 soil borings were installed along the abandoned pipeline in the vicinity of the five areas where the pipeline had been investigated during the initial investigation. Soil borings were installed along the pipeline to evaluate soil conditions between the abandoned pipeline and the water table. Selected excavation soil samples were analyzed for BTEX by U.S. EPA Method 8260 and naphthalene by U.S. EPA Method 8270 (SIM). COCs were detected in 17 of the 47 soil samples that were submitted for analysis and all results were below Regional Screening Levels. The investigation did not identify significant areas of impacted soil in the vicinity of the abandoned pipeline.

1.2.4.4 Groundwater Monitoring

Routine sampling of groundwater from monitoring wells at the Site has continued after submittal of the 2019 RI Report. During 2019, the groundwater monitoring program was the same as during RI. Forty-nine (49) monitoring wells were sampled quarterly and 27 monitoring annually. The sampled monitoring wells are located across the Site, some within the interiors of the groundwater plumes and some around the perimeters of the plumes, and account for two thirds of the 114 monitoring wells installed at the Site. Monitoring well construction details are provided in Table 1-5. Table 1-6 identifies the wells in the quarterly and semi-annual groundwater monitoring program. The procedures used for the 2019 groundwater sampling were the same as during the RI. During 2019, LNAPL was encountered in one monitoring well, M4-3, in which intermittent LNAPL has been encountered historically (Figure 1-9). On October 17, 2019, a layer of LNAPL, approximately 0.57 feet thick was observed in monitoring well M4-3 and was removed using a disposable bailer. Subsequently, on October 22, 2019, a 0.09-foot-thick layer of LNAPL was encountered in the well and was removed using a disposal bailer. The recovered LNAPL was disposed off-Site. There were no other occurrences of LNAPL in 2019. Results of 2019 groundwater monitoring well sampling were reported in the August 2020, 2019, Groundwater Sampling Summary, submitted by RMSC.

A revised monitoring program was proposed to Ohio EPA in May 2020 that transitioned groundwater monitoring from quarterly and semiannual events to an annual sampling event and included a one-time sampling event in June 2020. The existing groundwater monitoring data at that time generally provide sufficient information concerning the COC concentrations of the plume interiors for development of the FS. As a result, the primary objective of the modified groundwater monitoring program is to verify that the groundwater plumes do not migrate beyond their current lateral extents. The modified groundwater monitoring program includes annual sampling of 51 monitoring wells from a network of monitoring wells located primarily around the perimeters of the groundwater plumes. The one-time sampling event included 24 monitoring wells. The revised monitoring program was conditionally approved by Ohio EPA, pending completion of the investigation of the abandoned 6-inch Easton-Mogadore petroleum pipeline. Table 1-6 identifies the monitoring wells in the annual groundwater monitoring program and one-time sampling event. Due to the COVID 19 pandemic, the March 2020 quarterly monitoring event was only partially completed, and the April 2020 semi-annual monitoring event was cancelled. The annual and one-time sampling events were completed together in June 2020. Due to anomalous results from the June sampling event, monitoring wells RI-MW1-1 and RI-MW6-2 were resampled in August. The procedures used for the sampling were the same as during the RI. LNAPL was not encountered in any monitoring well during 2020. Results were reported in the June 2021, 2020, Groundwater Sampling Summary, submitted by RMSC.

Annual groundwater sampling of the 51 monitoring wells in the modified groundwater monitoring network was performed in June 2021. The procedures used for the sampling were the same as during the RI. LNAPL was not encountered in any monitoring well during the June 2021 sampling event. Results were reported in the August 2021, 2021, Groundwater Sampling Summary submitted by RMSC.

Repairs were performed on several monitoring wells in June and August 2021. On June 16, 2021, the riser on monitoring well RI-MW-6-24 was cut down with an internal PVC cutter and the flushmount cover was replaced. The well top-of-casing elevation was resurveyed on June 17, 2021, using the top-of-well casing at monitoring well RI-MW-6-20 as a benchmark. On August 19 and 20, 2021, the riser on monitoring well GW-1 was cut down with an internal PVC cutter and a new flushmount cover was installed; a new flushmount cover was installed on monitoring well GW-2 and monitoring well GW-3, and the flushmount cover on monitoring well RI-MW-4-14 was removed and reinstalled. The monitoring well top-of-casing elevation of GW-1 was resurveyed on August 20, 2021, using the top-of-well casing at monitoring well DP-2 as a benchmark. The updated monitoring well elevation data are provided in Table 1-5.

1.2.5 Nature and Extent of Contamination

As a result of conducting the RI and the subsequent sampling and investigations discussed in this FS, the following summary of the nature and extent of impacts has been developed.

1.2.5.1 Groundwater

The uppermost groundwater bearing zones in the Western, Central and Eastern Areas occur in HSU-1 (uppermost bedrock unit) and HSU-4 (unconsolidated deposits). In these Areas, this groundwater is impacted by petroleum hydrocarbon COCs attributed to gasoline releases from the abandoned buried 6-inch petroleum pipeline at concentrations above their respective MCL or RSL, along with exceedances of the corresponding VISLs. The horizontal and vertical extent of COC impacts in both HSUs have been adequately delineated to MCL or RSL concentrations and trend analysis indicates the magnitude and extent of COC impacts are generally decreasing over time. Sampling of the deeper groundwater bearing zone (HSU-2) indicates there are no COCs detected at depths greater than 60 feet bgs.

In the Western Area, groundwater is generally first encountered within the underlying fractured/weathered bedrock (Homewood Sandstone, HSU-1), at depths of approximately 0.3 to 37 feet bgs. The more competent, bedrock and deeper groundwater (Homewood Sandstone, HSU-1 and Mercer Shale/Sandstone, HSU-2) at depths greater than 60 feet bgs is not impacted by COCs. Also, the regional aquifers (Homewood Sandstone HSU-1, Mercer Shale/Sandstone HSU 2, and Massillon Sandstone HSU-3) that are used as potable water supplies are not impacted by COCs.

In the Central Area, groundwater is first encountered within unconsolidated glacial deposits (HSU-4) at depths of approximately 2 to 21 feet bgs. The bedrock (Homewood Sandstone HSU-1) groundwater directly beneath the unconsolidated materials is also impacted by similar COCs in a limited area. Sampling of residential drinking water wells has not detected COCs. Also, the regional aquifers that are used as a potable water supply are not impacted by COCs. Groundwater flow direction is toward the north-northeast.

In the Eastern Area, groundwater is first encountered within unconsolidated glacial deposits (HSU-4) at depths of approximately 0 to 41.9 feet bgs. This Area is located in a glacial buried valley setting within extensive, deep sand and gravel deposits. Sampling of residential drinking water wells installed in the unconsolidated deposits has not detected COCs. This deep buried valley aquifer is also used a potable water supply and is not impacted by COCs.

The source of historical petroleum hydrocarbon COCs impacts to some residential wells at the Site is related to well casing integrity issues. A new design for well replacement was developed that uses approximately 70 to 100 feet of 10-inch diameter PVC outer casing grouted with cement grout mix to minimize grout loss and a 5-inch diameter inner PVC casing also grouted with the cement grout mix, with the well completed as an open borehole. The Summit County Health Department and the Ohio EPA have approved this design and it will be required for any new wells being installed in impacted areas. COC impacts have not been observed in drinking water wells with intact casings.

1.2.5.2 LNAPL Occurrence

Measurable LNAPL has historically been observed intermittently in one monitoring well in the Western Area (RI-MW-1-20), and in two monitoring wells in the Central Area (RI-DMW-4-2 and M4-3). LNAPL has not been observed in RI-MW-1-20 since September 18, 2018, in monitoring well RI-DMW-4-2 since February 2013, and in monitoring well M4-3 since October 2019. Hydrographs illustrating groundwater elevations, and LNAPL thickness and elevations for monitoring wells RI-MW-1-20 and M4-3 are presented in Appendix D. The horizontal extent of measurable LNAPL has been defined and is of limited extent and likely low/residual LNAPL transmissivity due to isolated and infrequent in-well occurrences. A discussion of residual and mobile LNAPL is included in the evaluation in Appendix E.

1.2.5.3 Soil

The impacts to subsurface soils are principally related to petroleum hydrocarbon COCs that have been released to the shallow groundwater and occur within the HSU-1 and HSU-4 water table "smear zones" at depths greater than 10 feet bgs. Surface soils are not impacted.

1.2.5.4 Vapor Intrusion

The potential for vapor intrusion has been characterized at 17 EUs, by collecting soil vapor and/or subslab vapor samples at residences within 100 feet of monitoring wells where COCs in groundwater exceeded their respective VISLs. At all but 4 EUs, soil vapor and/or subslab vapor results were below VISLs. Soil vapor and subslab vapor sampling results indicate there are unresolved vapor intrusion concerns at two unoccupied BP-owned EUs in the Western Area (594 Fairwood and 605 Fairwood) and one occupied EU in the Central Area (359 Maywood) that require sampling of soil vapor, subslab and/or indoor air to evaluate risks at these EUs. At one occupied EU in the Eastern Area (5249/5253 Dailey Road), groundwater monitoring well results indicate that there are unresolved vapor intrusion concerns that require soil vapor, subslab or indoor air sampling to evaluate risks. As noted, VISLs are conservative indicators of vapor intrusion concerns because they don't account for the demonstrated tendency for petroleum vapors to bioattenuate in the subsurface. Further assessment is required to evaluate pathway completeness for these potentially unacceptable PVI risks, as outlined in Appendix C. At one EU in the Eastern Area (5239/5247 Dailey Road) subslab soil vapor results exceeded VISLs, and follow-up indoor air sample results exceeded residential target indoor air concentration VISLs. To mitigate the VISL target indoor air concentration exceedances at 5239/5247 Dailey Road, a temporary vapor mitigation system is in operation and follow-up indoor air sample results were below residential target indoor air concentration VISLs.

1.2.5.5 Sediment and Surface Water

Sediment and surface water samples collected in the intermittent stream in the Central Area indicated there were no significant COC impacts.

Surface water sample results collected from the wetland in the Eastern Area were below analytical detection limits for COCs.

1.2.5.6 Remedial Areas

As discussed in the 2019 RI Report, review of monitoring well groundwater analytical results indicates that COC concentrations in groundwater at the Site are generally stable, decreasing, or show no trend based on Mann-Kendall analysis of individual monitoring wells. In the 2019 RI Report, the risk evaluations and plume boundary determinations were based on groundwater data from the time period between 2014 and 2018. As agreed by Ohio EPA, this FS provides updated risk evaluations and plume boundary determinations based on monitoring well groundwater analytical results from the time period between 2017 and 2021. Tables 1-7, 1-8, and 1-9, present the maximum concentration of each COC in groundwater collected from monitoring wells at the Site between 2017 and 2021, for the Western, Central, and Eastern Areas, respectively, on an EU-by-EU basis. The concentrations are compared to MCLs or RSL (naphthalene) and groundwater VISLs, with exceedances of either criterion highlighted.

The 2019 RI Report presented isoconcentration maps of monitoring well COC maximum concentration data from the time period between 2014 and 2018 that showed that there were areas of higher concentrations located closer to the abandoned 6-inch petroleum pipeline. For a current illustration, the data in Table 1-7 were used to prepare an isoconcentration map for the maximum concentration of benzene in shallow groundwater (HSU-1 and HSU-4) between 2017 and 2021 in the Western Area, which is presented as Figure 1-4. The figure shows an area of higher concentrations (at MW-6S) closer to the abandoned pipeline, with concentrations decreasing in relatively short distances upgradient (south) and side-gradient (west and east) and over a longer distance downgradient (north, northeast) and overall stability in the Western Area benzene plume boundary when compared to the isoconcentration map prepared for the RI, with some improvements. The data in Table 1-8 were used to prepare an isoconcentration map for the maximum concentration of benzene in shallow groundwater (HSU-1 and HSU 4) between 2017 and 2021 in the Central Area, which is presented as Figure 1-5. The figure shows two areas of higher concentrations closer to the abandoned pipeline (at RI-MW-4-13 and GW-4), with concentrations decreasing in relatively short distances upgradient (south) and side-gradient (west and east) and over longer distances downgradient (north, northeast), and overall stability in the Central Area shallow benzene plume boundary when compared to the isoconcentration map prepared for the RI. The data in this table were also used to prepare an isoconcentration map for the maximum concentration of benzene in deep groundwater (competent Homewood Sandstone, HSU-1) between 2017 and 2021 in the Central Area, which is presented as Figure 1-6. The figure shows an area of higher concentrations north (downgradient) of the abandoned pipeline, with the highest concentrations located at RI-DM-4-5 and RI-DM-4-8. The figure shows overall stability in the Central Area deep benzene plume when compared with the iscoconcentration map prepared for the RI. The data in Table 1-9 were used to prepare an isoconcentration map for the maximum concentration of benzene in shallow groundwater (HSU-1 and HSU 4) between 2017 and 2021 in the Eastern Area, which is presented as Figure 1-7. The figure shows two areas of higher concentrations closer to the abandoned pipeline in the eastern portion of Area (6-12 and 6-17), with concentrations decreasing in relatively short distances upgradient (south) and side-gradient to the east, and over a longer distance side-gradient to the west and downgradient to the northeast, and overall stability in the Eastern Area benzene plume boundary when compared to the isoconcentration map prepared for the RI.

For current illustrations of the plume boundaries, the monitoring well groundwater data in Tables 1-7 through 1-9 were used to prepare Figure 1-8 through 1-10, which show the extent of HSU-1 and HSU-4 groundwater zone impacts that exceed an MCL (or RSL for naphthalene) or groundwater VISL, for the Western, Central, and Eastern Areas, respectively. Plume boundaries are conservatively drawn to generally coincide with monitoring wells which have been compliant with applicable RLs for all sampling events between 2017 and 2021, and plume boundary lines are dashed where inferred between wells above and below RLs. The approximate extents of groundwater impacts are the basis for the EUs retained for remedial response.

1.2.6 Risk Assessment Summary

As presented in the 2019 RI Report, both residual human health and potential ecological risks were evaluated as part of the RI process for the Site. The evaluation of human health risks at each EU was conducted to determine if soil and groundwater impacts at the Site have unacceptable risks associated with exposures to the COCs. The methodology used for this risk assessment compared environmental media concentrations for COCs to risk based and regulatory criteria. The screening levels used to evaluate potential human health risks included MCLs or RSLs for direct contact pathways, and VISLs for the inhalation of indoor air pathway.

As a result of conducting a Human Health and Ecological Risk Assessment at the Site, the following summary of risks has been developed:

- Human health risks are acceptable for exposure to surface and subsurface soil by residents at all EUs sampled in the Western, Central and Eastern Areas.
- Human health risks are not acceptable for hypothetical use of groundwater as drinking water (MCL or RSL exceedances) for several EUs in the Western, Central and Eastern Areas. Within these Areas, 38 EUs are located where shallow groundwater has, or potentially has, concentrations above the MCL or RSL for benzene, naphthalene, or ethylbenzene. The EUs having exceedances for an MCL or RSL are identified on Table 1-10. The EUs that have MCL/RSL exceedances will require some form of remedial action to mitigate unacceptable exposure due to potential shallow groundwater use.
- Human Health risks due to potential vapor intrusion were evaluated for several EUs in the Western, Central and Eastern Areas. Within these Areas, there are 30 EUs in which shallow groundwater concentrations exceed one or more groundwater VISLs, based on monitoring wells on the respective properties, or plume mapping. The EUs having exceedances for VISL screening are identified on Table 1-10.
- The potential for vapor intrusion has been characterized at 17 EUs, by collecting soil vapor and/or subslab vapor samples at residences within 100 feet of monitoring wells where COCs in groundwater exceeded their respective VISLs. At all but 4 EUs, soil vapor and/or subslab vapor results were below VISLs. Soil vapor and subslab vapor sampling results indicate there are unresolved vapor intrusion concerns at two unoccupied BP-owned EUs in the Western Area (594 Fairwood and 605 Fairwood) and one occupied EU in the Central Area (359 Maywood) that require further subslab and/or indoor air sampling to evaluate risks at these EUs. At one EU in the Eastern Area (5239/5247 Dailey Road) subslab soil vapor results exceeded VISLs, and follow-up indoor air sample results exceeded residential target indoor air concentration VISLs. To mitigate the VISL target indoor air concentration exceedances at 5239/5247 Dailey Road, a temporary vapor mitigation system is in operation and follow-up indoor air sample results were below residential target indoor air concentration VISLs. At one occupied EU in the Eastern Area (5249/5253 Dailey Road), groundwater monitoring well results indicate that there are unresolved vapor intrusion concerns that require additional subslab or indoor air sampling to evaluate risks.
- Stream sediment and intermittent surface water in the Central Area and surface water in a wetland in the Eastern Area were the only media considered ecologically significant. The impacts to these media do not represent an ecological concern and these media can be eliminated from further evaluation. Impacts from the Site do not represent an ecological concern.

As a result of conducting the RI and the subsequent sampling and investigations discussed in this FS, the applicable exposure pathways to be addressed in the FS are potable use of groundwater and groundwater and soil gas intrusion to indoor air. The following Remedial Levels (RLs) are being established in this FS for the Site COCs for the applicable exposure media, as presented in the table below.

	CONTAMINANTS OF CONCERN (COCs) / REMEDIAL LEVELS (RLs)			
Medium	**COC**	**RL**	**UNITS**	**RL Basis**
Ground Water: Potable	Benzene	5	µg/L	MCL
	Ethyl benzene	700	µg/L	MCL
	Naphthalene	1.7	µg/L	Risk-based[1]
	Toluene	1,000	µg/L	MCL

	CONTAMINANTS OF CONCERN (COCs) / REMEDIAL LEVELS (RLs)			
Medium	**COC**	**RL**	**UNITS**	**RL Basis**
	Xylenes	10,000	µg/L	MCL
Ground Water: Vapor Intrusion to Indoor Air	Benzene	29.7	µg/L	U.S. EPA VISL[2]
	Ethyl benzene	77.2	µg/L	U.S. EPA VISL[2]
	Naphthalene	128	µg/L	U.S. EPA VISL[2]
	Toluene	39,200	µg/L	U.S. EPA VISL[2]
	Xylenes	855	µg/L	U.S. EPA VISL[2]
Indoor Air	Benzene	3.60	µg/m³	U.S. EPA VISL[3]
	Ethyl benzene	11.2	µg/m³	U.S. EPA VISL[3]
	Naphthalene	0.826	µg/m³	U.S. EPA VISL[3]
	Toluene	5,210	µg/m³	U.S. EPA VISL[3]
	Xylenes	104	µg/m³	U.S. EPA VISL[3]
Soil Gas (Sub-slab and Near Source)	Benzene	120	µg/m³	U.S. EPA VISL[4]
	Ethyl benzene	374	µg/m³	U.S. EPA VISL[4]
	Naphthalene	27.5	µg/m³	U.S. EPA VISL[4]
	Toluene	174,000	µg/m³	U.S. EPA VISL[4]
	Xylenes	3,480	µg/m³	U.S. EPA VISL[4]

FOOTNOTES

1. Groundwater potable use standard calculated based on a cumulative excess lifetime carcinogenic risk of 1E-05 and a hazard index of 1.
2. "Target" ground water to indoor air single-chemical level calculated using U.S. EPA's vapor intrusion screening level calculator (August 2019 version). Single-chemical levels will need to be adjusted as necessary to meet the cumulative excess lifetime carcinogenic risk of 1E-05 and a hazard index of 1. These VISLs do not account for bioattenuation and will be used to identify areas with unresolved VI concerns. Indoor air and soil gas data will be used to verify concerns and establish compliance targets.
3. Indoor air single-chemical level at the risk goal (excess lifetime carcinogenic risk of 1E-05 and a hazard index of 1), calculated using U.S. EPA's vapor intrusion screening level calculator (August 2019 version). Single-chemical levels will need to be adjusted to meet the cumulative excess lifetime carcinogenic risk of 1E-05 and a hazard index of 1.
4. Sub-slab and near source soil gas to indoor air single-chemical level calculated using U.S. EPA's vapor intrusion screening level calculator (August 2019 version). Single-chemical levels will need to be adjusted as necessary to meet the cumulative excess lifetime carcinogenic risk of 1E-05 and a hazard index of 1. These VISLs do not account for bioattenuation and will be used to identify areas with unresolved VI concerns. Indoor air and soil gas data will be used to verify concerns and establish compliance targets.

1.2.7 EU Conceptual Exposure Scenarios

As discussed, as a result of investigations performed at the Site, 38 EUs have been retained for further evaluation in this FS. The EUs are listed in Table 1-10, which identifies the data collected on the EU, the rationale for retaining the EU for evaluation, and identifies whether maximum groundwater COC concentration (based on the maximum concentrations between 2017 and 2021) exceed groundwater potable RLs (MCL/RSL) or groundwater vapor intrusion to indoor air RLs (VISLs), or both. The table further distinguishes whether conclusions are based on data collected on the EU, or on adjacent EUs. Of the 38 EUs that are located where shallow groundwater has, or potentially has, concentrations above a potable RL (MCL or RSL), 25 are based on data collected on the EU and 13 are based on data collected on adjacent EUs. Of the 30 EUs in which shallow groundwater concentrations exceed one or more groundwater vapor intrusion to indoor air RLs (VISLs), 17 are based on data collected on the EU and 13 are based on data collected on adjacent EUs.

2.0 REMEDIAL ACTION OBJECTIVES & APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

2.1 Remedial Action Objectives

Based on results obtained from the RI and follow-up investigations that have been completed at the Site, the following is a summary of the Remedial Action Objectives (RAOs) that have been developed through consultation with Ohio EPA. The RAOs are focused on the protection of human health by preventing exposure to impacted media above acceptable levels.

- Restore and/or Prevent exposure to Site groundwater with COCs in excess of potable use standards. The potable use standards (potable groundwater RLs) are the Maximum Contaminant Levels (MCLs), or for COCs lacking an MCL (i.e., naphthalene), it is the risk-based potable use standard set at the single-chemical cumulative risk goal, i.e., an excess lifetime carcinogenic risk goal of 1 E-5 and a hazard index of 1.
- Prevent exposure to indoor air with COCs in excess of the cumulative risk goal (i.e., an excess lifetime carcinogenic risk goal of 1E-5 and a hazard index of 1).
- Mitigate or reduce the presence of LNAPL, if encountered, to the extent practicable in order to minimize the potential for future ongoing releases of dissolved phase COC into the groundwater.

LNAPL may be present as mobile and/or residual (immobile). Residual LNAPL is like the water that will not drain out of a sponge. LNAPL transmissivity is a measure of the mobility of LNAPL (ASTM, 2013 and ITRC, 2018). Transmissivity has been used for decades to represent the producibility of aquifers and is similarly applicable to LNAPL recoverability assessment. LNAPL assessment will be included in a Pre-Design Investigation (PDI), discussed further in Section 5.4. If LNAPL is encountered, transmissivity will be tested to evaluate if the source is dominated by mobile or residual LNAPL. Based on investigations at other sites and consistent with the Interstate Technology & Regulatory Council (ITRC) LNAPL-3: LNAPL Site Management: LCSM Evolution, Decision Process, and Remedial Technologies (ITRC, 2018), LNAPL reduction will be considered to have reached the extent practicable at a transmissivity of 0.5 ft^2/day, as recovery below this level does not result in a meaningful reduction in source. This value is consistent with accepted transmissivity values used to define limit of recoverability as accepted by U.S. EPA (Hartford, IL site) and several states (VA, MI, CO, and MA), which accept transmissivity values within the range of 0.1 to 0.8 ft^2/day, or 0.5 ft^2/day specifically (MI), to define the limit of LNAPL recoverability. ITRC identified that LNAPL recovery systems were demonstrated to result in asymptotic conditions at several sites at LNAPL transmissivities between 0.3 and 0.8 ft^2/day. While 0.1 ft^2/day is also referenced, ITRC references that value in 2009 as a site that exhibited this value and conducted recovery did not show additional decline in LNAPL transmissivity. All of these sites represented LNAPL sites with no impacts to receptors and stable LNAPL bodies and dissolved phase plumes. The ITRC LNAPL-3 2018 document (ITRC,2018) further discusses why the LNAPL transmissivity range is appropriate not based on past state demonstrations and case closures, but rather also based on how multiple sites with varying soil profiles and LNAPL transmissivity values ending or starting in this range represented sites where the residual mass dominated the total LNAPL mass remaining at the site, and therefore, LNAPL recovery would no longer have a significant impact on the remaining LNAPL body. The U.S. EPA led site of Hartford, IL has approved the LNAPL transmissivity range of 0.1 to 0.8 ft^2/day to define the limit of LNAPL recovery activities at that site followed by additional remediation where risk to receptors need to be addressed for vapor or groundwater. BP selected a transmissivity of 0.5 ft^2/day as a middle value for decision making within the accepted range of 0.1 to 0.8 ft^2/day discussed above. Further discussion regarding the occurrence, recoverability, and remediation of LNAPL is presented in Appendix E.

2.2 Applicable or Relevant and Appropriate Requirements

Section 121(d) of CERCLA requires that remedial actions at least attain legally applicable or relevant and appropriate Federal and State requirements, standards, criteria, and limitations which are collectively referred to as ARARs, unless such ARARs are waived under CERCLA Section 121(d)(4). Applicable requirements are those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under Federal environmental or State environmental or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a Superfund site. Relevant and appropriate requirements are those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under Federal environmental or State environmental or facility siting laws that, while not applicable, address problems or situations sufficiently similar to those encountered at the Site that their use is well-suited to the particular site. A list of the potential ARARs is presented in Table 2-1.

3.0 REMEDIAL TECHNOLOGY SCREENING

Potential remedial technologies for application at the Site were identified and evaluated, as discussed in the following sections.

3.1 Summary of Potential Remedial Technolgies

Considering the variability in plume characteristics, geologic and hydrogeologic settings, and property use and occupancy, different remedial technologies may be applied across the Site and over time as the remedy progresses and remedies will be evaluated for applicability to a specific location (e.g., EU) on an individual basis. A wide range of potential remedial technologies were included for consideration as part of the initial preliminary screening and include:

- No Action;
- Institutional Controls;
- Engineering Controls;
- Natural Source Zone Depletion (NSZD) and Monitored Natural Attenuation (MNA);
- Bioventing and Biosparging;
- Air Sparging and Soil Vapor Extraction (AS/SVE);
- In-Situ Chemical Oxidation (ISCO);
- Enhanced Anaerobic Degradation (e.g., sulfate injection);
- Activated Carbon Injection;
- Phytotechnology.
- Excavation and Disposal; and
- Multi-Phase Extraction (MPE).

These potential remedial technologies were put through a preliminary technology screening, as described in Section 3.2.

3.2 Remedial Technology Screening

To begin the initial screening process, a comparison was made of each of the potentially applicable remedial technologies considering the treatment objective; advantages and disadvantages; applicable geology, treatment zones (i.e., unsaturated or saturated), and treatment phase (i.e., dissolved, vapor, or LNAPL); potential elements of pre-design investigation; potential timeframe; and relative cost. Based on the comparison, a qualitative ranking was assigned to each technology. A summary of the screening of potentially remedial technologies is presented in Table 3.1.

3.3 Remedial Technologies Retained for Alternatives Development

Based on the initial screening process, the remedial technologies described in the following sections were retained for inclusion in development of potential Remedial Alternatives.

3.3.1 No Action

No Action was included as the baseline, lowest cost remedial approach against which other potential remedial technologies may be evaluated; however, it fails to achieve any of the RAOs.

3.3.2 Institutional Controls

Institutional Controls or use restrictions would be implemented to prevent unacceptable exposures to COCs in accordance with the Uniform Environmental Covenants Act, as applicable, and summarized below.

3.3.2.1 Potable Groundwater

Institutional controls are required to restrict use of shallow groundwater with exceedances of drinking water standards (MCLs for BTEX, RSL for naphthalene). An environmental covenant (EC) will be established between Ohio EPA and each affected property owner to restrict installation of groundwater wells in the shallow aquifer for uses other than maintaining or expanding remedial systems or monitoring groundwater quality, and to require that any new wells installed for non-remediation uses are constructed within the deep aquifer and in accordance with the procedures for Replacement Drinking Water Well Installation approved by the Ohio EPA on December 11, 2013 (Ohio EPA, 2013) and the Summit County Health Department. The EC will include irrevocable access for Ohio EPA and BP (including officers, employees, agents, and contractors) to perform Permitted Activities, such as drinking water testing, as defined in the EC.

3.3.2.2 Vapor Intrusion

Institutional controls are also required to restrict new residential construction or other occupied structures within areas of verified petroleum vapor intrusion concerns. An EC will be established between Ohio EPA and each affected property owner accordingly. The EC will include irrevocable access for Ohio EPA and BP (including officers, employees, agents, and contractors) to perform Permitted Activities, such as subslab vapor and indoor air sampling, as defined in the EC.

3.3.3 Engineering Controls

Engineering controls may be evaluated and implemented to provide for protection of a receptor from a verified exposure concern, e.g., potable supply well impacts approaching or above MCLs, or indoor air concentrations approaching or above Indoor Air VISLs, while longer-term remedial actions are ongoing to address the source of the exposure concern.

3.3.3.1 Potable Groundwater

Engineering controls may be considered to eliminate potential exposure via groundwater ingestion, including installation of a municipal water line and connection to all or a subset of properties within the Remedial Areas, which may be accompanied by a municipal ordinance and/or EC prohibiting use of private supply wells for groundwater consumption. Another potential engineering control to prevent ingestion of shallow groundwater with COC concentrations above MCLs is replacement of shallow wells or deep wells with inadequate seals with deep, double-cased wells.

3.3.3.2 Vapor Intrusion

Engineering controls such as subslab vapor barriers, subslab ventilation piping or sub-slab depressurization / ventilation blowers would be considered for installation in existing residences if there is a verified vapor intrusion concern above acceptable levels, or for future construction in areas of verified VI potential to control potential indoor air vapor intrusion, as appropriate.

3.3.4 NSZD and MNA

NSZD is a term that encompasses the natural processes that decrease subsurface LNAPL concentrations. These processes include sorption, volatilization, dissolution, and biodegradation. Biodegradation of petroleum compounds has been and will continue to be a significant process and is carried out by naturally occurring soil microbes that readily consume and degrade LNAPL, resulting in total contaminant mass reduction. Site conditions such as temperature, water, soil gas flux, and LNAPL composition and saturation determine the rate of LNAPL attenuation over time. Understanding the contribution of NSZD is judicious as biodegradation has been shown to limit dissolved phase plume extents (Wilson, 2021), limit the ability of petroleum vapors to impact receptors (EPA, 2015) and degrade source LNAPL (Douglas, et al., 1996 and ITRC, 2018). Understanding these effects on remaining impacts will result in data-based decision making for additional remedial targeting. NSZD is described further in Appendix E.

MNA is the natural attenuation of contaminated groundwater and includes a variety of physical, chemical, and biological processes that, under favorable conditions, act without human intervention to reduce the mass, mobility, volume, or concentration of contaminants (U.S. EPA, 1999). These processes include biodegradation; dispersion; dilution; sorption; volatilization; and chemical or biological stabilization, transformation, or destruction of contaminants (U.S. EPA, 1999). Historically this was estimated to be the dominant role of biodegradation, however recent vapor intrusion and natural source zone depletion research identify that natural attenuation in groundwater is a single component of a more extensive biodegradation regime for petroleum impacts.

Various interim measures have been undertaken within the study area, as detailed in Section 1, including five remediation systems which recovered a total of approximately 28,845 pounds of hydrocarbon and ceased operation in 2004 (Area 1 soil vapor extraction system and Areas 3, 4 and 6 multiphase extraction systems) and in 2008 (Area 5 multiphase extraction system). Other interim measures have been more limited in focus, including periodic bailing of intermittent LNAPL from 3 wells. Since the shutdown of the MPE and SVE systems, additional investigation and delineation activities have been conducted, and as presented in Section 1, the size of the groundwater plumes has generally contracted and decreased in maximum COC concentrations due to ongoing NSZD and MNA. This is evident reviewing the progression of concentration data and approximate plume extents based on individual constituent spatial plots developed using the Groundwater Spatiotemporal Data Analysis Tool (GWSDAT; Shell Global Solutions International, 2021), as presented in Appendix E.

NSZD is a key process contributing to groundwater restoration at the Site and will continue to drive improvements in groundwater quality due to both bulk removal of LNAPL (residual and mobile, if present), as well as compositional changes, which lead to both a decrease in mass flux of COCs to groundwater from residual LNAPL in the subsurface, as well as biodegradation of vapor phase COCs reducing PVI risk. In addition to monitoring groundwater and soil vapor COC concentrations, which provide an indirect indication of NSZD particularly in areas where no other active remedies are being employed, additional monitoring will be proposed in a separate Work Plan for a PDI to further evaluate NSZD and MNA mechanisms and effects.

3.3.5 Active Remediation

Areas within each of the three defined remedial areas (Western, Central and Eastern) that exhibit little or no improvement via natural mechanisms will be targeted with an active remedy (e.g., "target areas") until impacts are sufficiently reduced below remedial objectives, or until phytoremediation/natural mechanisms are sufficient to continue reducing the impacts towards the remedial objectives. It is expected that within a remedial area during a given time, there will be portions of the remedial area where natural mechanisms (NSZD / MNA) are effective in improving subsurface conditions demonstrated by decreasing trends or attainment of cleanup goals and will therefore be the primary remedy, while in other portions of the remedial area targeted active remedies will be implemented as the primary remedy to improve conditions. Active remediation technologies that can affect compositional change of the hydrocarbon which is acting as a source to dissolved phase COC concentrations above MCLs, and/or to verified PVI concerns will be evaluated for potential testing and implementation in applicable areas of the site. Active remediation technologies will be screened based on anticipated effectiveness in achieving the compositional change goal within the specific setting including consideration of current and future groundwater use, buildings and verified PVI concern, geology and hydrogeology, and vadose zone or saturated zone target. Retained active remediation technologies will be compared to each other for potential testing and implementation in areas with similar characteristics against the nine evaluation criteria. Following PDI it is expected that one or two technologies may be selected for pilot-scale testing within each target area, and pending pilot testing results, that remedy may be implemented more broadly within the target area, or a contingency technology may be evaluated. As stated in Section 1.1.1, the FS proposes a performance-based approach, as such technologies may be sequenced and a transition will occur after an implemented remedy is no longer achieving technology-specific goals, or if another technology is expected to be more effective. Remedial technologies as referenced in ITRC LNAPL-3: LNAPL Site Management: LCSM Evolution, Decision Process, and Remedial Technologies (ITRC, 2018) that have potential applicability to one or more areas of the site are summarized below and on Table 4-1.

3.3.5.1 Bioventing and Biosparging

This technology works by enhancing natural degradation (NSZD / MNA), which is already documented to be occurring, by providing an additional source of oxygen as the electron acceptor. Bioventing delivers ambient air at low flow rate and pressure to the vadose zone via a blower, subsurface piping, and vent well network, and biosparging delivers ambient air at low flowrate and pressure to the saturated zone in a similar fashion. Atmospheric oxygen concentrations are sufficient to degrade on the order of 60,000 parts per million vapor (ppmv) of vapors assuming 100% oxygen utilization. Bioventing and biosparging would be used where vapor concentrations are below this level and with a flow regime sufficient to maintain protection of receptors.

3.3.5.2 Air Sparging and Soil Vapor Extraction (AS/SVE)

AS injects air into the saturated zone to solubilize (turbulence), biodegrade (aerobic), and volatilize LNAPL constituents from the submerged and overlying portions of the LNAPL body where airflow occurs. SVE also enhances aerobic biodegradation and volatilization of the LNAPL constituents from the vadose zone and collects vapors created by AS. AS or SVE can also be used individually if conditions are appropriate. Depletion of LNAPL in the vadose zone is enhanced by SVE because it can draw continuous LNAPL from the saturated zone into the vadose zone via capillary processes (wicking). A significant portion of the LNAPL depletion accomplished by AS/SVE is due to enhancement of aerobic biodegradation (ITRC, 2018).

An example of remedial technology sequencing, transition from AS/SVE to bioventing/biosparging or NSZD/MNA, would occur once the hydrocarbon vapor recovery of the AS/SVE is small in comparison to natural biodegradation mechanisms.

3.3.5.3 In-situ Chemical Oxidation (ISCO)

LNAPL and dissolved phase hydrocarbon is depleted by enhanced solubilization and chemical destruction through the addition of a chemical oxidant into the LNAPL zone (e.g., hydrogen peroxide and persulfate). Chemical oxidation typically requires the addition of catalysts, stabilizers, and/or activators to control the rates of oxidation. Oxidation reactions with LNAPL can be vigorous and require controls for off-gas, for example (ITRC, 2018).

3.3.5.4 Enhanced Anaerobic Degradation

Electron acceptors other than oxygen are supplied to the subsurface to enhance natural anaerobic degradation. This is typically conducted with recurring injections of sulfate and/or nitrate either directly into wells, or via an injection system connected to a well network. This technology has been successful in addressing dissolved phase impacts but is inconsistent in treating residual source areas. Additionally, underground injection control requirements may have limitations / conditions for injection and monitoring of sulfate and/or nitrate within an area serviced by private potable supply wells. Anaerobic biodegradation can also be achieved by increasing the subsurface temperature to increase natural biodegradation rates (ITRC, 2018).

3.3.5.5 Activated Carbon Injection

Activated carbon with electron acceptors or chemical oxidants is injected or placed into excavations to enhance biodegradation or destruction processes. The activated carbon adsorbs organic compounds and provides a substrate for biomass growth. The added reagents support enhanced (aerobic or anaerobic) bioremediation or destruction by chemical oxidation (ITRC, 2018). Underground injection control requirements may have limitations / conditions for injection and monitoring of injectates including sulfate and/or nitrate within an area serviced by private potable supply wells.

All of the above active technologies require a permeable formation to be effective.

3.3.5.6 Phytotechnology

Phytotechnologies use plants to remediate or contain contaminants in the soil, groundwater, surface water, or sediments. Phytoremediation is generally considered a phase-change technology, enhancing subsurface biodegradation, but, to a lesser extent, can also be considered mass control technology if designed for hydraulic control (ITRC, 2018). Tree roots will pull water from depths of up to 18 feet. The actual depth for a given location is based on soil moisture. The time for tree roots to reach these depths can be aided by installation of larger more developed plants and tree wells. Tree wells may be utilized to install trees at depths that will direct roots down to groundwater that may be deeper than the species' roots would typically reach. Phytoremediation can outpace sparging or other active remediation in finer-grained soils. The root propagation and associated enhanced bioactivity is less dependent on soil permeability as compared to technologies that induce vacuums, sparge air or recover liquids, and has been documented to occur within bedrock.

3.4 Remedial Technologies Not Retained for Further Evaluation

Based on the initial screening process, the remedial technologies described in the following sections were not retained for inclusion in development of potential Remedial Alternatives.

3.4.1 Excavation and Disposal

Soil excavation and off-Site disposal was not retained for further evaluation at this time because vadose zone soil impacts are limited at the Site; and it may be disruptive, costly, or infeasible to implement in areas with significant infrastructure. This technology may be reconsidered based on conditions encountered in the future.

3.4.2 Multi-Phase Extraction (MPE)

LNAPL, water, and vapor are the fluids removed. LNAPL drawdown, groundwater drawdown, and vacuum induce an LNAPL gradient toward the recovery point. Groundwater drawdown may expose submerged LNAPL thereby increasing LNAPL recovery rate, though often recovered in vapor phase once exposed to the high vacuum and volatilized. Also referred to as dual-phase extraction (DPE) or two-phase extraction (TPE). MPE is also often used as a phase-change technology to expose submerged LNAPL (as well as LNAPL in the vadose zone) to volatilization and enhanced aerobic biodegradation with hydraulic LNAPL removal as a secondary remediation objective (ITRC, 2018). This technology was effectively employed at some locations of the Site in the past but was not retained for further evaluation due to high cost and limited occurrence of mobile LNAPL. The volatilization and enhanced biodegradation mechanisms are covered by other technologies that are retained.

4.0 REMEDIAL ALTERNATIVE APPROACH EVALUATION

Potential Remedial Alternatives for application at the Site were developed and evaluated, as discussed in the following sections.

4.1 Introduction

As stated in Section 1, the purpose of this FS is to define remedial alternatives that ensure compliance standards are met at the identified POCs. This FS is not limited to a single remedial technology, but rather defines a performance-based remediation approach which employs a range of technologies appropriate to the conditions to ensure current and future receptors are protected across a site that has varying geology, land use and impact magnitudes. The different remedial technologies that were retained from the initial screening (see Section 3) and may be utilized within an alternative include institutional controls, engineering controls, NSZD / MNA, and targeted active remediation to enhance natural source reduction. Potential active remedial technologies include Bioventing and Biosparging; AS/SVE; ISCO; Enhanced Anaerobic Degradation (e.g., sulfate injection); Activated Carbon Injection; and Phytotechnology. In addition, No Action, is included as the baseline, lowest cost option against which other potential remedies are evaluated.

Remedial Alternatives were developed to comprise a combination of the individual remedial technologies that were retained from the initial screening (see Section 3) to address the nine evaluation criteria and accomplish both near term and long-term goals. Remedial Alternatives will be evaluated for the various EUs depending upon Site-specific conditions as outlined in Section 1. Decisions related to utilizing remedial technologies will be performance-based depending upon the CSM specific to the EU, PDI findings, performance monitoring of existing technologies and design expectations of alternatives.

4.2 Description of Remedial Alternatives

As noted above, Remedial Alternatives were developed to comprise a combined remedy approach to address the nine evaluation criteria and accomplish both near term and long-term goals, drawing upon the various remedial technologies that were selected in the initial screening (see Section 3), as appropriate. Each alternative is presented below and presents a holistic approach to address the RAOs across the Site, though technologies implemented at specific locations may vary based on Site-specific conditions.

4.2.1 Alternative 1

Under this alternative, no further action would occur. No monitoring or interim actions would be performed. No institutional or engineering controls would be put in place. Naturally occurring processes would continue to occur on their own over time. This alternative is included as the baseline, lowest cost alternative against which other potential remedial alternatives are evaluated.

4.2.2 Alternative 2

This alternative represents a continuation of several existing protective activities. Alternative 2 includes monitoring of groundwater, potable supply wells, sub-slab vapor and indoor air (5239 Dailey Road), as outlined in Section 1.2.4 and maintenance of the sump ventilation system at 5239 Dailey Road. Data will continue to be evaluated to determine whether other response actions are warranted to prevent exposure to groundwater or indoor air with COCs in excess of applicable RLs, or LNAPL recovery where occurrence of mobile LNAPL is greater than an LNAPL transmissivity value of 0.5 ft^2/day. Restoration of Site groundwater will continue to occur through natural degradation via NSZD / MNA. Monitor groundwater and drinking water and maintain drinking water wells until groundwater COC concentrations are below potable RLs and groundwater VISLs or alternate acceptable attainment criteria.

4.2.3 Alternative 3

This alternative includes the activities of Alternative 2 plus the implementation of Institutional Controls in the form of Environmental Covenants between Ohio EPA and each affected property owner as detailed in Section 3.3.2. ECs will be specific to each property to restrict shallow groundwater use in areas of MCL exceedances, and / or restrict construction activities within areas of verified petroleum vapor intrusion concerns, as applicable. Monitor groundwater and drinking water and maintain drinking water wells until groundwater COC concentrations are below potable RLs and groundwater VISLs or alternate acceptable attainment criteria.

4.2.4 Alternative 4

This alternative includes the activities of Alternative 3, plus connecting homes in and adjacent to Remedial Areas to a water supply line and decommissioning drinking water wells at the connected homes. Monitor groundwater until COC concentrations are below VISL RLs or alternate acceptable attainment criteria.

4.2.5 Alternative 5

This alternative includes continuation of the current monitoring and interim response actions per Alternative 2, implementation of Institutional Controls in the form of Environmental Covenants per Alternative 3, completing PDI activities to aid technology selection and design, and remedial design and implementation within target areas where enhancements are warranted to aid naturally occurring degradation in achieving RAOs. PDI will be completed to:

1. Determine where there are verified Petroleum Vapor Intrusion risks sourced from residual hydrocarbon impacts by affected media;
2. Evaluate NSZD / MNA mechanisms and effectiveness in achieving RAOs;

3. Collect data to aid technology selection and design; and
4. Pilot test potential active remedies.

With this alternative, restoration of site groundwater will continue to occur through natural degradation via NSZD / MNA, as well as targeted active remedies in areas with recalcitrant COC concentrations. Recalcitrant concentrations at a given location over time represents an indicator that existing remedial mechanisms (i.e., background or a given active remedy) are unable to affect the source in a meaningful way as discussed in Appendix E. This is where active measures would be incorporated to support reduction of COC concentrations in dissolved or vapor media. This alternative is performance-based, and data driven and will allow for flexibility to transition from one technology to another based on performance monitoring relative to the technology-specific goals and RAOs. This methodology will allow for adaptation to varying site geology and contaminant distribution and other varying conditions. Performance monitoring will be specific to the selected technology and will be detailed in the Remedy Design.

4.3 Comparison of Alternative Features

There are common elements and distinguishing features of each Alternative, which are summarized below.

	Monitoring & Additional Response Actions, if needed	**Institutional Controls**	**Engineering Controls**	**Treatment by NSZD/MNA**	**Pre-Design Investigation**	**Targeted Active Remedy**
Alternative 1	no	no	no	no	no	no
Alternative 2	yes	no	5239 ventilation	yes	no	no
Alternative 3	yes	yes	5239 ventilation	yes	no	no
Alternative 4	yes	yes	5239 ventilation, alternative water supply	yes	no	no
Alternative 5	yes	yes	5239 ventilation	yes	yes	yes

4.4 Comparative Analysis of Alternatives

This section describes the process used to compare and select a recommended alternative.

4.4.1 Comparison Criteria

The five remedial alternatives were evaluated using the following nine criteria that U.S. EPA has developed to evaluate remedial alternatives to ensure that important considerations are factored into remedy-selection decisions which were used to evaluate the four remedial alternatives.

The two most important criteria, considered threshold criteria, are the following statutory requirements that must be satisfied by any alternative in order for the remedial alternative to be eligible for selection.

1. Overall protection of human health and environment addresses whether or not an alternative provides adequate protection of human health and the environment through institutional controls, engineering controls, and/or treatment.
2. Compliance with ARARs addresses wither or not an alternative will meet all of the ARARs or whether a waiver is justified.

The following five primary balancing criteria are used to select the most appropriate remedial alternative. select the final remedy.

1. Long-term effectiveness and permanence addresses the ability of a remedy to maintain reliable protection of human health and the environment over time.
2. Reduction of toxicity, mobility, or volume through treatment addresses the statutory preference for selecting remedial actions that employ treatment technologies that permanently and significantly reduce toxicity, mobility, or volume of the hazardous substances as their principal element.
3. Short-term effectiveness addresses the length of time needed to implement an alternative and the risks posed by the alternative during implementation.
4. Implementability addresses the technical and administrative feasibility of implementing the alternative.
5. Cost addresses estimated capital and annual operation and maintenance costs, including long-term monitoring. A comparison of potential costs for the five alternatives is presented in Appendix F. Included in Appendix F is a March 2023 response to comments received from Ohio EPA in December 2022, regarding the cost comparison.

The following two criteria are modifying criteria that cannot be fully evaluated until public comment is received. Anticipated responses were considered in this FS.

1. State agency acceptance addresses whether Ohio EPA concurs with the selected remedial alternative.
2. Community acceptance addresses whether the local community agrees with the analyses and the preferred alternative as proposed. This criterion will be formally evaluated during the public comment period.

4.4.2 Summary of Analysis

The five Alternatives were compared to each other against the nine evaluation criteria as summarized below:

Summary	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
	No Action	Monitoring, NSZD/MNA, and Interim Response Actions	Monitoring, NSZD/MNA, Interim Response Actions & Institutional Controls	Monitoring, NSZD/MNA, Interim Response Actions, Institutional Controls & Alternative Water Supply	Monitoring, NSZD/MNA, Interim Response Actions, Institutional Controls & Targeted Active Remediation
Protection of Human Health & Env.	Does Not Meet Criteria	Does Not Meet Criteria	Exceeds Criteria	Exceeds Criteria	Exceeds Criteria
Compliance w/ ARARs	Does Not Meet Criteria	Does Not Meet Criteria	Exceeds Criteria	Exceeds Criteria	Exceeds Criteria
Long-Term Effectiveness & Permanence	Does Not Meet Criteria	Does Not Meet Criteria	Meets Criteria	Exceeds Criteria	Exceeds Criteria
Reduction of Toxicity, Mobility, or Volume through Treatment	Does Not Meet Criteria	Meets Criteria	Meets Criteria	Meets Criteria	Exceeds Criteria
Short-Term Effectiveness	Does Not Meet Criteria	May Not Meet Criteria	Exceeds Criteria	Exceeds Criteria	Exceeds Criteria
Implementability	Meets Criteria	Exceeds Criteria	Meets Criteria	Meets Criteria	Meets Criteria
Cost	Meets Criteria	Meets Criteria	Meets Criteria	Meets Criteria	Meets Criteria
State Agency Acceptance*					
Community Acceptance**					

Notes:

Color coding: green = most favorable, yellow = mid-range, orange = least favorable

* State Agency Acceptance to be documented in the Decision Document.

** Community acceptance to be determined through the public comment process.

4.5 Recommended Alternative

Based on the comparison of the five alternatives against the nine evaluation criteria presented in Section 4.4, Alternative 5 is ranked most favorably and is therefore recommended for implementation at the Site. This alternative includes continuation of the current monitoring, interim response actions as needed, implementation of institutional controls in the form of ECs (further detailed in Section 5.3), completing PDI activities to aid technology selection and design, and remedial design and implementation within target areas where enhancements are warranted to aid naturally occurring degradation in achieving RAOs.

A summary of the recommended remedial alternative for the Western Remedial Area is provided in Table 4-1. In the Western Remedial Area, based on the preliminary evaluation presented in Appendix E, it is anticipated that the location(s) where targeted active remediation will be performed will include the area of elevated dissolved COC concentrations in shallow groundwater near monitoring well MW-6S, located near the former underground petroleum pipeline, and monitoring wells RI-MW-1-8 and RI-MW-1-10, where COC concentrations are not exhibiting clear declines over time. Because BP owns the EUs in the area, access is not expected to be an issue, except in the vicinity of the active underground petroleum pipeline. It is anticipated that the active remedy will consist of applying an air driven technology (AS/SVE, biosparging, bioventing), depending on PDI, which will include consideration of the permeability of the matrix sourcing the elevated dissolved concentrations, and pilot test results. If AS/SVE is selected as a primary active remedy, as described in Section 3.3.5.2, once vapor phase recovery rates diminish, the system may transition to bioventing or biosparging, operating at reduced air flow rates for the purpose of increasing subsurface oxygen to enhance aerobic degradation without volatilization and extraction of VOCs. It is anticipated that the contingent remedy may include phytotechnologies, depending upon the depth of hydrocarbon sourcing dissolved phase concentrations, or enhanced anaerobic biodegradation through targeted bioremediation injection (e.g., sulfate). In other portions of the Western Remedial Area, such as near M1-3S, groundwater concentration trends indicate that natural degradation is effectively reducing COCs towards attainment, and PDI activities will be completed to further evaluate natural degradation.

A summary of the recommended remedial alternative for the Central Remedial Area is provided in Table 4-2. In the Central Remedial Area, based on the preliminary evaluation presented in Appendix E, it is anticipated that the location(s) where targeted active remediation will be performed will include the areas of elevated dissolved COC concentrations in shallow groundwater near monitoring wells GW-4 and RI-DMW-4-7, located near the former underground petroleum pipeline. Elevated concentrations remain at RI-DMW-4-5, however, access has specifically been denied to the EU at 359 Maywood Drive, which will restrict access in that area. BP owns the EU (5265 Kaylin Drive) that is located along the pipeline to the north of GW-4 and west of RI-DMW-4-5, which will facilitate access to most of this area, except in the vicinity of the active underground petroleum pipeline; however, access has specifically been denied to the EU to the east (359 Maywood Drive), which will restrict access in that direction. Since there may be limited access to implement a technology in portions of the Central target area, alternatives that can be implemented upgradient to reduce flux downgradient will be considered. It is anticipated that the active remedy will consist of applying either an air-driven technology (biosparging, bioventing) in the area or installing an injected barrier (e.g., activated carbon), depending on PDI and pilot test results. It is anticipated that the contingent remedy may include phytotechnologies, depending upon the depth of hydrocarbon sourcing dissolved phase concentrations, or enhanced anaerobic biodegradation through targeted bioremediation injection (e.g., sulfate). In other portions of the Central Remedial Area, such as near RI-MW-4-9, groundwater concentration trends indicate that natural degradation is effectively reducing COCs towards attainment, and PDI activities will be completed to further evaluate the efficacy of natural degradation.

A summary of the recommended remedial alternative for the Eastern Remedial Area is provided in Table 4-3. In the Eastern Remedial Area, based on the preliminary evaluation presented in Appendix E, it is anticipated that the location(s) where targeted active remediation will be performed will include the area of elevated dissolved COC concentrations in shallow groundwater near monitoring well RI-MW-6-12, located near the former underground petroleum pipeline. BP doesn't own any of the EUs in this location, so access must be negotiated. It is anticipated that the active remedy will consist of applying an air driven technology (AS/SVE, biosparging, bioventing) in the area or installing an injected barrier (e.g., activated carbon), depending on PDI and pilot test results. It is anticipated that the contingent remedy may include phytotechnologies, depending upon the depth of hydrocarbon sourcing dissolved phase concentrations, or enhanced anaerobic biodegradation through targeted bioremediation injection (e.g., sulfate). In other portions of the Eastern Remedial Area, such as near RI-MW-6-6 and RI-MW-6-10, groundwater concentration trends indicate that natural degradation is effectively reducing COCs towards attainment, and PDI activities will be completed to further evaluate the efficacy of natural degradation.

Implementation of the recommended Remedial Alternative will be performed as outlined in Section 5.0 in order to achieve the RAOs.

5.0 IMPLEMENTATION OF RECOMMENDED ALTERNATIVE

This section discusses the proposed processes for implementation of the recommended remedial alternative, which includes continuation of the current monitoring, interim response actions as needed, implementation of institutional controls in the form of ECs, completing PDI activities to aid technology selection and design, and remedial design and implementation to target areas where enhancements are warranted to aid naturally occurring degradation. The proposed processes for implementation are summarized in the flow charts in Appendix G and are discussed below.

5.1 Monitoring

Under the recommended remedial alternative, the current monitoring activities will continue, including monitoring of groundwater, potable supply wells, and sub-slab vapor and indoor air (5239/5247 Dailey Road) as discussed in the following sections. Additional monitoring activities will be included as part of the PDI and remedy performance monitoring.

5.1.1 Groundwater

The current groundwater monitoring program will be continued. Monitoring well groundwater sampling will be performed annually from the network of 51 monitoring wells located primarily around the perimeters of the groundwater plumes to monitor plume stability. Additional groundwater monitoring activities will be proposed in a Remedial Design/Remedial Investigation (RD/RA) Work Plan. Groundwater monitoring will continue until COC concentrations within the Remedial Areas are below groundwater potable RLs and groundwater vapor intrusion to indoor air RLs, or attainment of alternate accepted criteria.

5.1.2 Drinking Water

Annual testing of drinking water will continue to be performed at the EUs (currently 38) in the Remedial Areas, with the exception of those that are owned by BP and unoccupied. If COCs are detected in drinking water samples, interim response actions will be implemented, as discussed in Section 5.2.1. Drinking water will be tested and drinking water wells will be maintained until monitoring well COC concentrations in the Remedial Areas are below potable RLs, or attainment of alternate accepted criteria.

5.1.3 PVI

To evaluate PVI concerns, indoor air sampling will continue to be performed at 5239/5247 Dailey Road to monitor the effectiveness of the temporary vapor mitigation (sump ventilation) system. Access will continue to be pursued at 5249/5253 Dailey Road and 359 Maywood Road to further evaluate PVI concerns through soil vapor, subslab and/or indoor air sampling, following the approach outlined in Appendix C. Monitoring well groundwater results will be monitored and if changes in groundwater COC concentrations result in potential PVI concerns at EUs where there had been none, PVI evaluation (e.g., subslab sampling) will be performed, following the approach outlined in Appendix C. If unacceptable PVI risks are identified, interim response actions will be implemented, as discussed in Section 5.2.2. A comprehensive plan for evaluation of PVI at EUs for closure following the approach outlined in Appendix C will be developed in a PDI Work Plan.

5.1.4 LNAPL

If LNAPL is encountered during monitoring well groundwater sampling, the LNAPL will be characterized as part of the comprehensive evaluation of LNAPL that will be included in the PDI, discussed in Section 5.4 (e.g., transmissivity testing).

5.2 Interim Response Actions

Data will continually be evaluated to determine whether interim response actions are warranted to prevent unacceptable exposure through potable use of groundwater, PVI, or to address LNAPL, if encountered.

5.2.1 Potable use of GW

If COCs are detected in a drinking water sample, the drinking water system will immediately be resampled. If detections are confirmed, bottled water will be provided for drinking purposes and the drinking water system will be inspected and repaired, if possible, or a replacement, double-cased drinking water well will be installed in accordance with the design approved by Ohio EPA (Ohio EPA, 2013). Or, if municipal water is available at the time, the EU will be connected to the municipal water supply and the existing drinking water well will be decommissioned. If COCs are detected in a drinking water sample at concentrations at or above a potable RL, an alternate source of potable water (e.g., bottled water, temporary water tank resupplied by water trucks) will immediately be provided on an interim basis while proceeding through the steps described above.

5.2.2 PVI

The temporary vapor mitigation (sump ventilation) system at 5239/5247 Dailey Road will continue to be maintained until a demonstration is made that that its operation is not required to prevent unacceptable risk. As mentioned previously, access will continue to be pursued to 5249/5253 Dailey Road and 359 Maywood Road to further evaluate PVI concerns and a comprehensive plan for evaluation of PVI at EUs for closure following the approach outlined in Appendix C will be developed in a PDI Work Plan. If future indoor air sampling results exceed indoor air RLs, interim actions (e.g., temporary vapor mitigation system, vacating access to the structure) will be implemented to prevent unacceptable risk.

5.2.3 LNAPL

If LNAPL is encountered during monitoring well groundwater sampling, the LNAPL will be characterized as part of the comprehensive evaluation of LNAPL that will be included in the PDI, discussed in Section 5.4 (e.g., transmissivity testing). Where LNAPL is encountered with transmissivity greater than 0.5 ft^2/day, LNAPL will be recovered using a solar powered skimmer and properly disposed off Site. Evaluation of LNAPL in the PDI will determine the appropriate remedial approach for addressing LNAPL, as outlined in Section 5.4 and Section 5.5.

5.3 Institutional Controls

It is anticipated that institutional controls will be needed to prevent potable use of groundwater where COC concentrations exceed RLs and inhalation of COCs at concentrations above the indoor air RLs until groundwater remediation is complete.

At each EU where COCs in groundwater exceed potable RLs, reasonable efforts will be made to establish an EC between Ohio EPA and the affected property owner to prohibit installation of groundwater wells in the shallow aquifer for uses other than maintaining or expanding remedial systems or monitoring groundwater quality, and to require that any new wells installed for non-remediation uses are installed within the deep aquifer and constructed of double-cased PVC in accordance with the procedures approved by Ohio EPA Ohio EPA, 2013). The EC will include irrevocable access for Ohio EPA and BP (including officers, employees, agents, and contractors) to perform Permitted Activities, such as drinking water testing, as defined in the EC. Each EC will include an associated program of O&M that will include routine inspection to ensure that any new drinking water wells conform with the restrictions.

In areas of verified PVI concerns, reasonable efforts will be made to establish an EC between Ohio EPA and each affected property owner to prohibit construction that modifies the footprint of an existing habitable structure (e.g., residence) outside of the existing footprint or construction of a new habitable structure, unless the new construction will be outfitted with approved mitigation measures for vapors or a demonstration is made that occupancy of the new construction poses no unacceptable PVI risk. The EC will include irrevocable access for Ohio EPA and BP (including officers, employees, agents, and contractors) to perform Permitted Activities, such as subslab vapor and indoor air sampling, as defined in the EC.

5.4 PDI

Pre-design investigation (PDI) activities will be conducted to further characterize ongoing degradation and potential PVI bio attainment and residual risk to determine where additional remedial actions are appropriate to supplement natural mechanisms. Subsequent rounds of PDI may focus on data collection at sufficient resolution within target areas for additional remedial action to design an effective remedy, which may include pilot testing. Details of the scope will be presented in one or more Work Plans to be developed with Ohio EPA approval. The work is anticipated to include the following:

1. Evaluate NSZD / MNA mechanisms and effectiveness in achieving RLs. Data collection methods may include testing soil vapor for biodegradation indicators in existing groundwater monitoring wells and additional new locations, and collection of groundwater samples, including from additional monitoring wells not currently in the monitoring program, for analysis of electron acceptor and biodegradation reaction products and/or COCs.
2. Determine where there is a verified PVI risk sourced from the former underground petroleum pipeline. A comprehensive step-wise plan for evaluation of PVI concerns will be developed and implemented following the approach outlined in Appendix C, in accordance with Ohio EPA guidance (Ohio EPA, 2020). Testing and evaluation may include soil gas profiling, subslab soil vapor sampling, indoor air sampling, modeling, and distance-based screening.
3. Perform testing on LNAPL, if encountered, to characterize its occurrence and composition and evaluate recoverability and applicability of potential remedial technologies. LNAPL baildown tests or other LNAPL transmissivity testing using ASTM methods will be used to assess mobile LNAPL occurrences for LNAPL transmissivity to determine the appropriate remedial approaches.
4. Perform additional data collection and evaluation to identify areas for targeted active remediation and aid in technology selection and design. Data evaluation will include review of spatial plots of groundwater COC concentrations in Remedial Areas over time and qualitative analysis of time series plots of COC concentrations for individual monitoring wells to identify areas exhibiting little or no improvement via natural mechanisms that will be targeted with an active remedy until impacts are sufficiently reduced below remedial objectives, or until natural mechanisms are sufficient to continue reducing the impacts towards the remedial objectives. Preliminary evaluations using GWSDAT are presented in Appendix E. Additional testing may include determination of physical and/or chemical properties of the aquifers within the target treatment areas and treatability studies to aid in technology selection and design.
5. Select and pilot test potential active remedies, identified in Section 3.3.5, based on results of additional data collection and evaluation to be performed in the PDI, as discussed above. Technologies with favorable results would be implemented at targeted locations, as discussed in Section 5.5.

5.5 Target Remediation Technology Selection, Design, and Implementation

As discussed in Section 1 and in Appendix E, preliminary review of existing data indicates that in many areas of the Site, restoration of groundwater is occurring through natural degradation via NSZD / MNA. NSZD / MNA is anticipated to be the selected remedy in some areas of the Site, and this will be further evaluated in the PDI.

Areas exhibiting little or no improvement via natural mechanisms (Target Areas) will be targeted with an active remedy that will be selected appropriate for the characteristics (e.g., hydrogeology) of each location based on results of the PDI; preliminary anticipated and contingent remedies are summarized in Tables 4-1 through 4-3. Based on results of performance monitoring of groundwater and soil vapor, remediation will be performed in a stepwise fashion transitioning from one technology to another based on performance relative to the technology-specific goals, adapting to varying contaminant distribution and Site geology until impacts are sufficiently reduced to meet RLs, or until natural mechanisms are determined to be sufficient to continue reducing the impacts towards the remedial objectives. Refer to Section 4.5 for a description of the anticipated locations for targeted active remediation, the anticipated active remedies to be applied, and the anticipated contingent remedies. Details of remedial design and implementation, including performance monitoring specific to selected technologies (including NSZD / MNA), will be presented in the Remedy Design.

5.6 EU Closure

Remedial actions and/or monitoring of drinking water, groundwater, soil vapor, and LNAPL will continue until potable groundwater use concerns and PVI concerns have been resolved and LNAPL has been recovered to the extent practicable. The following closure criteria will be used:

- Potable groundwater: attainment of potable RLs for COCs at compliance points to be established and verified by methods acceptable to Ohio EPA at the time of attainment demonstration
- PVI: groundwater monitoring well COC concentrations below vapor intrusion RLs, soil vapor COC concentrations below soil gas RLs, or Site-specific demonstrations of acceptable VI risks.
- LNAPL: LNAPL transmissivity below 0.5 ft^2/day.

Remediation is expected to progress at different rates across the Site and closure criteria may be achieved at some EUs before others. Because each EU is individually owned, it may be desirable to demonstrate achievement of closure criteria at an individual EU or group of EUs and remove the EU(s) from the Remedial Area (i.e., terminate remedial actions and monitoring) before closure criteria have been achieved at all 38 EUs. Petition for removal of an EU or group of EUs from a Remedial Area would be made by submittal of sufficient data to Ohio EPA to demonstrate achievement of closure criteria for the individual or group of EUs. It is recognized that this may require installation of additional monitoring wells or other monitoring points and/or evaluation of data on adjacent EUs that are upgradient of the subject EUs.

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TABLES

TABLE 1-1
WESTERN AREA SUBSLAB VAPOR
BP WEAVER WOODLANDS ALLOTMENT
NEW FRANKLIN, OHIO

Exposure Unit (Property Address)	Sample Type	Sample Location	Date	Benzene	Ethylbenzene	Toluene	m&p-Xylene	o-Xylene	Naphthalene
				ug/m^3	ug/m^3	ug/m^3	ug/m^3	ug/m^3	ug/m^3
	Vapor Intrusion Screening Level (VISL)[1]			**120**	**374**	**174,000**	**3,480**	**3,480**	**27.5**
569 Fairwood	Subslab	RI-SUB-1-22	04/26/19	0.73 U	2.0 U	1.7 U	4.0 U	2.0 U	6.0 U
		RI-SUB-1-23	04/26/19	0.57 U	1.5 U	1.3 U	3.1 U	1.5 U	4.7 U
		RI-SUB-1-23 dup	04/26/19	0.57 U	1.5 U	**3.1**	3.1 U	1.5 U	4.7 U
		RI-SUB-1-24	04/26/19	0.57 U	1.5 U	1.3 U	3.1 U	1.5 U	4.7 U
585 Fairwood	Subslab	RI-SUB-1-13	04/12/17	**4.8**	**14.8**	**55.6**	**56.1**	**20.4**	**10.5**
		RI-SUB-1-14	04/12/17	**5.3**	**16.2**	**63.7**	**62**	**22.6**	**16.4**
		RI-SUB-1-15	04/12/17	**5.8**	**15.5**	**61.1**	**60.7**	**22.2**	**27**
586 Fairwood	Subslab	RI-SUB-1-16	04/12/17	**3.1**	**10.8**	**36.4**	**39.3**	**15.0**	**8.2**
		RI-SUB-1-17	04/12/17	**2.2**	**12.2**	**38.2**	**45.5**	**17.9**	**17.5**
		RI-SUB-1-18	04/12/17	**3.1**	**12**	**42.7**	**44.4**	**16.7**	**7.1**
594 Fairwood	Subslab	RI-SUB-1-4	06/07/11	6.2 U	8.4 U	--	16 .0 U	8.4 U	10.0 U
		RI-SUB-1-4	06/12/12	0.47 U	1.3 U	--	2.5 U	1.3 U	**2.3 J+**
		RI-SUB-1-4	04/13/17	1.1 U	**5.5**	**2.3**	**22.5**	**5.7**	**6830**
		RI-SUB-1-5	06/07/11	2.8 U	3.8 U	--	7.5 U	3.8 U	**4.6**
		RI-SUB-1-5	06/12/12	**68.6**	**3.5**	--	**22.5**	**10.9 J**	**29.5 J+**
		DUP-9 (RI-SUB-1-5)	06/12/12	**57.4**	**3.4**	--	**28.3**	**16.9 J**	**10.4 J+**
		RI-SUB-1-5	04/13/17	1.1 U	1.5 U	**4.7**	**4.0**	**1.9**	**7.8**
		RI-SUB-1-6	06/07/11	2.8 U	3.8 U	--	7.5 U	3.8 U	4.6 U
		RI-SUB-1-6	06/12/12	**24.2**	1.3 U	--	2.6 U	1.3 U	**2.7 J+**
		RI-SUB-1-6	04/13/17	1 U	1.4 U	1.2 U	2.8 U	1.4 U	**134**
604 Fairwood	Subslab	RI-SUB-1-1	06/08/11	**9.4**	3.2 U	--	6.2 U	3.2 U	3.8 U
		RI-SUB-1-1	06/12/12	**11.3**	1.2 U	--	**4.0**	**1.6**	**16.3 J+**
		RI-SUB-1-1	04/13/17	**1.3**	**2.9**	**77.7**	**6.8**	**2.6**	**5.3**
		RI-SUB-1-2	06/08/11	2.6 U	3.5 U	--	7.1 U	3.5 U	4.3 U
		RI-SUB-1-2	06/12/12	**20.9**	1.2 U	--	**3.5**	**1.5**	**7.9 J+**
		RI-SUB-1-2	04/13/17	1.1 U	1.5 U	1.3 U	3 U	1.5 U	**5.5**
		RI-SUB-1-3	06/08/11	**11.0 J**	3.7 U	--	7.5 U	3.7 U	4.4 U
		DUP-3 (RI-SUB-1-3)	06/08/11	**20.1 J+**	3.1 U	--	6.2 U	3.1 U	3.7 U
		RI-SUB-1-3	06/12/12	**18.7**	**1.7**	--	**8.4**	**3.3**	**10.6 J+**
		RI-SUB-1-3	04/13/17	1.4 U	1.9 U	**3.8**	3.8 U	1.9 U	**6.8**
		DUP-A (1-3)	04/13/17	1.1 U	1.5 U	1.3 U	3 U	1.5 U	**4.9**
605 Fairwood	Subslab	RI-SUB-1-10	04/12/17	1.1 U	**2.4**	**3.4**	**10.7**	**5.1**	**7.7**
		RI-SUB-1-11	04/12/17	1.1 U	**2.2**	**3.7**	**9.3**	**4.4**	**7.1**
		RI-SUB-1-12	04/12/17	2.0 U	**4.0**	**4.7**	**20.7**	**8.0**	**135**

TABLE 1-1
WESTERN AREA SUBSLAB VAPOR
BP WEAVER WOODLANDS ALLOTMENT
NEW FRANKLIN, OHIO

Exposure Unit (Property Address)	Sample Type	Sample Location	Date	Benzene	Ethylbenzene	Toluene	m&p-Xylene	o-Xylene	Naphthalene
				ug/m^3	ug/m^3	ug/m^3	ug/m^3	ug/m^3	ug/m^3
	Vapor Intrusion Screening Level (VISL)[1]			**120**	**374**	**174,000**	**3,480**	**3,480**	**27.5**
614 Fairwood	Subslab	RI-SUB-1-19	11/28/17	0.48 U	1.3 U	--	2.6 U	1.3 U	7.9 U
		RI-SUB-1-20	11/28/17	0.52 U	1.4 U	--	2.8 U	1.4 U	8.6 U
		RI-SUB-1-20 dup	11/28/17	0.52 U	1.4 U	--	2.8 U	1.4 U	8.6 U
		RI-SUB-1-21	11/28/17	0.52 U	1.4 U	--	2.8 U	1.4 U	8.6 U
607 Highland Park	Subslab	RI-SUB-1-7	05/10/12	**55**	**1.5**	--	**4.2**	**2.0**	**5.7 J+**
		RI-SUB-1-7	06/13/12	0.5 U	1.4 U	--	2.7 U	1.4 U	1.7 U
		RI-SUB-1-7	04/20/17	**0.37**	**4.0**	**6.0**	**16.2**	**8.0**	**8.5 J**
		RI-SUB-1-8	05/10/12	**39.8**	**2.0**	--	**5.5**	**2.4**	**3.9 J+**
		DUP-8 (RI-SUB-1-8)	05/10/12	**37.3**	**1.7**	--	**4.2**	**1.9**	**4.5 J+**
		RI-SUB-1-8	06/13/12	**8.6**	1.4 U	--	**4.7**	**2.1**	**13.5 J+**
		RI-SUB-1-8	04/20/17	**0.28**	**8.4**	**11.7**	**30.9**	**15.3**	**13.2 J**
		RI-SUB-1-9	05/10/12	**101**	**1.8**	--	**5.0**	**2.5**	**5.5 J+**
		RI-SUB-1-9	06/13/12	**2.8**	1.3 U	--	2.6 U	1.3 U	**2.7 J+**
		DUP-10 (RI-SUB-1-9)	06/13/12	**2.0**	**1.6**	--	**2.6**	1.3 U	**2.1 J+**
		RI-SUB-1-9	04/20/17	**0.4**	**8.8**	**10.6**	**34.4**	**17.4**	**14.5 J**
		DUP-B (1-9)	04/20/17	**0.32**	**6.4**	**8.1**	**24.1**	**12.6**	**10.7 J**

Notes:

[1] From USEPA Vapor Intrusion Screening Level Calculator, August 2019 version.
U = The analyte was analyzed for, but was not detected. Value shown is the sample reporting limit.
UJ = The analyte was not detected at or above the sample reporting limit. However, the reporting limit is approximate and may
J = Estimated concentration because the result was below the sample reporting limit or quality control criteria were not met.
-- = Not analyzed in this sample.
bold = Analyte was detected above reporting limit.
[shaded box] = Reported concentration exceeded the subslab vapor VISL.

TABLE 1-2
CENTRAL AREA SOIL VAPOR AND SUBSLAB VAPOR
BP WEAVER WOODLANDS ALLOTMENT
NEW FRANKLIN, OHIO

Exposure Unit (Property Address)	Sample Type	Sample Location	Date	Benzene	Ethylbenzene	Toluene	m&p-Xylene	o-Xylene	Naphthalene
				ug/m^3	ug/m^3	ug/m^3	ug/m^3	ug/m^3	ug/m^3
	Vapor Intrusion Screening Level (VISL)[1]			120	374	174,000	3,480	3,480	27.5
5245 Kaylin	Exterior Soil Vapor	VP-4-1 (6.0')	05/11/11	4.3	2.7	--	5.1	2.6	6.9
		VP-4-2 (6.0')	05/12/11	12.1	17.8	--	56.7	15.9	5.1 U
		VP-4-3 (6.0')	05/12/11	8.3	23.7	--	79.8	23.6	4.5 U
		VP-4-3 (9.0')	05/12/11	3.1	16.3	--	57.4	20.2	12
		VP-4-4 (6.0')	05/12/11	5.5	16.2	--	58.4	17.1	4.5 U
		VP-4-4 (6.0') DUP-1	05/12/11	4.7	12.9	--	45.6	13.7	4.5 U
5255 Kaylin	Exterior Soil Vapor	RI-VP-4-11 (8.5')	10/11/11	5.2	11.1 U	--	24.3	11.1 U	34.1 U
		RI-VP-4-11 (13.5')	10/11/11	14.7	35.4	--	83.1	30.4 U	93.4 U
		RI-VP-4-12 (6.0')	10/11/11	39.8	48.2 U	--	117	48.2 U	148 U
		RI-VP-4-12 (7.25)	10/11/11	27.7	51.6	--	202	91	85.9 U
		RI-VP-4-12 (8.5')	10/11/11	186	435	--	2,530	1,120	89.6 U
		RI-VP-4-13 (6.0')	10/11/11	14.9	56.2	--	171	59.9	3.9 U
	Subslab	R1-SUB-4-7	01/17/17	5.7	3.4	10.2	13.5	5.1	4.8
		DUP-1 (4-7)	01/17/17	16.5	5.3	13.7	17.4	7.0	10.7 U
		R1-SUB-4-8	01/17/17	44.7	3.0	10	11.1	4.2	4.3
		R1-SUB-4-9	01/17/17	3.4	4.5	19.1	17	6.4	4.1 U
5265 Kaylin	Exterior Soil Vapor	RI-VP-4-14 (6.0')	10/11/11	89.4	38.3	--	170	62.2	79.9 U
		RI-VP-4-14 (9.0')	10/11/11	388	10,900	--	102,000	49,400	1,370 U
		RI-VP-4-15 (6.0')	10/11/11	0.62	9.5	--	50.1	25.3	4.3 U
		RI-VP-4-15 (7.5')	10/11/11	51.1	190	--	478	180	343 U
		RI-VP-4-15 (9.25)	10/11/11	43.3	184	--	634	210	89.6 U
		DUP-6 (RI-VP-4-15(9.25))	10/11/11	42.2	169	--	573	191	89.6 U
		RI-VP-4-16 (6.0')	10/10/11	2.9	27.9	--	96.6	39.7	4.0 U
		RI-VP-4-16 (8.0')	10/10/11	3.3	36.6	--	114	49.2	4.2 U
5265 Kaylin	Subslab	RI-SUB-4-1	01/05/12	0.52 U	1.4 U	--	2.8 U	1.4 U	4.3 U
			06/13/12	0.65	1.6	--	4.9	2.1	10.3 J+
			04/20/17	0.2 U	3.1	3.1	12.5	6.6	9.8 J
		RI-SUB-4-2	01/05/12	0.54	1.1 U	--	2.2 U	1.1 U	3.4 U
			06/13/12	1.6	1.5	--	4.6	1.8	13.9 J+
		RI-SUB-4-2R	04/20/17	0.27	3.9	3.6	16.3	8.7	14.7 J
		RI-SUB-4-3	01/05/12	41	1.3 U	--	2.6 U	1.3 U	4.0 U
			06/13/12	1.8	2.0	--	7.3 J	3.0 J	15.6 J+
		DUP-12 (RI-SUB-4-3)	06/13/12	2.5	2.9	--	16.6 J	8.1 J	40.2 J+
		RI-SUB-4-3	04/20/17	0.53	3.8	3.6	16	8.7	15.5 J
		DUP-C (4-3)	04/20/17	0.67	4.2	4.2	17.4	8.8	15.1 J
349 Maywood	Exterior Soil Vapor	RI-VP-4-5 (6.0')	10/17/11	0.5 U	1.4 U	--	2.7 U	1.4 U	4.2 U
		RI-VP-4-5 (9.0')	10/10/11	11.6	11.8	--	43.3	12.3	4.2 U
		DUP-4 (RI-VP-4-5 (9.0'))	10/10/11	3.5	2.0	--	9.0 J	3.3	4.3 U
		RI-VP-4-5 (12.0')	10/10/11	1.5	1.4 U	--	3.4 J	1.4 U	4.3 U
		RI-VP-4-6 (5.75)	10/10/11	0.48 U	18	--	66.1	20.2	4.5
		RI-VP-4-6 (6.75)	10/10/11	26.1	25.3	--	72.1	22.3	4.0 U
		RI-VP-4-6 (7.75)	10/10/11	5.4	40.6	--	106	34.9	4.2 U
		RI-VP-4-7 (6.0')	10/10/11	154 U	250 J	--	834 U	417 U	1280 U
		RI-VP-4-7 (6.0')	12/28/11	122	129	--	255	83.3	156 U
		DUP-7 (RI-VP-4-7 (6.0'))	12/28/11	113	130	--	256	83.8	145 U
		RI-VP-4-7 (6.0')	06/13/12	0.73 U	61.3	--	140	43	12.7 J+
		DUP-11 (RI-VP-4-7 (6.0'))	06/13/12	0.55 U	66.2 J+	--	157 J+	48.9 J+	9.6 J+
		RI-VP-4-7 (7.5')	10/10/11	22.2 U	30.8 J	--	120 U	60 U	184 U
		RI-VP-4-7 (7.5')	12/28/11	5.1	1.3 U	--	2.6 U	1.3 U	4.0 U
		RI-VP-4-7 (9.0')	10/10/11	331 U	895 U	--	1,790 U	895 U	2,750 U
		RI-VP-4-7 (9.0')	12/28/11	3.2	1.5 U	--	3.0 U	1.5 U	4.6 U
		RI-VP-4-7 (9.0')	06/13/12	1,400 U	34,100 J+	--	28,700 J+	4,950 J+	4,600 U
349 Maywood	Subslab	RI-SUB-4-4	08/24/12	0.52 U	1.4 U	--	2.8 U	1.4 U	1.7 U
		DUP-13 (RI-SUB-4-4)	08/24/12	0.55 U	1.5 U	--	3.0 U	1.5 U	1.8 U
		RI-SUB-4-5	08/24/12	0.5 U	1.4 U	--	2.7 U	1.4 U	1.7 U
		RI-SUB-4-6	08/24/12	24.5	1.3 U	--	2.6 U	1.3 U	1.6 U

TABLE 1-2
CENTRAL AREA SOIL VAPOR AND SUBSLAB VAPOR
BP WEAVER WOODLANDS ALLOTMENT
NEW FRANKLIN, OHIO

Exposure Unit (Property Address)	Sample Type	Sample Location	Date	Benzene	Ethylbenzene	Toluene	m&p-Xylene	o-Xylene	Naphthalene
				ug/m^3	ug/m^3	ug/m^3	ug/m^3	ug/m^3	ug/m^3
	Vapor Intrusion Screening Level (VISL)[1]			**120**	**374**	**174,000**	**3,480**	**3,480**	**27.5**
359 Maywood	Exterior Soil Vapor	RI-VP-4-8 (6.0')	10/10/11	**41.2**	**167**	--	**366**	**140**	**4.1**
		RI-VP-4-8 (9.0')	10/10/11	**3.8**	**4.3**	--	**17.1**	**4.2**	**54.4**
		RI-VP-4-8 (12.0')	10/10/11	**49.4**	**42.4**	--	**96.4**	**27.8**	20.8 U
		RI-VP-4-9 (6.0')	10/10/11	**5.6**	**2.6**	--	**7.9 J**	**2.7**	3.9 U
		DUP-5 (RI-VP-4-9 (6.0'))	10/10/11	**7.9**	**4.9**	--	**20 J**	**7.8**	4.2 U
		RI-VP-4-10 (6.0')	10/10/11	**38.1**	**143**	--	**324**	**122**	**5.0**
		RI-VP-4-10 (10.0')	10/10/11	2.3 U	**13.5**	--	**54.3**	**7.8**	19.5 U
		RI-VP-4-10 (14.0')	10/10/11	**7.6**	**20.5**	--	**63.5**	**18.1**	**8.5**

Notes:

[1] From USEPA Vapor Intrusion Screening Level Calculator, version 3.5.2, August 2019 version.

U = The analyte was analyzed for, but was not detected. Value shown is the sample reporting limit.

UJ = The analyte was not detected at or above the sample reporting limit. However, the reporting limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

J = Estimated concentration because the result was below the sample reporting limit or quality control criteria were not met. "+" indicates a potential high bias.

-- = Not analyzed in this sample.

bold = Analyte was detected above reporting limit.

[light blue fill] Reported concentration exceeded the soil vapor/subslab vapor VISL. Subslab sampling was conducted.

[blue outline] Reported concentration exceeded the soil vapor/subslab vapor VISL. Additional sampling conducted in 2017 did not confirm the exceedance.

[orange fill] Reported concentration exceeded the soil vapor/subslab vapor VISL. Subslab sampling was not authorized by the resident.

0.00 U = Reporting limit exceeded the soil vapor/subslab vapor VISL.

TABLE 1-3
EASTERN AREA SUBSLAB VAPOR
BP WEAVER WOODLANDS ALLOTMENT
NEW FRANKLIN, OHIO

Exposure Unit (Property Address)	Sample Type	Sample Location	Date	Benzene	Ethylbenzene	Toluene	m&p-Xylene	o-Xylene	Naphthalene
				ug/m^3	ug/m^3	ug/m^3	ug/m^3	ug/m^3	ug/m^3
Vapor Intrusion Screening Level (VISL)[1]				**120**	**374**	**174,000**	**3,480**	**3,480**	**27.5**
5206 Dailey	Subslab	RI-SUB-5-1	1/17/2017	**1.3**	**4.0**	**14.3**	**14.8**	**5.4**	4.7 U
		RI-SUB-5-2	1/17/2017	**4.0**	**5.0**	**20.8**	**19.4**	**7.0**	**6.1**
		DUP-2 (5-2)	1/17/2017	**3.8**	**4.8**	**19.2**	**17.6**	**6.5**	**9.3**
		RI-SUB-5-3	1/17/2017	**36.6**	**3.1**	**9.6**	**12.1**	**4.7**	**5.7**
5229 / 5233 Dailey	Subslab	RI-SUB-6-6	8/29/2019	0.55 U	1.5 U	**2.3**	3.0 U	1.5 U	4.5 U
		RI-SUB-6-7	8/29/2019	0.57 U	1.5 U	1.3 U	3.1 U	1.5 U	4.7 U
		RI-SUB-6-7 (duplicate)	8/29/2019	0.57 U	1.5 U	**1.5**	3.1 U	1.5 U	4.7 U
		RI-SUB-6-8	8/29/2019	**3.7**	**1.9**	**9.8**	**9.0**	**2.7**	4.5 U
5239 / 5247 Dailey	Subslab	RI-SUB-6-3	5/23/2019	**0.36 J**	0.63 U	**1.1 J**	1.4 U	0.71 U	**4 J**
		RI-SUB-6-4	4/26/2019	0.57 U	1.5 U	1.3 U	3.1 U	1.5 U	4.7 U
		RI-SUB-6-4 (duplicate)	4/26/2019	0.57 U	1.5 U	1.3 U	3.1 U	1.5 U	4.7 U
		RI-SUB-6-5	4/26/2019	**353**	**604**	**373**	**364**	**277**	**68.9**
	Subslab	RI-SUB-6-3	8/22/2019	**6**	**21.4**	**75.5**	**78.4**	**28**	**5.5**
		RI-SUB-6-4	8/22/2019	0.55 U	**2.2**	**9.8**	**9.5**	**1.8**	4.5 U
		RI-SUB-6-5	8/22/2019	0.57 U	**6**	**4.4**	**25.5**	**9.8**	4.7 U
		RI-SUB-6-5 (duplicate)	8/22/2019	0.57 U	**6.4**	**4.8**	**26.3**	**10**	4.7 U
5261 Dailey	Subslab	RI-SUB-6-1	11/9/2018	0.48 U	1.3 U	1.1 U	2.6 U	1.3 U	4.0 U
		RI-SUB-6-1 (duplicate)	11/9/2018	0.58 U	1.6 U	**3.1**	3.2 U	1.6 U	4.8 U
		RI-SUB-6-2	11/9/2018	0.55 U	1.5 U	1.3 U	3.0 U	1.5 U	4.5 U

Notes:

[1] From USEPA Vapor Intrusion Screening Level Calculator, August 2019 version.

U = The analyte was analyzed for, but was not detected. Value shown is the sample reporting limit.

J = Indicates result is an estimated value between the method detection limit and the laboratory practical quantitation limit.

bold = Analyte was detected above reporting limit.

(shaded) Reported concentration exceeded the subslab vapor VISL.

TABLE 1-4
RISK CHARACTERIZATION - EASTERN AREA INDOOR AIR
BP WEAVER WOODLANDS ALLOTMENT
NEW FRANKLIN, OHIO

Exposure Unit (Property Address)	Sample Type	Sample Location	Date	Benzene (ug/m3)	Ethylbenzene (ug/m3)	Toluene (ug/m3)	m&p-Xylene (ug/m3)	o-Xylene (ug/m3)	Naphthalene (ug/m3)
VISL Target Indoor Air Concentration [1]				**3.6**	**11.2**	**5,210**	**104**	**104**	**0.826**
5239 / 5247 Dailey	Indoor Air (Basement Level)	RI-IA-6-1	5/24/2019	**6.6**	**2.9**	**15.9**	**9.6**	**4.7**	2 U
	Indoor Air (Basement Level)	RI-IA-6-1	8/23/2019	**3.2**	**128**	**548**	**407**	**95.9**	4 U
	Indoor Air (Basement Level)	RI-IA-6-1	10/10/2019	**2.6**	**2.5**	**9.5**	**9.4**	**2.2**	**2.6**
	Indoor Air (Basement Level)	RI-IA-6-1	12/12/2019	**1.61**	**0.672 J**	**3.74**	**2.25**	**0.607 J**	0.806 U
	Indoor Air (Basement Level)	RI-IA-6-2	12/12/2019	**1.67**	**0.688 J**	**3.6**	**2.23**	**0.598 J**	0.806 U
	Indoor Air (Basement Level)	RI-IA-6-1	8/13/2020	**2.29**	**1.41**	**6.82**	**5.64**	**2.07**	1.83 U
	Indoor Air (Basement Level)	RI-IA-6-2	8/13/2020	**1.97**	**0.876**	**5.91**	**2.61**	**0.811**	1.83 U
	Indoor Air (Basement Level)	RI-IA-6-1	10/30/2020	**2.3**	**0.88**	**6.4**	**2.8**	**0.88**	**0.36**
	Indoor Air (Basement Level)	RI-IA-6-2	10/30/2020	**2.2**	**1.0**	**6.9**	**3.1**	**1.1**	0.26 U
	Indoor Air (Basement Level)	RI-IA-6-1	3/26/2021	**0.85**	**0.33**	**2.3**	**0.88**	**0.27**	0.26 U
	Indoor Air (Basement Level)	RI-IA-6-2	3/26/2021	**1.7**	**0.62**	**4.9**	**1.7**	**0.48**	0.26 U

TABLE 1-4
RISK CHARACTERIZATION - EASTERN AREA INDOOR AIR
BP WEAVER WOODLANDS ALLOTMENT
NEW FRANKLIN, OHIO

Exposure Unit (Property Address)	Sample Type	Sample Location	Date	Benzene	Ethylbenzene	Toluene	m&p-Xylene	o-Xylene	Naphthalene
				(ug/m³)	(ug/m³)	(ug/m³)	(ug/m³)	(ug/m³)	(ug/m³)
VISL Target Indoor Air Concentration [1]				**3.6**	**11.2**	**5,210**	**104**	**104**	**0.826**
5239 / 5247 Dailey	Indoor Air (Basement Level)	RI-IA-6-1	11/11/2021	**2.7**	**0.76 J**	**6.5**	**2.1 J**	**0.66 J**	0.27 U
	Indoor Air (Basement Level)	RI-IA-6-2	11/11/2021	**2.4**	**0.71 J**	**5.6**	**2.0 J**	**0.63 J**	0.27 U
	Indoor Air (Basement Level)	RI-IA-6-1	3/17/2022	**9.2**	**4.1**	**31**	**18**	**5.5**	0.4 U
	Indoor Air (Basement Level)	RI-IA-6-2	3/17/2022	**7.8**	**3.4**	**25**	**15**	**4.5**	0.39 U
	Indoor Air (Basement Level)	RI-IA-6-1	7/21/2022	**3.2**	**0.8**	**8.2**	**2.5**	**0.63**	0.43 U
	Indoor Air (Basement Level)	RI-IA-6-2	7/21/2022	**2.8**	**0.7**	**6.6**	**2.3**	**0.5**	0.41 U
	Indoor Air (Basement Level)	RI-IA-6-1	11/30/2022	**1.7**	**0.9**	**4.3**	**1.6**	**0.44**	0.40 U
	Indoor Air (Basement Level)	RI-IA-6-2	11/30/2022	**1.6**	**0.8**	**3.9**	**1.5**	**0.41**	0.36 U

Exposure Unit (Property Address)	Sample Type	Sample Location	Date	Benzene	Ethylbenzene	Toluene	m&p-Xylene	o-Xylene	Naphthalene
				(ug/m^3)	(ug/m^3)	(ug/m^3)	(ug/m^3)	(ug/m^3)	(ug/m^3)
VISL Target Indoor Air Concentration [1]				**3.6**	**11.2**	**5,210**	**104**	**104**	**0.826**
5239 / 5247 Dailey	Indoor Air (Basement Level)	RI-IA-6-1	3/22/2023	**2.33**	**0.9**	**5.88**	**2.28**	**0.642**	0.294 U
	Indoor Air (Basement Level)	RI-IA-6-2	3/22/2023	**2.32**	**0.9**	**5.69**	**2.17**	**0.603**	0.317 U

Notes:

[1] target cancer risk (TCR) of 1 x 10^{-5} and a target hazard quotient (THQ) of 1. Calculated via the U.S. EPA online VISL Calculator, August 2019.

Note 1: A temporary vapor mitigation system was installed and put into operation on September 26, 2019.

Note 2: Household chemicals and materials that could be sources of COCs in indoor air were removed from the basement on or about December 3, 2019.

Note 3: Sump cover had been opened and incompletely sealed at time of March 17, 2022 sampling. Cover was resealed prior to July 21, 2022 sampling.

U = The analyte was analyzed for, but was not detected. For results prior to the December 2019 sampling event, the value shown is the practical quantitation limit. For results beginning with the December 2019 sampling event, the

J = Indicates result is an estimated value between the method detection limit and the laboratory practical quantitation limit.

bold = Analyte was detected above reporting limit.

[shaded box] Reported concentration exceeded the VISL Target Indoor Air Concentration.

0.00 U = Reporting limit exceeded the VISL Target Indoor Air Concentration.

TABLE 1-5
SUMMARY OF MONITORING WELL CONSTRUCTION DETAILS
BP WEAVER WOODLANDS ALLOTMENT
NEW FRANKLIN, OHIO

REMEDIAL AREA	LOCATION	Coordinates		ELEVATION AT TOP OF RISER (Feet MSL)[1]	TOTAL DEPTH (Feet BGS)[2]	SCREEN LENGTH (Feet)	TOS (Feet MSL)[3]	BOS (Feet MSL)[4]
		X	Y					
WESTERN	M1-1	2229366.9221	468452.9335	1122.87	Well log not available			
	M1-2S	2229329.6520	468235.1920	1126.86	39	10	1077.86	1087.86
	M1-2D	2229331.4384	468226.2396	1127.18	76.5	10	1040.68	1050.68
	M1-3S	2229349.0684	468356.6820	1123.54	33	10	1080.54	1090.54
	M1-3D	2229348.5964	468351.2473	1123.54	101	5	1017.54	1022.54
	M1-4S	2229367.2810	468566.9194	1121.24	46	10	1065.24	1075.24
	M1-4D	2229374.2974	468560.8474	1121.12	76	5	1040.12	1045.12
	MW-6S	2229342.4311	468140.2727	1129.27	40.5	18	1070.77	1088.77
	MW-6D	2229332.8033	468140.0694	1129.14	80.5	10	1038.64	1048.64
	RI-MW-1-1	2229385.9209	468072.8279	1128.57	37	10	1081.57	1091.57
	RI-MW-1-2	2229292.2789	468091.1084	1130.06	35	10	1085.06	1095.06
	RI-MW-1-3	2229306.9093	468232.3686	1125.97	33	10	1082.97	1092.97
	RI-MW-1-4	2229309.9190	468358.2022	1122.39	30	10	1082.39	1092.39
	RI-MW-1-5	2229322.4794	468570.1907	1120.79	43	10	1067.79	1077.79
	RI-MW-1-6	2229375.8095	468644.4010	1118.38	40	10	1068.38	1078.38
	RI-MW-1-7	2229468.4399	468565.5298	1119.55	41	10	1068.55	1078.55
	RI-MW-1-8	2229475.9091	468379.2604	1119.94	31	10	1078.94	1088.94
	RI-MW-1-9	2229473.5596	468222.2059	1122.97	33	10	1079.97	1089.97
	RI-MW-1-10	2229550.3900	468363.1800	1118.71	35	10	1073.71	1083.71
	RI-MW-1-11	2229545.4200	468240.9400	1120.57	35	10	1075.57	1085.57
	RI-MW-1-12	2229267.9900	468148.4800	1129.41	38	15	1076.41	1091.41
	RI-MW-1-13	2229549.9340	468556.3860	1118.14	35	10	1073.14	1083.14
	RI-MW-1-14	2229259.9924	468255.0000	1126.13	35	10	1081.13	1091.13
	RI-MW-1-15	2229404.5830	468802.3460	1114.33	24	10	1080.33	1090.33
	RI-MW-1-16	2229265.9470	468659.5990	1120.15	40	10	1070.15	1080.15
	RI-MW-1-17	2229236.6080	468096.3680	1131.71	38	10	1083.71	1093.71
	RI-MW-1-18	2229269.9760	467985.0090	1132.91	40	10	1082.91	1092.91
	RI-MW-1-19	2229672.1860	468373.8510	1116.40	28	10	1078.40	1088.40
	RI-MW-1-20	2229641.1290	468554.3770	1116.40	29	10	1077.40	1087.40
	RI-MW-1-21	2229702.1070	468647.4960	1112.20	33	10	1069.20	1079.20
	RI-MW-1-22	2229567.6720	468659.0980	1115.60	30	10	1075.60	1085.60
	RI-MW-1-23	2229456.7860	468942.3720	1108.61	23	10	1075.61	1085.61
	RI-MW-1-24	2229594.8540	468902.8270	1106.94	27	10	1069.94	1079.94
	RI-MW-1-25	2229718.2540	468898.5510	1102.31	27.5	10	1064.81	1074.81
	RI-MW-1-26	2229757.7630	468539.7870	1112.51	30	10	1072.51	1082.51
	RI-MW-1-27	2229225.1260	468511.6920	1123.83	30	10	1083.83	1093.83
	RI-MW-1-28	2229247.3920	468922.5630	1114.10	27	10	1077.10	1087.10
	RI-MW-1-29	2229754.7740	468914.6000	1121.19	20	10	1091.19	1101.19
	MW-1	2229562.2380	468988.2060	1104.77	26	15.5	1063.27	1078.77
	MW-2	2229509.7115	468741.4393	1114.34	24	26	1064.34	1090.34
	MW-3	2229803.7409	468823.8823	1104.44	16.5	14.5	1073.44	1087.94
	DP-1	2229982.1491	469109.5657	1085.38	14	9	1062.38	1071.38
	M3-1	2229974.6254	469057.8484	1087.73	Well log not available			
	M3-2	2230121.1836	469022.2993	1085.29	Well log not available			
	M3-3	2229859.5505	469191.0419	1087.36	Well log not available			
	GW-5	2230032.3956	469102.5767	1083.91	14	9	1060.91	1069.91
	PZ-2D	2229986.1886	469156.3115	1084.10	Well log not available			
	PZ-2S	2229986.7260	469164.6931	1084.11	Well log not available			
	RI-MW-3-1	2230075.7520	469163.7170	1081.47	14	5	1062.47	1067.47
	RI-MW-3-2	2230230.8340	469118.4860	1079.79	23	10	1046.79	1056.79

TABLE 1-5
SUMMARY OF MONITORING WELL CONSTRUCTION DETAILS
BP WEAVER WOODLANDS ALLOTMENT
NEW FRANKLIN, OHIO

REMEDIAL AREA	LOCATION	Coordinates		ELEVATION AT TOP OF RISER (Feet MSL)[1]	TOTAL DEPTH (Feet BGS)[2]	SCREEN LENGTH (Feet)	TOS (Feet MSL)[3]	BOS (Feet MSL)[4]
		X	Y					
CENTRAL	DP-4	2231594.3100	468075.7200	1070.05	19	5	1046.05	1051.05
	GW-4	2231645.6600	468073.7600	1067.04	14	9	1044.04	1053.04
	M4-1	2231852.8300	468351.4800	1046.79	Well log not available			
	M4-2	2231685.2500	468256.1700	1055.81	Well log not available			
	M4-3	2231492.7500	468209.8200	1064.24	Well log not available			
	PZ-5D	2231949.5100	468138.4700	1055.13	Well log not available			
	PZ-5S	2231949.9000	468134.2600	1055.06	Well log not available			
	RI-MW-4-1	2231615.6200	468017.7200	1075.86	20	10	1045.86	1055.86
	RI-DMW-4-2	2231666.9800	468082.7600	1067.15	24.5	5	1037.65	1042.65
	RI-MW-4-3	2231743.1500	468280.2500	1049.79	15	10	1024.79	1034.79
	RI-MW-4-4	2231693.6000	468129.1500	1061.62	15	10	1036.62	1046.62
	RI-DMW-4-5	2231690.3200	468129.3000	1061.61	33	10	1018.61	1028.61
	RI-DMW-4-6	2231565.7300	468088.3100	1067.64	35	10	1022.64	1032.64
	RI-DMW-4-7	2231758.3100	468078.5700	1066.36	36	10	1020.36	1030.36
	RI-DMW-4-8	2231753.0100	468157.8900	1060.14	35	10	1015.14	1025.14
	RI-DMW-4-9	2231737.0000	468283.2300	1050.00	35	10	1005.00	1015.00
	RI-DMW-4-10	2231682.8400	468251.3900	1054.9	36	10	1008.90	1018.90
	RI-MW-4-11	2231757.8800	468381.1100	1054.95	20	10	1024.95	1034.95
	RI-DMW-4-12	2231895.8600	468324.5900	1046.44	40.5	10	995.94	1005.94
	RI-MW-4-13	2231424.9800	468104.6600	1063.56	18	10	1035.56	1045.56
	RI-MW-4-14	2231402.1630	468023.1060	1068.26	22	10	1036.26	1046.26
	RI-MW-4-15	2231374.5790	468161.4320	1065.98	29	10	1026.98	1036.98
	RI-MW-4-16	2231533.2380	468297.4420	1061.76	23	10	1028.76	1038.76
	RI-MW-4-17	2231449.6170	468254.1040	1061.93	32	10	1019.93	1029.93
	RI-MW-4-18	2231666.2420	468360.3670	1057.64	20	10	1027.64	1037.64

TABLE 1-5
SUMMARY OF MONITORING WELL CONSTRUCTION DETAILS
BP WEAVER WOODLANDS ALLOTMENT
NEW FRANKLIN, OHIO

REMEDIAL AREA	LOCATION	Coordinates		ELEVATION AT TOP OF RISER (Feet MSL)[1]	TOTAL DEPTH (Feet BGS)[2]	SCREEN LENGTH (Feet)	TOS (Feet MSL)[3]	BOS (Feet MSL)[4]
		X	Y					
EASTERN	DP-3	2232469.1000	468254.5300	1049.62	33.5	10	1006.12	1016.12
	GW-2	2232457.9100	468180.7500	1054.31	30	10	1014.31	1024.31
	GW-3	2232467.6900	468180.9600	1053.98	20	10	1023.98	1033.98
	M5-1	2232591.1800	468240.7500	1032.16	Well log not available			
	M5-2	2232595.2500	468365.1300	1032.77	Well log not available			
	M5-3	2232359.0100	468337.1500	1042.32	Well log not available			
	PZ-6D	2232438.1500	468383.1600	1040.53	Well log not available			
	PZ-6S	2232432.4400	468381.4800	1039.9	Well log not available			
	PZ-7S1	2232577.3599	468816.9375	1011.74	Well log not available			
	PZ-7S2	2232577.5573	468812.1094	1011.79	Well log not available			
	RI-MW-5-1	2232677.4500	468351.7600	1024.13	15	10	999.13	1009.13
	RI-MW-5-2	2232440.5200	468447.9900	1030.51	16	10	1004.51	1014.51
	DP-2	2233160.4877	467996.0768	1045.63	34.5	15	996.13	1011.13
	GW-1	2233149.8896	468033.6088	1039.96	28	15	995.50	1010.50
	M6-1	2232827.3819	468237.2882	1024.46	Well log not available			
	M6-2	2232957.4800	468312.6700	1017.15	Well log not available			
	RI-MW-6-1	2233044.8300	468300.7000	1015.86	15	10	990.86	1000.86
	RI-MW-6-2	2233078.7000	468106.7600	1037.77	20	10	1007.77	1017.77
	RI-DMW-6-3	2233145.5000	467996.4300	1046.26	50	5	991.26	996.26
	RI-MW-6-4	2232815.7590	468606.7250	1009.28	16	10	983.28	993.28
	RI-MW-6-5	2233039.3390	468584.5930	1005.43	19	10	976.43	986.43
	RI-MW-6-6	2232675.0910	468444.5070	1020.95	21	10	989.95	999.95
	RI-MW-6-7	2232674.4380	468189.5480	1024.46	20	10	994.46	1004.46
	RI-MW-6-8	2233334.6050	468169.2320	1013.02	20	10	983.02	993.02
	RI-MW-6-9	2233309.9630	467971.1000	1046.76	53	10	983.76	993.76
	RI-MW-6-10	2233285.2740	467902.1200	1046.90	53	10	983.90	993.90
	RI-MW-6-11	2233281.1730	467853.7430	1045.45	49	10	986.45	996.45
	RI-MW-6-12	2233487.5140	467976.5050	1031.74	43	10	978.74	988.74
	RI-MW-6-13	2233479.5070	468128.4140	1016.49	29	10	977.49	987.49
	RI-MW-6-14	2233601.6670	467971.9850	1014.42	37	10	967.42	977.42
	RI-MW-6-15	2233670.5190	468132.2310	1000.48	21	10	969.48	979.48
	RI-MW-6-16	2233807.4780	467962.5450	1000.85	23	10	967.85	977.85
	RI-MW-6-17	2233656.1410	467867.5850	1014.90	35	10	969.90	979.90
	RI-MW-6-18	2233794.8960	467871.5710	1001.48	30	10	961.48	971.48
	RI-MW-6-19	2233721.4530	467767.3680	1008.76	30	10	968.76	978.76
	RI-MW-6-20	2232655.0990	468141.3450	1027.25	14	10	1003.25	1013.25
	RI-MW-6-21	2232901.9110	468104.7390	1029.56	16	10	1003.56	1013.56
	RI-MW-6-22	2232997.8326	467969.0578	1045.48	20	10	1015.48	1025.48
	RI-MW-6-23	2232815.1947	467947.9628	1042.40	18	10	1014.40	1024.40
	RI-MW-6-24	2232658.6632	467954.4918	1038.38	20	10	1008.80	1018.80
	RI-MW-6-25	2232820.4946	467763.5530	1050.38	30	10	1010.38	1020.38

Notes:
1. Elevations referenced to Mean Sea Level (MSL)
2. BGS - below ground surface
3. TOS - top of screen
4. BOS - bottom of screen
Elevations of top of risers at GW-1 and RI-MW-6-24 were resurveyed on August 20, 2021, and June 17, 2021, respectively, after well casings were cut down during well repairs.

TABLE 1-6
GROUNDWATER MONITORING PLAN SUMMARY
BP WEAVER WOODLANDS
NEW FRANKLIN, OHIO

Area	Monitoring Well ID	Location[a]	Former Quarterly Sampling Program	Former Semi-Annual Sampling Program	Well Not Included in Routine Sampling	Annual Monitoring Program[b]	June 2020 One-Time COC Sampling	Rationale
Western Area	M1-1	Interior			X		X	Not sampled between 2016 and 2019.
	M1-2D	Interior			X			Previously ND. Redundant with other wells being sampled.
	M1-2S	Interior			X		X	Not sampled between 2016 and 2019.
	M1-3D	Interior			X			Previously ND. Redundant with other wells being sampled.
	M1-3S	Interior			X		X	Not sampled between 2016 and 2019.
	M1-4D	Interior		X				Interior well with recent data available.
	M1-4S	Interior		X				Interior well with recent data available.
	MW-6D	Interior		X				Interior well with recent data available.
	MW-6S	Interior		X				Interior well with recent data available.
	RI-MW-1-1	Perimeter			X	X		To monitor plume stability. Not sampled between 2016 and 2019.
	RI-MW-1-2	Interior		X			X	Interior well with recent data available.
	RI-MW-1-3	Interior			X		X	Not sampled between 2016 and 2019.
	RI-MW-1-4	Interior			X		X	Not sampled between 2016 and 2019.
	RI-MW-1-5	Interior		X				Interior well with recent data available.
	RI-MW-1-6	Interior			X		X	Not sampled between 2016 and 2019.
	RI-MW-1-7	Interior			X		X	Not sampled between 2016 and 2019.
	RI-MW-1-8	Interior			X		X	Not sampled between 2016 and 2019.
	RI-MW-1-9	Interior			X	X		To monitor plume stability.
	RI-MW-1-10	Interior		X				Interior well with recent data available.
	RI-MW-1-11	Perimeter			X	X		To monitor plume stability.
	RI-MW-1-12	Perimeter			X		X	Not sampled between 2016 and 2019.
	RI-MW-1-13	Interior	X					Interior well with recent data available.
	RI-MW-1-14	Perimeter	X			X		To monitor plume stability.
	RI-MW-1-15	Interior	X					Interior well with recent data available.
	RI-MW-1-16	Perimeter	X			X		To monitor plume stability.
	RI-MW-1-17	Perimeter	X			X		To monitor plume stability.
	RI-MW-1-18	Perimeter	X			X		To monitor plume stability.
	RI-MW-1-19	Perimeter	X			X		To monitor plume stability.
	RI-MW-1-20	Perimeter	X			X		To monitor plume stability.
	RI-MW-1-21	Perimeter	X			X		To monitor plume stability.
	RI-MW-1-22	Interior	X			X		To monitor plume stability. Establish trend for exposure unit.
	RI-MW-1-23	Perimeter	X			X		To monitor plume stability.
	RI-MW-1-24	Perimeter	X			X		To monitor plume stability.
	RI-MW-1-25	Perimeter	X			X		To monitor plume stability.
	RI-MW-1-26	Exterior	X					Exterior well. Recent data available.
	RI-MW-1-27	Perimeter	X			X		To monitor plume stability.
	RI-MW-1-28	Perimeter	X			X		To monitor plume stability.
	RI-MW-1-29	Perimeter	X					Redundant with other nearby wells. Recent data available.
	MW-1	Exterior			X			Exterior well.
	MW-2	Perimeter			X	X		To monitor plume stability. Not sampled between 2016 and 2019.
	MW-3	Perimeter			X		X	Not sampled between 2016 and 2019.
	DP-1	Perimeter			X		X	Not sampled between 2016 and 2019. Redundant with other nearby wells.
	GW-5	Interior		X		X		To monitor stability of smaller plume at 542 Center.
	M3-1	Interior			X	X		To monitor stability of smaller plume at 542 Center.
	M3-2	Perimeter			X		X	Not sampled between 2016 and 2019. Redundant with other nearby wells.
	PZ-2D	Interior		X				Interior well with recent data available.
	PZ-2S	Interior		X		X		To monitor stability of smaller plume at 542 Center.
	RI-MW-3-1	Perimeter	X					Recent data available. Redundant with other nearby wells.
	RI-MW-3-2	Exterior	X					Exterior well. Recent data available.

TABLE 1-6
GROUNDWATER MONITORING PLAN SUMMARY
BP WEAVER WOODLANDS
NEW FRANKLIN, OHIO

Area	Monitoring Well ID	Location[a]	Former Quarterly Sampling Program	Former Semi-Annual Sampling Program	Well Not Included in Routine Sampling	Annual Monitoring Program[b]	June 2020 One-Time COC Sampling	Rationale
Central Area	DP-4	Interior		X				Interior well with recent data available.
	GW-4	Interior		X				Interior well with recent data available.
	M4-1	Perimeter	X			X		To monitor plume stability.
	M4-2	Interior		X				Interior well with recent data available.
	M4-3	Interior		X		X		To monitor plume stability. Recent COC detection.
	PZ-5D	Perimeter			X	X		To monitor plume stability. Not sampled between 2016 and 2019.
	PZ-5S	Perimeter			X	X		To monitor plume stability. Not sampled between 2016 and 2019.
	RI-MW-4-1	Perimeter			X	X		To monitor plume stability. Not sampled between 2016 and 2019.
	RI-DMW-4-2	Interior			X		X	Not sampled between 2016 and 2019.
	RI-MW-4-3	Perimeter		X		X		To monitor plume stability.
	RI-MW-4-4	Interior		X				Interior well with recent data available.
	RI-DMW-4-5	Interior		X				Interior well with recent data available.
	RI-DMW-4-6	Interior			X		X	Not sampled between 2016 and 2019.
	RI-DMW-4-7	Interior		X				Interior well with recent data available.
	RI-DMW-4-8	Interior		X				Interior well with recent data available.
	RI-DMW-4-9	Perimeter		X		X		To monitor plume stability.
	RI-DMW-4-10	Interior			X		X	Not sampled between 2016 and 2019.
	RI-MW-4-11	Exterior			X			Exterior well.
	RI-DMW-4-12	Perimeter	X			X		To monitor plume stability.
	RI-MW-4-13	Interior		X				Interior well with recent data available.
	RI-MW-4-14	Perimeter	X			X		To monitor plume stability.
	RI-MW-4-15	Perimeter	X			X		To monitor plume stability.
	RI-MW-4-16	Perimeter	X			X		To monitor plume stability.
	RI-MW-4-17	Perimeter	X			X		To monitor plume stability.
	RI-MW-4-18	Perimeter	X			X		To monitor plume stability.

TABLE 1-6
GROUNDWATER MONITORING PLAN SUMMARY
BP WEAVER WOODLANDS
NEW FRANKLIN, OHIO

Area	Monitoring Well ID	Location[a]	Former Quarterly Sampling Program	Former Semi-Annual Sampling Program	Well Not Included in Routine Sampling	Annual Monitoring Program[b]	June 2020 One-Time COC Sampling	Rationale
Eastern Area	GW-2	Perimeter			X		X	Not sampled between 2016 and 2019. Redundant with other nearby wells.
	GW-3	Perimeter			X	X		To monitor plume stability. Not sampled between 2016 and 2019.
	M5-1	Interior			X		X	Not sampled between 2016 and 2019.
	M5-2	Interior		X				Interior well with recent data available.
	M5-3	Perimeter			X	X		To monitor plume stability. Not sampled between 2016 and 2019.
	PZ-6D	Interior			X		X	Not sampled between 2016 and 2019.
	PZ-6S	Interior			X	X		Not sampled between 2016 and 2019.
	PZ-7S1	Perimeter		X		X		To monitor plume stability.
	PZ-7S2	Perimeter		X				Recent data available. Redundant with other nearby wells.
	RI-MW-5-1	Interior			X		X	Not sampled between 2016 and 2019.
	RI-MW-5-2	Interior			X	X		To monitor plume stability. Not sampled between 2016 and 2019.
	DP-2	Interior		X				Interior well with recent data available.
	GW-1	Interior			X		X	Not sampled between 2016 and 2019.
	M6-1	Interior		X				Interior well with recent data available.
	M6-2	Interior			X		X	Not sampled between 2016 and 2019.
	RI-MW-6-1	Perimeter	X			X		To monitor plume stability.
	RI-MW-6-2	Interior			X		X	Not sampled between 2016 and 2019.
	RI-DMW-6-3	Perimeter		X		X		To monitor plume stability.
	RI-MW-6-4	Perimeter	X			X		To monitor plume stability.
	RI-MW-6-5	Exterior	X					Exterior well. Recent data available.
	RI-MW-6-6	Interior	X					Interior well with recent data available.
	RI-MW-6-7	Interior	X			X		To monitor plume stability.
	RI-MW-6-8	Perimeter	X			X		To monitor plume stability.
	RI-MW-6-9	Interior	X					Interior well with recent data available.
	RI-MW-6-10	Perimeter	X					Recent data available. Redundant with other nearby wells.
	RI-MW-6-11	Perimeter	X			X		To monitor plume stability.
	RI-MW-6-12	Interior	X					Interior well with recent data available.
	RI-MW-6-13	Perimeter	X			X		To monitor plume stability.
	RI-MW-6-14	Perimeter	X			X		To monitor plume stability.
	RI-MW-6-15	Exterior	X					Exterior well. Recent data available.
	RI-MW-6-16	Perimeter	X			X		To monitor plume stability.
	RI-MW-6-17	Interior	X					Interior well with recent data available.
	RI-MW-6-18	Interior	X					Interior well with recent data available.
	RI-MW-6-19	Perimeter	X			X		To monitor plume stability.
	RI-MW-6-20	Perimeter	X			X		To monitor plume stability.
	RI-MW-6-21	Interior	X					Interior well with recent data available.
	RI-MW-6-22	Interior	X					Interior well with recent data available.
	RI-MW-6-23	Interior	X					Interior well with recent data available.
	RI-MW-6-24	Perimeter	X			X		To monitor plume stability.
	RI-MW-6-25	Perimeter	X			X		To monitor plume stability.

Notes:

[a] Location is relative to the plume boundaries.

b Annual groundwater monitoring program was initiated in June 2020.

TABLE 1-7
WESTERN AREA GROUNDWATER
BP WEAVER WOODLANDS ALLOTMENT
NEW FRANKLIN, OHIO

Exposure Unit (Property Address)	Monitoring Well ID	Maximum Concentration between January 2017 and June 2021 (ug/L)[1]				
		Benzene	Ethylbenzene	Toluene	Xylene (Total)	Naphthalene
Screening Level (MCL)[2,3]		5.0	700	1,000	10,000	1.7
Screening Level (VISL)[4]		29.7	77.2	39,200	855	128
536 Center Road	RI-MW-3-2	1.0 U	1.0 U	1.0 U	3.0 U	1.0 U
542 Center Road	DP-1	1.0 U	1.0 U	1.0 U	3.0 U	1.0 U
	GW-5	**2.8**	**37.4**	**13.3**	**45.0**	**7.7**
	M3-1	1.0 U	1.0 U	1.0 U	3.0 U	**4.3**
	M3-2	1.0 U	1.0 U	1.0 U	3.0 U	1.0 U
	PZ-2D	1.0 U	1.0 U	1.0 U	3.0 U	1.0 U
	PZ-2S	**2.6**	**16.1**	**6.0**	**20.6**	**3.3**
	RI-MW-3-1	1.0 U	1.0 U	1.0 U	3.0 U	1.0 U
550 Center Road	M3-3[5]	1.0 U	1.0 U	1.0 U	2.0 U	1.0 U
590 Center Road	MW-1	1.0 U	1.0 U	1.0 U	2.0 U	1.0 U
555 Fairwood Road	MW-3	1.0 U	1.0 U	1.0 U	3.0 U	1.0 U
569 Fairwood Road	RI-MW-1-21	**2.0**	1.0 U	**0.23**	**0.42**	1.0 U
	RI-MW-1-25	**8.4**	**1.7**	1.0 U	**3.1**	1.0 U
	RI-MW-1-29	1.0 U	1.0 U	1.0 U	3.0 U	1.0 U
570 Fairwood Road	RI-MW-1-26	1.0 U	1.0 U	1.0 U	3.0 U	1.0 U
578 Fairwood Road	RI-MW-1-19	**1.8**	1.0 U	**1.8**	2.0 U	1.0 U
	RI-MW-1-20	**2.7**	**8.1**	**4.9**	**19.5**	**6.7**
585 Fairwood Road	MW-2	1.0 U	1.0 U	1.0 U	3.0 U	1.0 U
	RI-MW-1-22	**1.2**	**2.4**	**1.4**	**6**	1.0 U
	RI-MW-1-24	1.0 U	1.0 U	1.0 U	3.0 U	1.0 U
586 Fairwood Road	RI-MW-1-10	25 U	**144**	**94.8**	**421**	**52.9**
	RI-MW-1-11	1.0 U	1.0 U	1.0 U	3.0 U	1.0 U
	RI-MW-1-13	**6**	**6.4**	**1.9**	**7**	**1.4**
594 Fairwood Road	RI-MW-1-7	1.0 U	1.0 U	1.0 U	3.0 U	1.0 U
	RI-MW-1-8	**35.2**	**154**	**57.8**	**364**	**58.4**
	RI-MW-1-9	**11.3**	1.0 U	1.0 U	3.0 U	1.0 U
604 Fairwood Road	M1-2D[5]	**1.4**	1.0 U	**1.2**	2.0 U	1.0 U
	M1-2S	**701**	**40**	**94.2**	**90.9**	**2.7**
	M1-3D[5]	1.0 U	1.0 U	1.0 U	2.0 U	1.0 U
	M1-3S	**30.5**	**177**	**119**	**429**	**49.3**
	M1-4D	1.0 U	**1.2**	1.0 U	3.0 U	**1.4**
	M1-4S	**31.1**	**296**	**75.7**	**441**	**69.4**
	RI-MW-1-3	**143**	**2.1**	**2.1**	3.0 U	1.0 U
	RI-MW-1-4	1.0 U	1.0 U	1.0 U	3.0 U	1.0 U
	RI-MW-1-5	**80.4**	**26**	**31.3**	**22**	**3.5**
605 Fairwood Road (and adjacent parcel 23000994)	RI-MW-1-6	**12**	**90.4**	**34.3**	**166**	**22.9**
	RI-MW-1-15	1.0 U	**80.2**	**23.0**	**342**	**62.3**
	RI-MW-1-23	1.0 U	1.0 U	1.0 U	3.0 U	1.0 U
614 Fairwood Road	RI-MW-1-14	1.0 U	1.0 U	1.0 U	3.0 U	1.0 U
	RI-MW-1-27	1.0 U	1.0 U	1.0 U	3.0 U	1.0 U
615 Fairwood Road	RI-MW-1-16	1.0 U	1.0 U	1.0 U	3.0 U	1.0 U
	RI-MW-1-28	1.0 U	1.0 U	1.0 U	3.0 U	1.0 U

TABLE 1-7
WESTERN AREA GROUNDWATER
BP WEAVER WOODLANDS ALLOTMENT
NEW FRANKLIN, OHIO

Exposure Unit (Property Address)	Monitoring Well ID	Maximum Concentration between January 2017 and June 2021 (ug/L)[1]				
		Benzene	Ethylbenzene	Toluene	Xylene (Total)	Naphthalene
Screening Level (MCL)[2,3]		**5.0**	**700**	**1,000**	**10,000**	**1.7**
Screening Level (VISL)[4]		**29.7**	**77.2**	**39,200**	**855**	**128**
607 Highland Park Drive	MW-6D	1.0 U	1.0 U	1.0 U	3.0 U	1.0 U
	MW-6S	**2,120**	**115**	**310**	**143**	5 U
	RI-MW-1-1	1.0 U	1.0 U	1.0 U	3.0 U	1.0 U
	RI-MW-1-2	**630**	1.0 U	**19.8**	3.0 U	1.0 U
	RI-MW-1-12	1.0 U	1.0 U	1.0 U	3.0 U	1.0 U
	RI-MW-1-18	1.0 U	1.0 U	1.0 U	3.0 U	**2.2**
615 Highland Park Drive	RI-MW-1-17	1.0 U	1.0 U	1.0 U	3.0 U	1.0 U

Notes:

[1] A subsequent sampling event was performed in June and July 2022 that did not alter the substantive conclusions, and an upcoming ground water sampling event is planned for July 2023.

[2] USEPA Maximum Contaminant Level (MCL).

[3] There is no MCL for naphthalene; the value shown is the tap water Regional Screening Level adjusted for a Target Risk of 1.0E-5.

[4] USEPA Vapor Intrusion Screening Level (VISL) based on a target cancer risk of 1E-5 or noncancer hazard Index of 1.

[5] Monitoring well not sampled between 2017 and 2021. Results presented are for latest sampling event.

U = The analyte was analyzed for, but was not detected. Value shown is the sample reporting limit.

Bold = Analyte was detected above the laboratory reporting limit.

(yellow shading) Concentration exceeds the MCL.

0.00 (red box) Concentration exceeds the VISL. Property was evaluated for vapor intrusion if residence is located within 100 feet.

(green shading) A single minor exceedance of the naphthalene RSL was not confirmed by additional sampling of this well.

TABLE 1-8
CENTRAL AREA GROUNDWATER
BP WEAVER WOODLANDS ALLOTMENT
NEW FRANKLIN, OHIO

Exposure Unit (Property Address)	Monitoring Well ID	Maximum Concentration between January 2017 and June 2021 (ug/L)[1]				
		Benzene	Ethylbenzene	Toluene	Xylene (Total)	Naphthalene
Screening Level (MCL)[2,3]		5.0	700	1,000	10,000	1.7
Screening Level (VISL)[4]		29.7	77.2	39,200	855	128
5245 Kaylin Drive	RI-MW-4-18	1.0 U	1.0 U	1.0 U	3.0 U	1.0 U
5255 Kaylin Drive	M4-2	**269**	**81**	**59.2**	**97.2**	**13.9**
	RI-DMW-4-10	1.0 U	1.0 U	1.0 U	3.0 U	1.0 U
	RI-MW-4-16	**36.4**	1.0 U	**1**	3.0 U	1.0 U
5260 Kaylin Drive	RI-MW-4-17	1.0 U	1.0 U	1.0 U	3.0 U	1.0 U
5265 Kaylin Drive	M4-3	**192**	**1080**	**76.1**	**2290**	**435**
5270 Kaylin Drive	RI-MW-4-15	1.0 U	1.0 U	1.0 U	3.0 U	1.0 U
5282 Kaylin Drive	DP-4	**5.1**	**215**	**21**	**494**	**128**
	GW-4	**1,380**	**364**	**770**	**651**	**29.4**
	RI-MW-4-1	1.0 U	1.0 U	1.0 U	3.0 U	1.0 U
	RI-DMW-4-2	**242**	**779**	**426**	**1,320**	**291**
	RI-DMW-4-6	1.0 U	1.0 U	1.0 U	3.0 U	1.0 U
	RI-MW-4-13	**2,810**	**1,940**	**381**	**2,970**	**435**
	RI-MW-4-14	1.0 U	1.0 U	1.0 U	3.0 U	1.0 U
339 Maywood Drive	M4-1	1.0 U	1.0 U	1.0 U	3.0 U	1.0 U
	RI-DMW-4-12	1.0 U	1.0 U	1.0 U	3.0 U	1.0 U
349 Maywood Drive	RI-MW-4-3	1.0 U	**1.8**	1.0 U	3.0 U	**4.5**
	RI-DMW-4-9	**1.5**	**3.0**	1.0 U	**6.9**	**9.5**
	RI-MW-4-11[5]	1.0 U	1.0 U	1.0 U	2.0 U	1.0 U
359 Maywood Drive	RI-MW-4-4	**386**	**246**	**328**	**721**	**72.8**
	RI-DMW-4-5	**693**	**546**	**641**	**761**	**173**
	RI-DMW-4-8	**682**	**415**	**423**	**632**	**107**
Parcel 2301171 on Maywood Dr	PZ-5D	1.0 U	1.0 U	1.0 U	3.0 U	1.0 U
	PZ-5S	1.0 U	1.0 U	1.0 U	3.0 U	1.0 U
Parcel 2305125 on Maywood Dr	RI-DMW-4-7	**102**	**35.4**	**35.1**	**12.8**	**3.3**

Notes:

1 A subsequent sampling event was performed in June and July 2022 that did not alter the substantive conclusions, and an upcoming ground water sampling event is planned for July 2023.

2 USEPA Maximum Contaminant Level (MCL).

3 There is no MCL for naphthalene; the value shown is the tap water Regional Screening Level adjusted for a Target Risk of 1.0E-5.

4 USEPA Vapor Intrusion Screening Level (VISL) based on a target cancer risk of 1E-5 or noncancer hazard Index of 1.

5 Monitoring well not sampled between 2017 and 2021. Results presented are for latest sampling event.

U = The analyte was analyzed for, but was not detected. Value shown is the sample reporting limit.

Bold = Analyte was detected above the laboratory reporting limit.

[yellow fill] Concentration exceeds the MCL.

0.00 [red] Concentration exceeds the VISL. Property was evaluated for vapor intrusion if residence is located within 100 feet.

TABLE 1-9
EASTERN AREA GROUNDWATER
BP WEAVER WOODLANDS ALLOTMENT
NEW FRANKLIN, OHIO

Exposure Unit (Property Address)	Monitoring Well ID	Maximum Concentration between January 2017 and June 2021 (ug/L)[1]				
		Benzene	Ethylbenzene	Toluene	Xylene (Total)	Naphthalene
Screening Level (MCL)[2,3]		5.0	700	1,000	10,000	1.7
Screening Level (VISL)[4]		29.7	77.2	39,200	855	128
174 / 176 / 178 Center Road	RI-MW-6-14	1.0 U	1.0 U	1.0 U	3.0 U	1.0 U
178 Center Road	RI-MW-6-15	1.0 U	1.0 U	1.0 U	3.0 U	1.0 U
	RI-MW-6-16	1.0 U	1.0 U	**1.2**	2.0 U	**1.7**
200 / 202 / 204 Center Road	RI-MW-6-8	1.0 U	1.0 U	1.0 U	3.0 U	1.0 U
	RI-MW-6-9	**617**	**2,590**	**1,360**	**3,200**	**983**
	RI-MW-6-12	**1,500**	**500**	**225**	**300**	**92.7**
	RI-MW-6-13	1.0 U	**3.8**	1.0 U	**3.3**	**1.6**
Parcel 2304275 on Center Road	DP-2	**88.8**	**82.9**	**6.1**	**86.1**	**88.9**
	GW-1	1.0 U	1.0 U	1.0 U	3.0 U	1.0 U
	RI-MW-6-2	**368**	**123**	**1.5**	**142**	**23.8**
	RI-DMW-6-3	1.0 U	1.0 U	1.0 U	3.0 U	**1.4**
5180 Dailey Road	PZ-6D	1.0 U	1.0 U	1.0 U	3.0 U	1.0 U
	PZ-6S	**82.4**	**17**	**36.8**	30 U	10.0 U
	PZ-7S1	1.0 U	1.0 U	1.0 U	3.0 U	1.0 U
	PZ-7S2	1.0 U	1.0 U	1.0 U	3.0 U	1.0 U
	RI-MW-5-2	**11.9**	**104**	**54.6**	**191**	**42.8**
5201 / 5203 / 5205 Dailey Road	RI-MW-6-1	1.0 U	**1.4**	1.0 U	2.0 U	**8.1**
	RI-MW-6-4	1.0 U	1.0 U	1.0 U	3.0 U	1.0 U
	RI-MW-6-5	1.0 U	1.0 U	1.0 U	3.0 U	1.0 U
5206 Dailey Road	M5-1	1.0 U	**74**	**8.2**	**140**	**23.6**
	M5-2	**3.8**	**304**	**160**	**611**	**140**
5215 / 5219 Dailey Road	RI-MW-6-6	**9.1**	**26.2**	**38.6**	**74**	**16.2**
5222 Dailey Road	GW-2	1.0 U	1.0 U	1.0 U	3.0 U	1.0 U
	GW-3	1.0 U	1.0 U	1.0 U	3.0 U	1.0 U
5229 / 5233 Dailey Road	RI-MW-5-1	1.0 U	**9**	**4.5**	**24.6**	**3.7**
	M6-1	**1.1**	**53.3**	**3.7**	**96.9**	**20.2**
	M6-2	1.0 U	1.0 U	1.0 U	3.0 U	1.0 U
5239/ 5247 Dailey Road	RI-MW-6-7	*8.0 U*	**99.4**	**9.5**	**130**	**60.1**
	RI-MW-6-20	1.0 U	**21.0**	**3.2**	**19.1**	**6.3**
	RI-MW-6-21	**41.2**	**167**	**104**	**119**	**272**
5261 Dailey Road	RI-MW-6-23	**117**	**806**	**908**	**947**	**419**
	RI-MW-6-24	5 U	5 U	5 U	10 U	1 U
	RI-MW-6-25	5 U	5 U	5 U	10 U	1 U

TABLE 1-9
EASTERN AREA GROUNDWATER
BP WEAVER WOODLANDS ALLOTMENT
NEW FRANKLIN, OHIO

Exposure Unit (Property Address)	Monitoring Well ID	Maximum Concentration between January 2017 and June 2021 (ug/L)[1]				
		Benzene	Ethylbenzene	Toluene	Xylene (Total)	Naphthalene
Screening Level (MCL)[2,3]		**5.0**	**700**	**1,000**	**10,000**	**1.7**
Screening Level (VISL)[4]		**29.7**	**77.2**	**39,200**	**855**	**128**
303 Maywood Dr (Vacant Parcel 2300034)	M5-3	1.0 U	1.0 U	1.0 U	3.0 U	1.0 U
Parcel 2305653 (Former Wisdom Woods Property)	RI-MW-6-10	**1.6**	1.0 U	1.0 U	3.0 U	1.0 U
	RI-MW-6-11	1.0 U	1.0 U	1.0 U	3.0 U	1.0 U
	RI-MW-6-17	**2,360**	**960**	**263**	**1,100**	**424**
	RI-MW-6-18	**89.3**	**37**	5.0 U	**26.1**	**5.6**
	RI-MW-6-19	1.0 U	1.0 U	1.0 U	3.0 U	**5.9**
	RI-MW-6-22	**26.5**	**1200**	**257**	**1530**	**323**

Notes:

1 A subsequent sampling event was performed in June and July 2022 that did not alter the substantive conclusions, and an upcoming ground water sampling event is planned for July 2023.

2 USEPA Maximum Contaminant Level (MCL).

3 There is no MCL for naphthalene; the value shown is the tap water Regional Screening Level adjusted for a Target Risk of 1.0E-5.

4 USEPA Vapor Intrusion Screening Level (VISL) based on a target cancer risk of 1E-5 or noncancer hazard Index of 1.

U = The analyte was analyzed for, but was not detected. Value shown is the sample reporting limit.

Bold = Analyte was detected above the laboratory reporting limit.

[yellow] Concentration exceeds the MCL.

0.00 [red box] Concentration exceeds the VISL. Property was evaluated for vapor intrusion if

[green] A single minor exceedance of the naphthalene RSL was not confirmed by additional sampling of this well.

Sub-slab sampling at 5249 Dailey Road was not authorized by the property owner.

TABLE 1-10
PROPERTIES (EXPOSURE UNITS) RETAINED FOR FURTHER EVALUATION
BP WEAVER WOODLANDS ALLOTMENT
NEW FRANKLIN, OHIO

Property Identification		Data Collected on Property									
Street No.	**Street Name**	**Monitoring Well**	**Soil Boring**	**Exterior Soil Vapor**	**Subslab Vapor**	**Indoor Air**	**Drinking Water**	**Rationale**	**Monitoring Wells on Property**	**Groundwater Exceeds MCL/RSL**	**Groundwater Exceeds VISL**
174 / 176 / 178	Center Rd.	●					●	Plume mapping indicates groundwater impacts may extend onto property. No detections of COCs in the three monitoring wells on the property. Subslab sampling not conducted because home is >100 feet from impacted well. No detections of COCs in drinking water.	RI-MW-6-14, RI-MW-6-15, RI-MW-6-16	🟡	🟡
200 / 202 / 204	Center Rd.	●					●	Groundwater exceeds MCL/RSL based on MW data. Groundwater exceeds VISL based on MW data. Vapor sampling not conducted because home is >100 feet from impacted well. No detections of COCs in drinking water. Soil meets risk-based criteria.	RI-MW-6-8, RI-MW-6-9, RI-MW-6-12, RI-MW-6-13	🔴	🔴
Parcel 2304275	Center Rd.	●	●				●	Groundwater exceeds MCL/RSL based on MW data. Groundwater exceeds VISL based on MW data (no residence located on the property). No detections of COCs in drinking water. Soil meets risk-based criteria.	RI-MW-6-2, RI-MW-6-3, GW-1, DP-2	🔴	🔴
542 (and adjacent parcel 2302478)	Center Rd.	●					●	Groundwater exceeds MCL/RSL based on MW data. No detections of COCs in drinking water.	M3-1, M3-2, DP-1, PZ-2S, RI-MW-3-1, GW-5	🔴	
5180	Dailey Rd.	●	●				●	Groundwater exceeds MCL/RSL based on MW data. Groundwater exceeds VISL based on MW data. Subslab sampling not conducted because home is >100 feet from impacted well. No detections of COCs in drinking water. Soil meets risk-based criteria.	RI-MW-5-2, PZ-6S/D, PZ-7S1/S2	🔴	🔴
5201 / 5203 / 5205	Dailey Rd.	●	●				●	Plume mapping indicates groundwater impacts may extend onto property. No detections of COCs in MW-6-4 and 6-5; occasional low-level detections in RI-MW-6-1 (naphthalene >RSL). Subslab sampling not conducted because home is >100 feet from impacted well. No detections of COCs in drinking water.	RI-MW-6-1,RI-MW-6-4, RI-MW-6-5	🔴	
5206	Dailey Rd.	●	●		●		●	Groundwater exceeds MCL/RSL based on MW data. Groundwater exceeds VISL based on MW data. No exceedances of screening levels in subslab vapor. No detections of COCs in drinking water. Soil meets risk-based criteria.	M5-1, M5-2	🔴	🔴
5215 / 5219	Dailey Rd.	●					●	Groundwater exceeds MCL/RSL based on MW data. Groundwater meets VISL based on MW data. No detections of COCs in drinking water.	RI-MW-6-6	🔴	
5222	Dailey Rd.	●					●	Plume mapping indicates groundwater impacts may extend onto property. No detections of COCs in the two monitoring wells on the property since 2010. No detections of COCs in drinking water.	GW-2, GW-3	🟡	

TABLE 1-10
PROPERTIES (EXPOSURE UNITS) RETAINED FOR FURTHER EVALUATION
BP WEAVER WOODLANDS ALLOTMENT
NEW FRANKLIN, OHIO

Property Identification		Data Collected on Property						Rationale	Monitoring Wells on Property	Groundwater Exceeds MCL/RSL	Groundwater Exceeds VISL
Street No.	Street Name	Monitoring Well	Soil Boring	Exterior Soil Vapor	Subslab Vapor	Indoor Air	Drinking Water				
5229 / 5233	Dailey Rd.	●	●		●		●	Groundwater exceeds MCL/RSL based on MW data. Groundwater likely to exceed VISL based on exceedances of VISL on adjacent properties at MWs within 100 feet of the residence. No exceedances of screening levels in subslab vapor. No detections of COCs in drinking water. Soil meets risk-based criteria.	RI-MW-5-1, M6-1, M6-2	🔴	🟡
5239	Dailey Rd.	●			●	●	●	Groundwater exceeds MCL/RSL based on MW data. Groundwater exceeds VISL based on MW data. Subslab vapor exceeded screening levels. Initial indoor air results exceeded target indoor air concentrations. Indoor air results have been below target levels following the installation of a temporary vapor abatement system. No detections of COCs in drinking water.	RI-MW-6-7, RI-MW-6-20, RI-MW-6-21	🔴	🔴
5249	Dailey Rd.				●		●	Groundwater impacts are likely to extend onto property (exceedances of RSL and VISL on properties to the north and south at MWs within 100 feet of the residence). Subslab sampling not authorized by property owner. No detections of COCs in drinking water.	None	🟡	🟡
5261	Dailey Rd.	●			●		●	Groundwater exceeds MCL/RSL based on MW data. Groundwater exceeds VISL based on MW data. Subslab vapor meets VISL. No detections of COCs in drinking water.	RI-MW-6-23, RI-MW-6-24, RI-MW-6-25	🔴	🔴
Parcel 2301504	Dailey Rd. (vacant parcel)							Groundwater impacts are assumed to extend onto property (exceedances of RSL and VISL on properties to the north and east). No sampling conducted. Subslab sampling not performed due to absence of a structure on the property.	None	🟡	🟡
569	Fairwood Rd.	●			●		●	Groundwater exceeds MCL/RSL based on MW data. Groundwater meets VISL based on MW data. No exceedances of screening levels in subslab vapor. No detections of COCs in drinking water.	RI-MW-1-21, RI-MW-1-25, RI-MW-1-29	🔴	
578	Fairwood Rd.	●					●	Groundwater exceeds MCL/RSL based on MW data. Groundwater meets VISL based on MW data. No detections of COCs in drinking water.	RI-MW-1-20, RI-MW-1-19	🔴	
585	Fairwood Rd.	●			●		●	Groundwater exceeds MCL/RSL based on MW data. Groundwater meets VISL based on MW data. No exceedances of screening levels in subslab vapor. No detections of COCs in drinking water.	RI-MW-1-24, RI-MW-1-22, MW-2	🔴	
586	Fairwood Rd.	●			●		●	Groundwater exceeds MCL/RSL based on MW data. Groundwater exceeds VISL based on MW data. No exceedances of screening levels in subslab vapor. No detections of COCs in drinking water	RI-MW-1-10, RI-MW-1-11, RI-MW-1-13	🔴	🔴

Property Identification		Data Collected on Property						Rationale	Monitoring Wells on Property	Groundwater Exceeds MCL/RSL	Groundwater Exceeds VISL
Street No.	Street Name	Monitoring Well	Soil Boring	Exterior Soil Vapor	Subslab Vapor	Indoor Air	Drinking Water				
594	Fairwood Rd.	●	●		●		●	Groundwater exceeds MCL/RSL based on MW data. Groundwater exceeds VISL based on MW data. Subslab vapor exceeds VISL. No detections of COCs in drinking water. Soil meets risk-based criteria.	MW-1-7, RI-MW-1-8	● (red)	● (red)
604	Fairwood Rd.	●	●		●		●	Groundwater exceeds MCL/RSL based on MW data. Groundwater exceeds VISL based on MW data. No exceedances of screening levels in subslab vapor. No detections of COCs in drinking water. Soil meets risk-based criteria.	RI-MW-1-3, RI-MW-1-4, RI-MW-1-5, M1-4S/D, M1-3S/D, M1-2S/D	● (red)	● (red)
605 (and adjacent parcel 23000994)	Fairwood Rd.	●	●		●		●	Groundwater exceeds MCL/RSL based on MW data. Groundwater exceeds VISL based on MW data. Subslab vapor exceeds VISL. No detections of COCs in drinking water. Soil meets risk-based criteria.	RI-MW-1-6, RI-MW-1-15, RI-MW-1-23	● (red)	● (red)
614	Fairwood Rd.	●			●		●	Groundwater likely to exceed MCL/RSL based on exceedances of MCL/RSL on adjacent property to the east. Groundwater likely to exceed VISL based on exceedances of VISL on adjacent property to the east. No detections of COCs in subslab vapor. No detections of COCs in drinking water.	MW-1-14, RI-MW-1-27	● (yellow)	● (yellow)
615	Fairwood Rd.	●					●	Plume mapping indicates groundwater impacts may extend onto property. No detections of COCs in the two monitoring wells on the property. No detections of COCs in drinking water.	RI-MW-1-16, RI-MW-1-28	● (yellow)	● (yellow)
607	Highland Park	●	●		●		●	Groundwater exceeds MCL/RSL based on MW data. Groundwater exceeds VISL based on MW data. No exceedances of screening levels in subslab vapor. No detections of COCs in drinking water. Soil meets risk-based criteria.	RI-MW-1-1, RI-MW-1-2, RI-MW-1-12, RI-MW-1-18, MW-6S/D	● (red)	● (red)
615	Highland Park	●					●	Plume mapping indicates groundwater impacts may extend onto property. No detections of COCs in the monitoring well on the property. No detections of COCs in drinking water.	RI-MW-1-17	● (yellow)	● (yellow)
5245	Kaylin Dr.	●		●			●	Plume mapping indicates groundwater impacts may extend onto property. No detections of COCs in the monitoring well on the property. No exceedances of screening levels in exterior soil vapor. No detections of COCs in drinking water.	RI-MW-4-18	● (yellow)	● (yellow)
5255	Kaylin Dr.	●		●	●		●	Groundwater exceeds MCL/RSL based on MW data. Groundwater exceeds VISL based on MW data. Exterior soil vapor exceeds VISL; no exceedances in subslab vapor (one sampling event). No detections of COCs in drinking water.	RI-DMW-4-10, RI-MW-4-16, M4-2	● (red)	● (red)

TABLE 1-10
PROPERTIES (EXPOSURE UNITS) RETAINED FOR FURTHER EVALUATION
BP WEAVER WOODLANDS ALLOTMENT
NEW FRANKLIN, OHIO

Property Identification		Data Collected on Property									
Street No.	Street Name	Monitoring Well	Soil Boring	Exterior Soil Vapor	Subslab Vapor	Indoor Air	Drinking Water	Rationale	Monitoring Wells on Property	Groundwater Exceeds MCL/RSL	Groundwater Exceeds VISL
5260	Kaylin Dr.	●					●	Plume mapping indicates groundwater impacts may extend onto property. No detections of COCs in groundwater. No detections of COCs in drinking water.	RI-MW-4-17	● (yellow)	● (yellow)
5265	Kaylin Dr.	●		●	●		●	Groundwater exceeds MCL based on MW data. Groundwater exceeds VISL based on MW data. Exterior soil vapor exceeds VISL; subslab vapor exceeded VISL in 2012, did not exceed when resampled in 2017. No detections of COCs in drinking water.	M4-3, RI-MW-4-13	● (red)	● (red)
5270	Kaylin Dr.	●					●	Plume mapping indicates groundwater impacts may extend onto property. No exceedances of MCL/RSL in the monitoring well on the property. No detections of COCs in drinking water.	RI-MW-4-15	● (yellow)	● (yellow)
5282	Kaylin Dr.	●	●				●	Groundwater exceeds MCL/RSL based on MW data. Groundwater exceeds VISL based on MW data. Vapor sampling not conducted because home is >100 feet from impacted well, and no detections of COCs in groundwater in closest well (RI-MW-4-14, >100 feet from home). No detections of COCs in drinking water. Soil meets risk-based criteria.	RI-DMW-4-6, RI-DMW-4-2, DP-4, GW-4, RI-MW-4-1, RI-MW-4-14	● (red)	● (red)
300	Maywood Dr.						●	Plume mapping indicates groundwater impacts may extend onto property. No monitoring well on the property. No detections of COCs in drinking water.		● (yellow)	● (yellow)
303	Maywood Dr. (vacant parcel 2300034)	●						Plume mapping indicates groundwater impacts may extend onto property. Single low-level detection of naphthalene >RSL in M5-3 once since 2011; no detections of other COCs.	M5-3	● (yellow)	● (yellow)
339	Maywood Dr.	●					●	Plume mapping indicates groundwater impacts do not likely extend onto property. Sporadic low-level detections historically in both wells; single low-level detection of naphthalene >RSL once in each well in 2015. No detections of COCs in drinking water.	M4-1, RI-DMW-4-12		
349	Maywood Dr.	●	●	●	●		●	Groundwater exceeds RSL based on MW data. Plume mapping indicates groundwater exceeding VISL likely extends onto property. Exterior soil vapor exceeds VISL; no exceedances in subslab vapor (one sampling event). No detections of COCs in drinking water. Soil meets risk-based criteria.	RI-DMW-4-9, RI-MW-4-3, RI-MW-4-11	● (red)	● (yellow)
359	Maywood Dr.	●	●	●			●	Groundwater exceeds MCL/RSL based on MW data. Groundwater exceeds VISL based on MW data. Exterior soil vapor exceeds VISL; subslab sampling not authorized by resident. No detections of COCs in drinking water. Soil meets risk-based criteria.	RI-DMW-4-6, RI-MW-4-4	● (red)	● (red)

TABLE 1-10
PROPERTIES (EXPOSURE UNITS) RETAINED FOR FURTHER EVALUATION
BP WEAVER WOODLANDS ALLOTMENT
NEW FRANKLIN, OHIO

Property Identification		Data Collected on Property						Rationale	Monitoring Wells on Property	Groundwater Exceeds MCL/RSL	Groundwater Exceeds VISL
Street No.	Street Name	Monitoring Well	Soil Boring	Exterior Soil Vapor	Subslab Vapor	Indoor Air	Drinking Water				
Parcel 2305125	Maywood Dr.	● (blue)						Groundwater exceeds MCL/RSL based on MW data. Groundwater exceeds VISL based on MW data. Subslab sampling not performed due to absence of a structure on the property.	RI-DMW-4-7	● (red)	● (red)
Parcel 2305653 (Wisdom Woods Property)	S. Main Street	● (blue)						Groundwater exceeds MCL/RSL based on MW data. Groundwater exceeds VISL based on MW data. Subslab sampling not performed due to absence of a structure on the property.	RI-MW-6-10, RI-MW-6-11, RI-MW-6-17, RI-MW-6-18, RI-MW-6-19, RI-MW-6-22	● (red)	● (red)

Notes:

1) MCL - Maximum Contaminant Level for Benzene, Ethylbenzene, Toluene, and Total Xylenes. USEPA Regional Screening Level (RSL, June 2017) used for naphthalene since no MCL exists.
2) VISL - Vapor Intrusion Screening Level (USEPA, June 2017).
3) MW - Monitoring Well
4) COC - Chemical of Concern
5) ● (red) Exceeds MCL/RSL or VISL based on maximum concentrations from 2017 through 2021 (see Tables 1-7, 1-8 and 1-9).
6) ● (yellow) Likely exceeds MCL/RSL or VISL based on data collected from adjacent EUs.

TABLE 2-1
APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS
BP WEAVER WOODLANDS ALLOTMENT
NEW FRANKLIN, OHIO

CATEGORY	ORC	OAC	PARAGRAPH	CAPTION	TEXT	APPLICATION
ODNR	1518.02			ENDANGERED PLANT SPECIES	PROHIBITS REMOVAL OR DESTRUCTION OF ENDANGERED PLANT SPECIES (SOME PRIVATE PROPERTY EXCEPTIONS).	APPLIES TO REMEDIATION SITES WHERE CHEMICALS MAY HARM ENDANGERED SPECIES. CLEARLY ESTABLISHES THAT RECEPTOR PLANT SPECIES MUST BE CONSIDERED IN RISK ASSESSMENTS. THIS ACT MAY REQUIRE CONSIDERATION OF ENDANGERED SPECIES IN REMEDIATIONS THAT INVOLVE MOVEMENT OR DISPLACEMENT OF LARGE VOLUMES OF SURFACE SOIL.
ODNR	1531.25			ENDANGERED ANIMAL SPECIES	PROHIBITS REMOVAL OR DESTRUCTION OF ENDANGERED ANIMAL SPECIES	APPLIES TO REMEDIATION SITES WHERE CHEMICALS MAY HARM ENDANGERED SPECIES. CLEARLY ESTABLISHES THAT RECEPTOR ANIMAL SPECIES MUST BE CONSIDERED IN RISK ASSESSMENTS. THIS ACT MAY REQUIRE CONSIDERATION OF ENDANGERED SPECIES IN REMEDIATIONS THAT INVOLVE MOVEMENT OR DISPLACEMENT OF LARGE VOLUMES OF SURFACE SOIL.
APC	3704.05		A-I	PROHIBITS VIOLATION OF AIR POLLUTION CONTROL RULES	PROHIBITS EMISSION OF AN AIR CONTAMINANT IN VIOLATION SEC. 3704 OR ANY RULES, PERMIT, ORDER OR VARIANCE ISSUED PURSUANT TO THAT SECTION OF THE ORC.	MAY PERTAIN TO ANY SITE WHERE EMISSIONS OF AN AIR CONTAMINANT OCCURS EITHER AS A PRE-EXISTING CONDITION OF THE SITE OR AS A RESULT OF REMEDIAL ACTIVITIES. SHOULD BE CONSIDERED FOR VIRTUALLY ALL SITES THAT REQUIRE THE MANAGEMENT OF SOLID/HAZARDOUS WASTES.
HW APC	3734.02		(I)	AIR EMISSIONS FROM HAZARDOUS WASTE FACILITIES	NO HAZARDOUS WASTE FACILITY SHALL EMIT ANY PARTICULATE MATTER, DUST, FUMES, GAS, MIST, SMOKE, VAPOR OR ODOROUS SUBSTANCE THAT INTERFERES WITH THE COMFORTABLE ENJOYMENT OF LIFE OR PROPERTY OR IS INJURIOUS TO PUBLIC HEALTH.	PERTAINS TO ANY SITE AT WHICH HAZARDOUS WASTE WILL BE MANAGED SUCH THAT AIR EMISSIONS MAY OCCUR. CONSIDER FOR SITES THAT WILL UNDERGO MOVEMENT OF EARTH OR INCINERATION.
DSIWM	3734.03			PROHIBITS OPEN DUMPING OR BURNING	PROHIBITS OPEN BURNING OR OPEN DUMPING OF SOLID WASTE OR TREATED OR UNTREATED INFECTIOUS WASTE.	PERTAINS TO ANY SITE AT WHICH SOLID WASTE HAS COME TO BE LOCATED OR WILL BE GENERATED DURING A REMEDIAL ACTION.
APC DSW	3767.13			PROHIBITION OF NUISANCES	PROHIBITS NOXIOUS EXHALATIONS OR SMELLS AND THE OBSTRUCTION OF WATERWAYS.	PERTAINS TO ANY SITE THAT MAY HAVE NOXIOUS SMELLS OR MAY OBSTRUCT WATERWAYS.
DSW	3767.14			PROHIBITION OF NUISANCES	PROHIBITION AGAINST THROWING REFUSE, OIL, OR FILTH INTO LAKES, STREAMS, OR DRAINS.	PERTAINS TO ALL SITES LOCATED ADJACENT TO LAKES, STREAMS, OR DRAINS.
DERR	5301.00		.80 to .92	UNIFORM ENVIRONMENTAL COVENANTS ACT	STANDARDS FOR ENVIRONMENTAL COVENANTS	CONSIDER FOR SITES WITH INSTITUTIONAL CONTROLS OR USE RESTRICTIONS
DSW	6111.04			ACTS OF POLLUTION PROHIBITED	POLLUTION OF WATERS OF THE STATE IS PROHIBITED.	PERTAINS TO ANY SITE WHICH HAS CONTAMINATED ON-SITE GROUND OR SURFACE WATER OR WILL HAVE A DISCHARGE TO ON-SITE SURFACE OR GROUND WATER.
DSW	6111.07		A,C	WATER POLLUTION CONTROL REQUIREMENTS - DUTY TO COMPLY	PROHIBITS FAILURE TO COMPLY WITH REQUIREMENTS OF SECTIONS 6111.01 TO 6111.08 OR ANY RULES, PERMIT OR ORDER ISSUED UNDER THOSE SECTIONS.	PERTAINS TO ANY SITE WHICH HAS CONTAMINATED GROUND WATER OR SURFACE WATER OR WILL HAVE A DISCHARGE TO ON-SITE SURFACE OR GROUND WATER.
UIC	6111.04.3			INJECTION OF SEWAGE OR WASTES INTO WELLS	ESTABLISHES A REGULATORY PROGRAM FOR THE INJECTION OF WASTES INTO WELLS THAT PREVENTS THE CONTAMINATION OF UNDERGROUND SOURCES OF DRINKING WATER.	PERTAINS TO ANY SITE THAT EITHER HAS OR INTENDS TO INJECT WASTES OF ANY TYPE INTO WELLS.
ODNR		1501:31-23	01, A-B	LIST OF ENDANGERED ANIMAL SPECIES	LIST OF OHIO ANIMAL SPECIES CONSIDERED ENDANGERED.	MAY APPLY TO REMEDIATION SITES WHERE LISTED SPECIES ARE THREATENED BY CHEMICAL RELEASES. MAY ALSO APPLY AT SITES WHERE REMEDIAL ACTIVITIES COULD DISTURB EXISTING HABITATS.
ODNR		1501-18-1	03, A	LIST OF ENDANGERED PLANT SPECIES	PLANT SPECIES CONSIDERED ENDANGERED IN OHIO	MAY APPLY AT REMEDIATION SITES WHERE CHEMICAL RELEASE THREATENS LISTED SPECIES. SHOULD ALSO BE CONSIDERED WHERE REMEDIAL ACTIVITIES MAY DISRUPT HABITATS.
APC		3745-15-05	A-D	DE MINIMIS AIR CONTAMINANT SOURCE EXEMPTION	ESTABLISHES LIMITS BELOW WHICH AIR DISCHARGE PERMITS ARE NOT NEEDED	PERTAINS TO ANY SITE WHICH UTILIZES OR WILL UTILIZE AIR POLLUTION CONTROL EQUIPMENT ON-SITE.
APC		3745-15-06	A1,A2	MALFUNCTION & MAINTENANCE OF AIR POLL CONTROL EQUIPMENT	ESTABLISHES SCHEDULED MAINTENANCE AND SPECIFIES WHEN POLLUTION SOURCE MUST BE SHUT DOWN DURING MAINTENANCE	PERTAINS TO ANY SITE WHICH UTILIZES OR WILL UTILIZE AIR POLLUTION CONTROL EQUIPMENT ON-SITE.
APC		3745-15-07	A	AIR POLLUTION NUISANCES PROHIBITED	DEFINES AIR POLLUTION NUISANCE AS THE EMISSION OR ESCAPE INTO THE AIR FROM ANY SOURCES(s)) OF SMOKE, ASHES, DUST, DIRT, GRIME, ACIDS, FUMES, GASES, VAPORS, ODORS AND COMBINATIONS OF THE ABOVE THAT ENDANGER HEALTH, SAFETY OR WELFARE OF THE PUBLIC OR CAUSE PERSONAL INJURY OR PROPERTY DAMAGE. SUCH NUISANCES ARE PROHIBITED.	PERTAINS TO ANY SITE WHICH CAUSES, OR MAY REASONABLY CAUSE, AIR POLLUTION NUISANCES. CONSIDER FOR SITES THAT WILL UNDERGO EXCAVATION, DEMOLITION, CAP INSTALLATION, METHANE PRODUCTION, CLEARING AND GRUBBING, WATER TREATMENT, INCINERATION AND WASTE FUEL RECOVERY.
APC		3745-15-08	A	CIRCUMVENTION	FORBIDS DILUTION OR OTHER MEANS TO CONCEAL EMISSIONS WITHOUT ACTUAL REDUCTIONS	CONSIDER FOR SITES WITH EMISSIONS TO AIR, AIR STRIPPING, INCINERATION, SOIL VAPOR EXTRACTION ETC.
APC		3745-17-08	A1,A2,B,D	EMISSION RESTRICTIONS FOR FUGITIVE DUST	ALL EMISSIONS OF FUGITIVE DUST SHALL BE CONTROLLED.	PERTAINS TO SITES WHICH MAY HAVE FUGITIVE EMISSIONS (NON-STACK) OF DUST. CONSIDER FOR SITES THAT WILL UNDERGO GRADING, LOADING OPERATIONS, DEMOLITION, CLEARING AND GRUBBING AND CONSTRUCTION UTILIZE INCINERATION OR FUEL RECOVERY (WASTE FUEL RECOVERY)
APC		3745-21-09		VOC EMISSIONS CONTROL: STATIONARY SOURCES	ESTABLISHES LIMITATIONS FOR EMISSIONS OF VOLATILE ORGANIC COMPOUNDS FROM STATIONARY SOURCES.	PERTAINS TO ANY SITE WITH TREATMENT SYSTEMS THAT EMIT VOLATILE ORGANIC COMPOUNDS, INCLUDING THOSE WITH THERMAL DESORPTION AND AIR STRIPPING.

TABLE 2-1
APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS
BP WEAVER WOODLANDS ALLOTMENT
NEW FRANKLIN, OHIO

CATEGORY	ORC	OAC	PARAGRAPH	CAPTION	TEXT	APPLICATION
HW		3745-270-40	A-J	APPLICABILITY OF TREATMENT STANDARDS	DETAILED LISTING OF CHEMICAL SPECIFIC LAND TREATMENT STANDARDS OR REQUIRED TREATMENT TECHNOLOGIES.	CONSIDER FOR SITES THAT GENERATE WASTES OR WITH WASTES DISPOSED ON-SITE
HW		3745-270-42	A-D	TREATMENT STANDARDS EXPRESSED AS SPECIFIED TECHNOLOGIES	LISTS SPECIFIC TREATMENT TECHNOLOGIES REQUIRED FOR SPECIFIC WASTES	CONSIDER AT ALL SITES GENERATING WASTES OR WITH ON-SITE DISPOSAL
HW		3745-270-48	A	UNIVERSAL TREATMENT STANDARDS	GIVES CONTAMINANT CHEMICAL SPECIFIC STANDARDS FOR LAND DISPOSAL	CONSIDER FOR SITES WITH WASTE GENERATION OR ON-SITE DISPOSAL
HW		3745-270-49	A-E	LAND DISPOSAL RESTRICTION FOR CONTAMINATED SOILS	SPECIFIES STANDARDS FOR SOIL TREATMENT	CONSIDER AT SITES WHERE CONTAMINATED SOILS ARE GENERATED
DSIWM		3745-27-05	A,B,C	AUTHORIZED, LIMITED & PROHIBITED SOLID WASTE DISPOSAL	ESTABLISHES ALLOWABLE METHODS OF SOLID WASTE DISPOSAL; SANITARY LANDFILL, INCINERATION, COMPOSTING. PROHIBITS MANAGEMENT BY OPEN BURNING AND OPEN DUMPING.	PERTAINS TO ANY SITE AT WHICH SOLID WASTES WILL BE MANAGED. PROHIBITS MANAGEMENT BY OPEN BURNING AND OPEN DUMPING.
DSW		3745-3-04	A-D	PROHIBITED DISCHARGES	PLACES RESTRICTIONS ON DISCHARGES TO POTW'S THAT MAY HARM TREATMENT FUNCTIONS OR PASS THROUGH TO RECEIVING STREAM.	CONSIDER FOR SITES WITH DISCHARGES TO POTW.
DSW		3745-3-05	A-C	NOTIFICATION OF POTENTIAL PROBLEMS INCLUDING SLUG LOAD	REQUIRES INDUSTRIAL USERS TO NOTIFY POTW OF DISCHARGES THAT MAY ADVERSELY AFFECT TREATMENT OPERATIONS, INCLUDING SLUG LOADS	CONSIDER FOR SITES WITH DISCHARGES TO POTW.
UIC		3745-34-06		PROHIBITION OF UNAUTHORIZED INJECTION	UNDERGROUND INJECTION IS PROHIBITED WITHOUT AUTHORIZATION FROM THE DIRECTOR.	PERTAINS TO SITES AT WHICH MATERIALS ARE TO BE INJECTED UNDERGROUND. CONSIDER FOR TECHNOLOGIES SUCH AS BIOREMEDIATION AND SOIL FLUSHING.
UIC		3745-34-07		NO MOVEMENT OF FLUID INTO UNDERGROUND DRINKING WATER	THE UNDERGROUND INJECTION OF FLUID CONTAINING ANY CONTAMINANT INTO AN UNDERGROUND SOURCE OF DRINKING WATER IS PROHIBITED IF THE PRESENCE OF THAT CONTAMINANT MAY CAUSE A VIOLATION OF THE PRIMARY DRINKING WATER STANDARDS OR OTHER WISE ADVERSELY AFFECT THE HEALTH OF PERSONS.	PERTAINS TO SITES AT WHICH MATERIALS ARE TO BE INJECTED UNDERGROUND. CONSIDER FOR TECHNOLOGIES SUCH AS BIOREMEDIATION AND SOIL FLUSHING.
UIC		3745-34-08		ELIMINATION OF CLASS IV WELLS	THE INJECTION OF HAZARDOUS OR RADIOACTIVE WASTE DIRECTLY INTO AN UNDERGROUND SOURCE OF DRINKING WATER IS PROHIBITED.	PERTAINS TO SITES AT WHICH MATERIALS ARE TO BE INJECTED UNDERGROUND. CONSIDER FOR TECHNOLOGIES SUCH AS BIOREMEDIATION AND SOIL FLUSHING.
UIC		3745-34-09		REQUIREMENTS FOR WELLS INJECTING HAZARDOUS WASTE	SPECIFIES REQUIREMENTS FOR THE INJECTION OF HAZARDOUS WASTES UNDERGROUND. SEE 3745-34-08 FOR LIMITATIONS.6 OF THE ORC.	PERTAINS TO SITES AT WHICH MATERIALS ARE TO BE INJECTED UNDERGROUND. CONSIDER FOR TECHNOLOGIES SUCH AS BIOREMEDIATION AND SOIL FLUSHING.
UIC		3745-34-16		CLASS V WELLS	SPECIFIES REQUIREMENTS FOR CLASS V WELLS. SEE 3745-34-04 FOR DEFINITIONS.	PERTAINS TO SITES AT WHICH MATERIALS ARE TO BE INJECTED UNDERGROUND. CONSIDER FOR TECHNOLOGIES SUCH AS BIOREMEDIATION AND SOIL FLUSHING.
UIC		3745-34-26		CONDITIONS APPLICABLE TO ALL PERMITS	SPECIFIES MINIMUM CONDITIONS TO BE APPLIED TO ALL UNDERGROUND INJECTIONS.	PERTAINS TO SITES AT WHICH MATERIALS ARE TO BE INJECTED UNDERGROUND. CONSIDER FOR TECHNOLOGIES SUCH AS BIOREMEDIATION AND SOIL FLUSHING.
HW		3745-52-11	A-D	EVALUATION OF WASTES	ANY PERSON GENERATING A WASTE MUST DETERMINE IF THAT WASTE IS A HAZARDOUS WASTE (EITHER THROUGH LISTING OR BY CHARACTERISTIC).	PERTAINS TO SITES AT WHICH WASTES OF ANY TYPE (BOTH SOLID AND HAZARDOUS) ARE LOCATED.
HW		3745-52-12	A-C	GENERATOR IDENTIFICATION NUMBER	A GENERATOR MUST NOT STORE, TREAT DISPOSE OR TRANSPORT HAZARDOUS WASTES WITHOUT A GENERATOR NUMBER	PERTAINS TO SITES WHERE HAZARDOUS WASTE WILL BE TRANSPORTED OFF-SITE FOR TREATMENT, STORAGE OR DISPOSAL
HW		3745-52-20		HAZARDOUS WASTE MANIFEST - GENERAL REQUIREMENTS	REQUIRES A GENERATOR WHO TRANSPORTS OR OFFERS FOR TRANSPORTATION HAZARDOUS WASTE FOR OFF-SITE TREATMENT, STORAGE OR DISPOSAL TO PREPARE A UNIFORM HAZARDOUS WASTE MANIFEST	PERTAINS TO SITES WHERE HAZARDOUS WASTE WILL BE TRANSPORTED OFF-SITE FOR TREATMENT, STORAGE OR DISPOSAL
HW		3745-52-22		HAZARDOUS WASTE MANIFEST - NUMBER OF COPIES	SPECIFIES THE NUMBER OF MANIFEST COPIES TO BE PREPARED	PERTAINS TO SITES WHERE HAZARDOUS WASTE WILL BE TRANSPORTED OFF-SITE FOR TREATMENT, STORAGE OR DISPOSAL
HW		3745-52-23		HAZARDOUS WASTE MANIFEST - USE	SPECIFIES PROCEDURES FOR THE USE OF HAZARDOUS WASTE MANIFESTS INCLUDING A REQUIREMENT THAT THEY BE HAND SIGNED BY THE GENERATOR	PERTAINS TO SITES WHERE HAZARDOUS WASTE WILL BE TRANSPORTED OFF-SITE FOR TREATMENT, STORAGE OR DISPOSAL
HW		3745-52-30		HAZARDOUS WASTE PACKAGING	REQUIRES A GENERATOR TO PACKAGE HAZARDOUS WASTE IN ACCORDANCE WITH U.S. DOT REGULATIONS FOR TRANSPORTATION OFF-SITE.	PERTAINS TO ANY SITE WHERE HAZARDOUS WASTE WILL BE GENERATED BY ON-SITE ACTIVITIES AND SHIPPED OFF-SITE FOR TREATMENT AND/OR DISPOSAL.
HW		3745-52-31		HAZARDOUS WASTE LABELING	REQUIRES PACKAGES OF HAZARDOUS WASTE TO BE LABELED IN ACCORDANCE WITH U.S.DOT REGULATIONS FOR OFF-SITE TRANSPORTATION.	PERTAINS TO ANY SITE WHERE HAZARDOUS WASTE WILL BE GENERATED BY ON-SITE ACTIVITIES AND SHIPPED OFF-SITE FOR TREATMENT AND/OR DISPOSAL.
HW		3745-52-32		HAZARDOUS WASTE MARKING	SPECIFIES LANGUAGE FOR MARKING PACKAGES OF HAZARDOUS WASTE PRIOR TO OFF-SITE TRANSPORTATION	PERTAINS TO ANY SITE WHERE HAZARDOUS WASTE WILL BE GENERATED BY ON-SITE ACTIVITIES AND SHIPPED OFF-SITE FOR TREATMENT AND/OR DISPOSAL.
HW		3745-52-33		HAZARDOUS WASTE PLACARDING	GENERATOR SHALL PLACARD HAZARDOUS WASTE PRIOR TO OFF-SITE TRANSPORTATION.	PERTAINS TO ANY SITE WHERE HAZARDOUS WASTE WILL BE GENERATED BY ON-SITE ACTIVITIES AND SHIPPED OFF-SITE FOR TREATMENT AND/OR DISPOSAL.
HW		3745-52-34		ACCUMULATION TIME OF HAZARDOUS WASTE	IDENTIFIES MAXIMUM TIME PERIODS THAT A GENERATOR MAY ACCUMULATE A HAZARDOUS WASTE WITHOUT BEING CONSIDERED AN OPERATOR OF A STORAGE FACILITY. ALSO ESTABLISHES STANDARDS FOR MANAGEMENT OF HAZARDOUS WASTES BY GENERATORS.	PERTAINS TO A SITE WHERE HAZARDOUS WASTE WILL BE GENERATED AS A RESULT OF THE REMEDIAL ACTIVITIES.
HW		3745-52-40	A-D	RECORDKEEPING REQUIREMENTS, THREE YEAR RETENTION	SPECIFIES RECORDS THAT SHALL BE KEPT FOR THREE YEARS	CONSIDER FOR SITES AT WHICH HAZARDOUS WASTES ARE GENERATED
HW		3745-52-41	A,B	ANNUAL REPORT	REQUIRES GENERATORS TO PREPARE ANNUAL REPORT TO OEPA	APPLICABLE AT SITES GENERATING WASTES FOR OFF--SITE SHIPMENT

CATEGORY	ORC	OAC	PARAGRAPH	CAPTION	TEXT	APPLICATION
HW		3745-54-13	A	GENERAL ANALYSIS OF HAZARDOUS WASTE	PRIOR TO ANY TREATMENT, STORAGE OR DISPOSAL OF HAZARDOUS WASTES, A REPRESENTATIVE SAMPLE OF THE WASTE MUST BE CHEMICALLY AND PHYSICALLY ANALYZED.	PERTAINS TO ANY SITE AT WHICH HAZARDOUS IS TO BE TREATED, STORED OR DISPOSED OF (OR HAS BEEN DISPOSED OF).
HW		3745-54-14	A,B,C	SECURITY FOR HAZARDOUS WASTE FACILITIES	HAZARDOUS WASTE FACILITIES MUST BE SECURED SO THAT UNAUTHORIZED AND UNKNOWING ENTRY ARE MINIMIZED OR PROHIBITED.	PERTAINS TO ANY SITE AT WHICH HAZARDOUS IS TO BE TREATED, STORED OR DISPOSED OF (OR HAS BEEN DISPOSED OF).
HW		3745-54-15	A,C	INSPECTION REQUIREMENTS FOR HAZARDOUS WASTE FACILITIES	HAZARDOUS WASTE FACILITIES MUST BE INSPECTED REGULARLY TO DETECT MALFUNCTIONS, DETERIORATIONS, OPERATIONAL ERRORS AND DISCHARGES. ANY MALFUNCTIONS OR DETERIORATIONS DETECTED SHALL BE REMEDIED EXPEDITIOUSLY.	PERTAINS TO ANY SITE AT WHICH HAZARDOUS IS TO BE TREATED, STORED OR DISPOSED OF (OR HAS BEEN DISPOSED OF).
HW		3745-54-16		PERSONNEL TRAINING	ESTABLISHES REQUIREMENTS FOR TRAINING OF PERSONNEL AT HAZARDOUS WASTE FACILITIES	PERTAINS TO ANY SITE AT WHICH HAZARDOUS IS TO BE TREATED, STORED OR DISPOSED OF (OR HAS BEEN DISPOSED OF).
HW		3745-54-32	A,B,C,D	REQUIRED EQUIPMENT FOR HAZARDOUS WASTE FACILITIES	ALL HAZARDOUS WASTE FACILITIES MUST BE EQUIPPED WITH EMERGENCY EQUIPMENT, SUCH AS AN ALARM SYSTEM, FIRE CONTROL EQUIPMENT AND A TELEPHONE OR RADIO.	PERTAINS TO ANY SITE AT WHICH HAZARDOUS IS TO BE TREATED, STORED OR DISPOSED OF (OR HAS BEEN DISPOSED OF). SPECIFICATIONS
HW		3745-54-33		TESTING & MAINTENANCE OF EQUIPMENT; HAZ WASTE FACILITIES	ALL HAZARDOUS WASTE FACILITIES MUST TEST AND MAINTAIN EMERGENCY EQUIPMENT TO ASSURE PROPER OPERATION.	PERTAINS TO ANY SITE AT WHICH HAZARDOUS WASTE IS TO BE TREATED, STORED OR DISPOSED OF (OR HAS BEEN DISPOSED OF).
HW		3745-54-34		ACCESS TO COMMUNICATIONS OR ALARM SYSTEM; HAZ WASTE FAC	WHENEVER HAZARDOUS WASTE IS BEING HANDLED, ALL PERSONNEL INVOLVED SHALL HAVE IMMEDIATE ACCESS TO AN INTERNAL ALARM OR EMERGENCY COMMUNICATION DEVICE.	PERTAINS TO ANY SITE AT WHICH HAZARDOUS WASTE IS TO BE TREATED, STORED OR DISPOSED OF (OR HAS BEEN DISPOSED OF).
HW		3745-54-37	A,B	ARRANGEMENTS/ AGREEMENTS WITH LOCAL AUTHORITIES	ARRANGEMENTS OR AGREEMENTS WITH LOCAL AUTHORITIES, SUCH AS POLICE, FIRE DEPARTMENT AND EMERGENCY RESPONSE TEAMS MUST BE MADE. IF LOCAL AUTHORITIES WILL NOT COOPERATE, DOCUMENTATION OF THAT NON-COOPERATION SHOULD BE PROVIDED.	PERTAINS TO ANY SITE AT WHICH HAZARDOUS WASTE IS TO BE TREATED, STORED OR DISPOSED OF (OR HAS BEEN DISPOSED OF).
HW		3745-54-52	A-F	CONTENT OF CONTINGENCY PLAN; HAZ WASTE FACILITIES	HAZARDOUS WASTE FACILITIES MUST HAVE A CONTINGENCY PLAN THAT ADDRESSES ANY UNPLANNED RELEASE OF HAZARDOUS WASTES OR HAZARDOUS CONSTITUENTS INTO THE AIR, SOIL OR SURFACE WATER. THIS RULE ESTABLISHES THE MINIMUM REQUIRED INFORMATION OF SUCH A PLAN.	PERTAINS TO ANY SITE AT WHICH HAZARDOUS WASTE IS TO BE TREATED, STORED OR DISPOSED OF (OR HAS BEEN DISPOSED OF).
HW		3745-54-53	A,B	COPIES OF CONTINGENCY PLAN; HAZARDOUS WASTE FACILITIES	COPIES OF THE CONTINGENCY PLAN REQUIRED BY 3745-54-50 MUST BE MAINTAINED AT THE FACILITY AND SUBMITTED TO ALL LOCAL POLICE DEPARTMENTS, FIRE DEPARTMENTS, HOSPITALS LOCAL EMERGENCY RESPONSE TEAMS AND THE OHIO EPA.	PERTAINS TO ANY SITE AT WHICH HAZARDOUS WASTE IS TO BE TREATED, STORED OR DISPOSED OF (OR HAS BEEN DISPOSED OF)
HW		3745-54-54	A	AMENDMENT OF CONTINGENCY PLAN; HAZ WASTE FACILITIES	THE CONTINGENCY PLAN MUST BE AMENDED IF IT FAILS IN AN EMERGENCY, THE FACILITY CHANGES (IN ITS DESIGN, CONSTRUCTION, MAINTENANCE OR OPERATION), THE LIST OF EMERGENCY COORDINATORS CHANGE OR THE LIST OF EMERGENCY EQUIPMENT.	PERTAINS TO ANY SITE AT WHICH HAZARDOUS WASTE IS TO BE TREATED, STORED OR DISPOSED OF (OR HAS BEEN DISPOSED OF).
HW		3745-54-55		EMERGENCY COORDINATOR; HAZARDOUS WASTE FACILITIES	AT ALL TIMES THERE SHOULD BE AT LEAST ONE EMPLOYEE EITHER ON THE PREMISES OR ON CALL TO COORDINATE ALL EMERGENCY RESPONSE MEASURES.	PERTAINS TO ANY SITE AT WHICH HAZARDOUS WASTE IS TO BE TREATED, STORED OR DISPOSED OF (OR HAS BEEN DISPOSED OF).
HW		3745-54-56	A-I	EMERGENCY PROCEDURES; HAZARDOUS WASTE FACILITIES	SPECIFIES THE PROCEDURES TO BE FOLLOWED IN THE EVENT OF AN EMERGENCY.	PERTAINS TO ANY SITE AT WHICH HAZARDOUS WASTE IS TO BE TREATED, STORED OR DISPOSED OF (OR HAS BEEN DISPOSED OF).
HW		3745-55-14		DISPOSAL/ DECON OF EQUIPMENT, STRUCTURES & SOILS	REQUIRES THAT ALL CONTAMINATED EQUIPMENT, STRUCTURES AND SOILS BE PROPERLY DISPOSED OF OR DECONTAMINATED. REMOVAL OF HAZARDOUS WASTES OR CONSTITUENTS FROM A UNIT MAY CONSTITUTE GENERATION OF HAZARDOUS WASTES.	PERTAINS TO ANY SITE AT WHICH HAZARDOUS WASTE IS TO BE TREATED, STORED OR DISPOSED OF (OR HAS BEEN TREATED, STORED OR DISPOSED OF).
HW		3745-55-17	B	POST-CLOSURE CARE AND USE OF PROPERTY	SPECIFIES THE POST-CLOSURE CARE REQUIREMENTS, INCLUDING MAINTENANCE, MONITORING AND POST-CLOSURE USE OF PROPERTY.	PERTAINS TO ALL SITES WITH LAND-BASED HAZARDOUS WASTE UNITS (LANDFILLS AND SURFACE IMPOUNDMENTS, WASTE PILES, LAND TREATMENT UNITS AND TANKS THAT MEET REQUIREMENTS OF LANDFILLS AFTER CLOSURE). THIS INCLUDES EXISTING LAND-BASED AREAS OF CONTAMINATION.
HW		3745-55-18	B	POST-CLOSURE PLAN	PRESENTS THE INFORMATION NECESSARY FOR OHIO EPA TO DETERMINE THE ADEQUACY OF A POST-CLOSURE PLAN.	PERTAINS TO ALL SITES WITH LAND-BASED HAZARDOUS WASTE UNITS (LANDFILLS AND SURFACE IMPOUNDMENTS, WASTE PILES, LAND TREATMENT UNITS AND TANKS THAT MEET REQUIREMENTS OF LANDFILLS AFTER CLOSURE). THIS INCLUDES EXISTING LAND-BASED AREAS OF CONTAMINATION.

TABLE 2-1
APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS
BP WEAVER WOODLANDS ALLOTMENT
NEW FRANKLIN, OHIO

CATEGORY	ORC	OAC	PARAGRAPH	CAPTION	TEXT	APPLICATION
HW		3745-55-19	B	NOTICE TO LOCAL LAND AUTHORITY	REQUIRES THAT A RECORD OF THE TYPE, LOCATION AND QUANTITY OF HAZARDOUS WASTES DISPOSED OF IN EACH UNIT BE SUBMITTED TO THE LOCAL LAND AUTHORITY AND THE DIRECTOR OF THE OHIO EPA. ALSO REQUIRES THAT A NOTATION TO THE DEED TO THE FACILITY PROPERTY BE MADE INDICATING THAT THE LAND WAS USED TO MANAGE HAZARDOUS WASTES AND THAT CERTAIN USE RESTRICTIONS MAY APPLY TO THE PROPERTY.	PERTAINS TO ALL SITES WITH LAND-BASED HAZARDOUS WASTE UNITS (LANDFILLS AND SURFACE IMPOUNDMENTS, WASTE PILES, LAND TREATMENT UNITS AND TANKS THAT MEET REQUIREMENTS OF LANDFILLS AFTER CLOSURE). THIS INCLUDES EXISTING LAND-BASED AREAS OF CONTAMINATION.
HW		3745-66-11	A,B,C	CLOSURE PERFORMANCE STANDARD	OWNER SHALL CLOSE FACILITY IN MANNER THAT MINIMIZES NEED FOR FURTHER MAINTENANCE AND REDUCES OR ELIMINATES POLLUTION OF GROUND WATER, SURFACE WATER OR ATMOSPHERE.	CONSIDER FOR REMEDIAL PLANS THAT MAY REQUIRE EXTENDED OPERATION AND MAINTENANCE OF EQUIPMENT. CONSIDER ALTERNATIVES WITH LESS LONG-TERM O&M. APPLICABLE FOR RCRA FACILITIES, APPROPRIATE AND RELEVANT FOR OTHER SITES.
DW		3745-81-11	A,B,C	MAXIMUM CONTAMINANT LEVELS FOR INORGANIC CHEMICALS	PRESENTS MAXIMUM CONTAMINANT LEVELS FOR INORGANICS.	PERTAINS TO ANY SITE WHICH HAS CONTAMINATED GROUND OR SURFACE WATER THAT IS EITHER BEING USED, OR HAS THE POTENTIAL FOR USE, AS A DRINKING WATER SOURCE.
DW		3745-81-12	A,B,C	MAXIMUM CONTAMINANT LEVELS FOR ORGANIC CHEMICALS	PRESENTS MCLS FOR ORGANICS.	PERTAINS TO ANY SITE WHICH HAS CONTAMINATED GROUND OR SURFACE WATER THAT IS EITHER BEING USED, OR HAS THE POTENTIAL FOR USE, AS A DRINKING WATER SOURCE.
GW		3745-9-03	A-C	MONITORING WELL	STANDARDS FOR DESIGN AND CLOSURE OF WELLS, COMPLIANCE WITH DDAGW GUIDANCE	PERTAINS TO ALL GROUND WATER WELLS ON THE SITE THAT EITHER WILL BE INSTALLED OR HAVE BEEN INSTALLED SINCE FEB. 15, 1975. WOULD PERTAIN DURING THE FS IF NEW WELLS ARE CONSTRUCTED FOR TREATABILITY STUDIES.
GW		3745-9-10	A,B,C	ABANDONED WELL SEALING	PROCEDURES FOR CLOSING AND SEALING WELLS.	PERTAINS TO ALL GROUND WATER WELLS ON THE SITE THAT EITHER WILL BE INSTALLED OR HAVE BEEN INSTALLED SINCE FEB. 15, 1975.

TABLE 3-1
POTENTIALLY APPLICABLE TREATMENT TECHNOLOGIES
BP WEAVER WOODLANDS ALLOTMENT
NEW FRANKLIN, OHIO

				Applicable Geology				Treatment Zone		Treatment Phase						
Technology	**Treatment Objective**	**Advantages**	**Disadvantages**	**Fine Grained**	**Coarse Grained**	**Shale**	**Sandstone**	**Unsaturated**	**Saturated**	**Dissolved**	**Vapor**	**Residual LNAPL**	**Potential Pre-Design Investigation**	**Potential Time Frame**	**Relative Cost**	**Qualitative Ranking**
No Action	Lowest cost alternative; for comparative purposes only	No cost, no disturbance	Does not achieve RAOs; lack of regulatory acceptance	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	none	long (>10 years)	low	Not Amenable
Institutional Controls	Exposure Prevention	No disturbance, low cost, can be targeted to specific areas	Potential restriction to future land use; requires long term application and monitoring	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	none	long (>10 years)	low	Amenable (as a component of overall remedial approach)
Engineering Controls	Exposure Prevention	Addresses risk at point of exposure	Requires long term application and monitoring	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	none	long (>10 years)	variable	Potential Amenability (as component of overall remedial approach)
Demonstrate Background biodegradation mechanism is sufficient for destruction (NSZD/MNA)	Compositional Change	No disturbance, low carbon footprint	Regulatory acceptance emerging	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	headspace readings, compositional analysis	long (>10 years)	low	Potential Amenability
Bioventing - Enhancing biodegradation	Compositional Change	Proven, lower energy	Treatment requires VOCs to be less than 60k ppmv and sufficient distance to any receptor	Yes - Silt, not clay	Yes	Potential	Potential	Yes	No	Not Direct	Yes	Yes	headspace readings, pilot testing	short (<5 years)	medium	Potential Amenability
Biosparging - Enhancing Biodegradation	Compositional Change	Proven, lower energy	Treatment requires VOCs to be less than 60k ppmv and sufficient distance to any receptor	Yes - Silt, not clay	Yes	Potential	Potential	No	Yes	Yes	Not Direct	Yes	soil/gas headspace readings, efflux testing, soil or LNAPL samples for composition of remaining impacts, pilot testing	short (<5 years)	medium	Potential Amenability
AS/SVE - Enhancing Biodegradation with vapor extraction	Compositional Change	Proven, vapor control	Vapor fraction drops off within first 6-months year, biodegradation then dominates, spacing, energy required	Yes - Silt, not clay	Yes	Unlikely	Unlikely	Yes - sufficient unsaturated zone thickness is required to capture vapors	Yes	Yes	Yes	Yes	HRSC, bedrock geophysics, pilot testing	short (<5 years)	high	Potential Amenability
ISCO - targets dissolved mass not the hydrocarbon source	Compositional Change	Minimal infrastructure	Limited to dissolved media, potential vapor generation, rebound, spacing, delivery efficiency (ROI)	Unlikely	Yes	Yes - long-lived oxidants	Yes - long-lived oxidants	No	Yes	Yes	No	Limited to soluble components, mass demand often excessive	HRSC, oxidant demand, bedrock geophysics, pilot testing	shortest (<2 years) - if successful	high	Potential Amenability
Enhanced Anaerobic Degradation of dissolved phase	Compositional Change	Accelerate ambient biodegradation, minimal infrastructure	Limited to dissolved media, spacing, delivery efficiency (ROI)	Unlikely	Yes	Yes	Yes	No	Yes	Yes	No	Unlikely	HRSC, bedrock geophysics, MBT, pilot testing	Medium (<10 years)	medium	Potential Amenability

TABLE 3-1
POTENTIALLY APPLICABLE TREATMENT TECHNOLOGIES
BP WEAVER WOODLANDS ALLOTMENT
NEW FRANKLIN, OHIO

				Applicable Geology				Treatment Zone		Treatment Phase						
Technology	**Treatment Objective**	**Advantages**	**Disadvantages**	**Fine Grained**	**Coarse Grained**	**Shale**	**Sandstone**	**Unsaturated**	**Saturated**	**Dissolved**	**Vapor**	**Residual LNAPL**	**Potential Pre-Design Investigation**	**Potential Time Frame**	**Relative Cost**	**Qualitative Ranking**
Activated Carbon Injection - stabilizes hydrocarbon source and dissolved and relies on background biodegradation for destruction	Compositional Change & Mass Control	Minimal infrastructure, sequestration	Spacing, delivery efficiency (ROI); longer-term degradation unproven	Yes	Yes	Unlikely without fracturing	Unlikely without fracturing	No	Yes	Yes	Unproven - not the typical subsurface target media	Potential	HRSC, bedrock geophysics, pilot testing	shortest (<2 years) - if successful	high	Potential Amenability
Soil Excavation and Disposal	Mass Removal	Rapid implementation	Limited locations of vadose zone soil impacts at this site; implementation in saturated zone requires dewatering; may be disruptive, costly, or infeasible in areas with infrastructure	Yes	Yes	Unlikely	No	Yes	Unlikely	Yes - if dewatering is performed	Yes - if source is in soil	Yes - if in soil	none	shortest (<2 years) - if successful	variable	Limited Amenability
MPE - enhanced biodegradation, vapor extraction and groundwater extraction, LNAPL recovery possible but other mechanisms often dominate	Compositional Change & Mass Removal	Successfully implemented at this site, vapor control, expose trapped LNAPL, volatile depletion, enhance aerobic bio, treat residual LNAPL	Generated fluids separation, multiple fluid streams to treat/dispose	Yes - Silt, not clay	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	HRSC, bedrock geophysics, pilot testing	short (<5 years)	high	Limited Amenability
Phytotechnology - enhance background biodegradation through enhanced microbial community, soil aeration	Compositional Change & Mass Control	Natural treatment system - aesthetically pleasing above ground Less dependent on soil permeability than some other technologies	Limited to root zone depth, acclimation period	Optimal - root network is efficient at aerating soil in multiple directions / planes	Yes	Potential	Potential	Yes	Yes	Yes	No	Yes	MBT, pilot testing, evaluation of existing trees	medium (<10 years)	medium	Potential Amenability

Notes:
NSZD/MNA = Natural Source Zone Depletion/Monitored Natural Attenuation
RAOs = Remedial Action Objectives
ISCO = In-Situ Chemical Oxidation
LNAPL = Light Non-Aqueous Phase Liquid
ROI = Radius of Influence
HRSC = High Resolution Site Characterization
MBT = Microbiological Testing
Sources: ITRC LNAPL-3 Table 6-2 and ITRC FracturedRx Table 6-2
[yellow highlight] = Treatment technology considered for targeted remediation in Alternative 5.

TABLE 4-1
WESTERN AREA
SUMMARY OF RECOMMENDED REMEDIAL ALTERNATIVE
BP WEAVER WOODLANDS ALLOTMENT
NEW FRANKLIN, OHIO

Potential Exposure/Risk	Interim Actions (including options)	Anticipated Remedies	Contingent Remedies	Closure Criteria (per EU)
Potable Use of Groundwater	Drinking water testing Provide bottled water Install double-cased water supply well to deeper aquifer Install public water supply line	AS/SVE or Biosparging in Target Area(s) to be further defined in PDI ECs for shallow groundwater NSZD / MNA	Enhanced bioremediation injection (e.g., sulfate) Phytotechnologies in Target Area(s) to be further defined in PDI or after performance of anticipated remedy	Groundwater monitoring well COC concentrations below potable RLs
Vapor Intrusion	Temporary vapor mitigation system	AS/SVE or Biosparging in Target Area(s) to be further defined in PDI Restrictions on future buildings NSZD / MNA	Enhanced bioremediation injection (e.g., sulfate) Phytotechnologies in Target Area(s) to be further defined in PDI or after performance of anticipated remedy	Groundwater monitoring well COC concentrations below vapor intrusion RLs, soil vapor COC concentrations below soil gas RLs, or site-specific standards
Recoverable LNAPL	Skimming Transmissivity testing	NSZD / MNA	Not applicable	Recovery to extent practicable (transmissivity < 0.5 ft^2/day)

Notes:
LNAPL - light non-aqueous phase liquid
EC - environmental covenant
AS/SVE - air sparge/soil vapor extraction
NSZD - natural source zone depletion
MNA - monitored natural attenuation
EU - exposure unit
COC - chemical of concern
PDI - Pre-Design Investigation
RL - remedial level

TABLE 4-2
CENTRAL AREA
SUMMARY OF RECOMMENDED REMEDY
BP WEAVER WOODLANDS ALLOTMENT
NEW FRANKLIN, OHIO

Potential Exposure/Risk	Interim Actions (including options)	Anticipated Remedies	Contingent Remedies	Closure Criteria (per EU)
Potable Use of Groundwater	Drinking water testing Provide bottled water Install double-cased water supply well to deeper aquifer Install public water supply line	Biosparging and/or injected barrier (e.g., activated carbon) in Target Area(s) to be further defined in PDI and dependent on access ECs for shallow groundwater NSZD / MNA	Enhanced bioremediation injection (e.g., sulfate) Phytotechnologies in Target Area(s) to be further defined in PDI or after performance of anticipated remedy	Groundwater monitoring well COC concentrations below potable RLs
Vapor Intrusion	Temporary vapor mitigation system	Bioventing and/or injected barrier (e.g., activated carbon) in Target Area(s) to be further defined in PDI Restrictions on future buildings NSZD / MNA	Enhanced bioremediation injection (e.g., sulfate) Phytotechnologies in Target Area(s) to be further defined in PDI or after performance of anticipated remedy	Groundwater monitoring well COC concentrations below vapor intrusion RLs, soil vapor COC concentrations below soil gas RLs, or site-specific standards
Recoverable LNAPL	Skimming Transmissivity testing	NSZD / MNA	Biosparging/bioventing	Recovery to extent practicable (transmissivity < 0.5 ft^2/day)

Notes:
LNAPL - light non-aqueous phase liquid
EC - environmental covenant
AS/SVE - air sparge/soil vapor extraction
NSZD - natural source zone depletion
MNA - monitored natural attenuation
EU - exposure unit
COC - chemical of concern
PDI - Pre-Design Investigation
RL - remedial level

TABLE 4-3
EASTERN AREA
SUMMARY OF RECOMMENDED REMEDY
BP WEAVER WOODLANDS ALLOTMENT
NEW FRANKLIN, OHIO

Potential Exposure/Risk	Interim Actions (including options)	Anticipated Remedies	Contingent Remedies	Closure Criteria (per EU)
Potable Use of Groundwater	Drinking water testing Provide bottled water Install double-cased water supply well to deeper aquifer Install public water supply line	AS/SVE or Biosparging in Target Area(s) to be further defined in PDI ECs for shallow groundwater NSZD / MNA	Enhanced bioremediation injection (e.g., carbon, sulfate) Phytotechnologies in Target Area(s) to be further defined in PDI or after performance of anticipated remedy	Groundwater monitoring well COC concentrations below potable RLs
Vapor Intrusion	Temporary vapor mitigation system	Restrictions on future buildings NSZD / MNA AS/SVE or Bioventing in Target Area(s)	Enhanced bioremediation injection (e.g., carbon, sulfate) Phytotechnologies in Target Area(s) to be further defined in PDI or after performance of anticipated remedy	Groundwater monitoring well COC concentrations below vapor intrusion RLs, soil vapor COC concentrations below soil gas RLs, or site-specific standards
Recoverable LNAPL	Not applicable	Not applicable	Not applicable	Not applicable

Notes:
LNAPL - light non-aqueous phase liquid
EC - environmental covenant
AS/SVE - air sparge/soil vapor extraction
NSZD - natural source zone depletion
MNA - monitored natural attenuation
EU - exposure unit
COC - chemical of concern
PDI - Pre-Design Investigation
RL - remedial level

FIGURES

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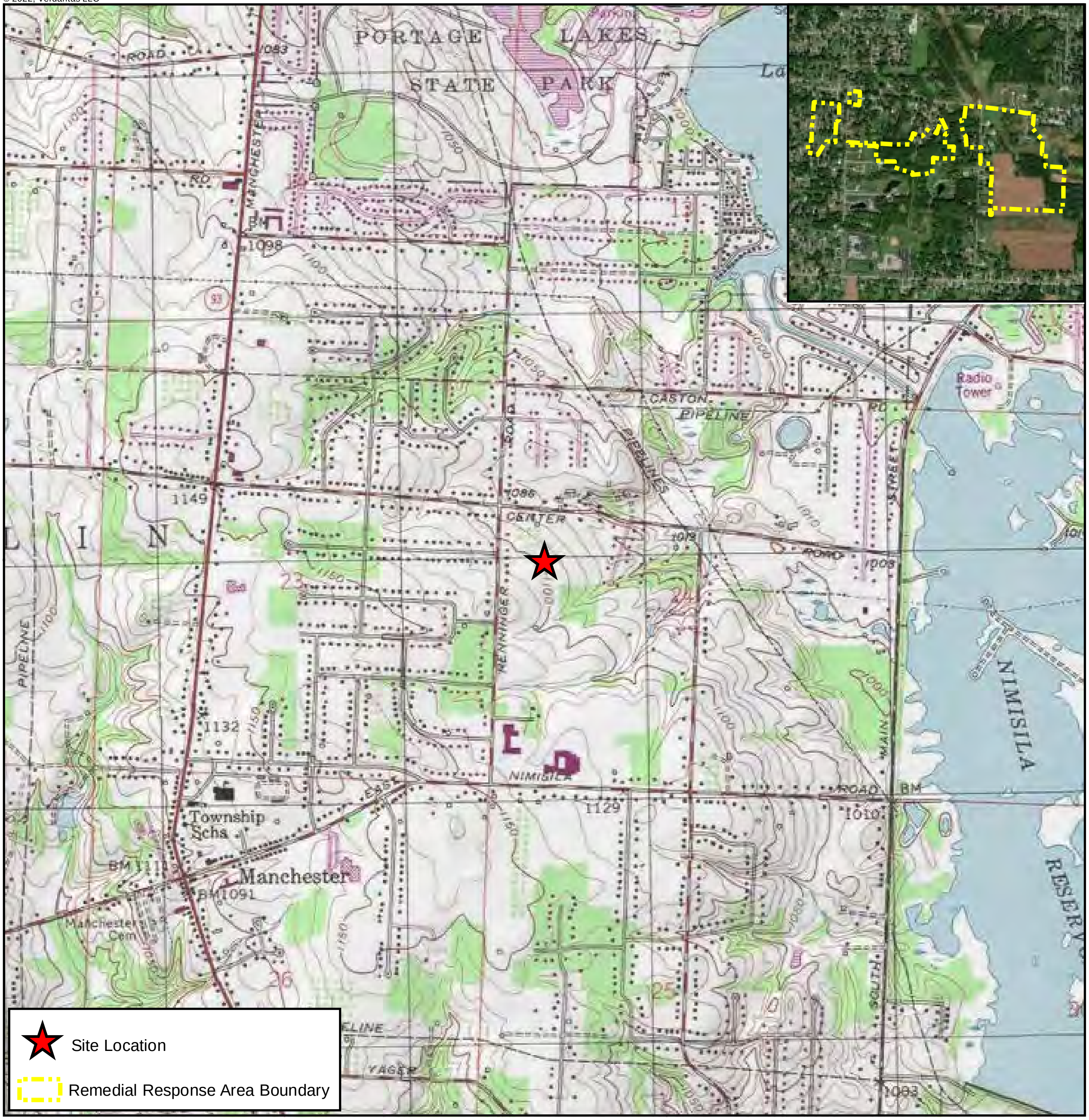

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0 1,000 2,000 4,000 Feet

1:24,000

Quadrangle: Canal Fulton, Ohio

Source: The topographic map was acquired through the USGS Topographic Map Web Service.

The aerial photo in the inset was acquired through the Esri Image Web Service. Aerial photography dated 2015.

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Site Location Map

Weaver Woodlands Allotment
New Franklin, Summit County, Ohio

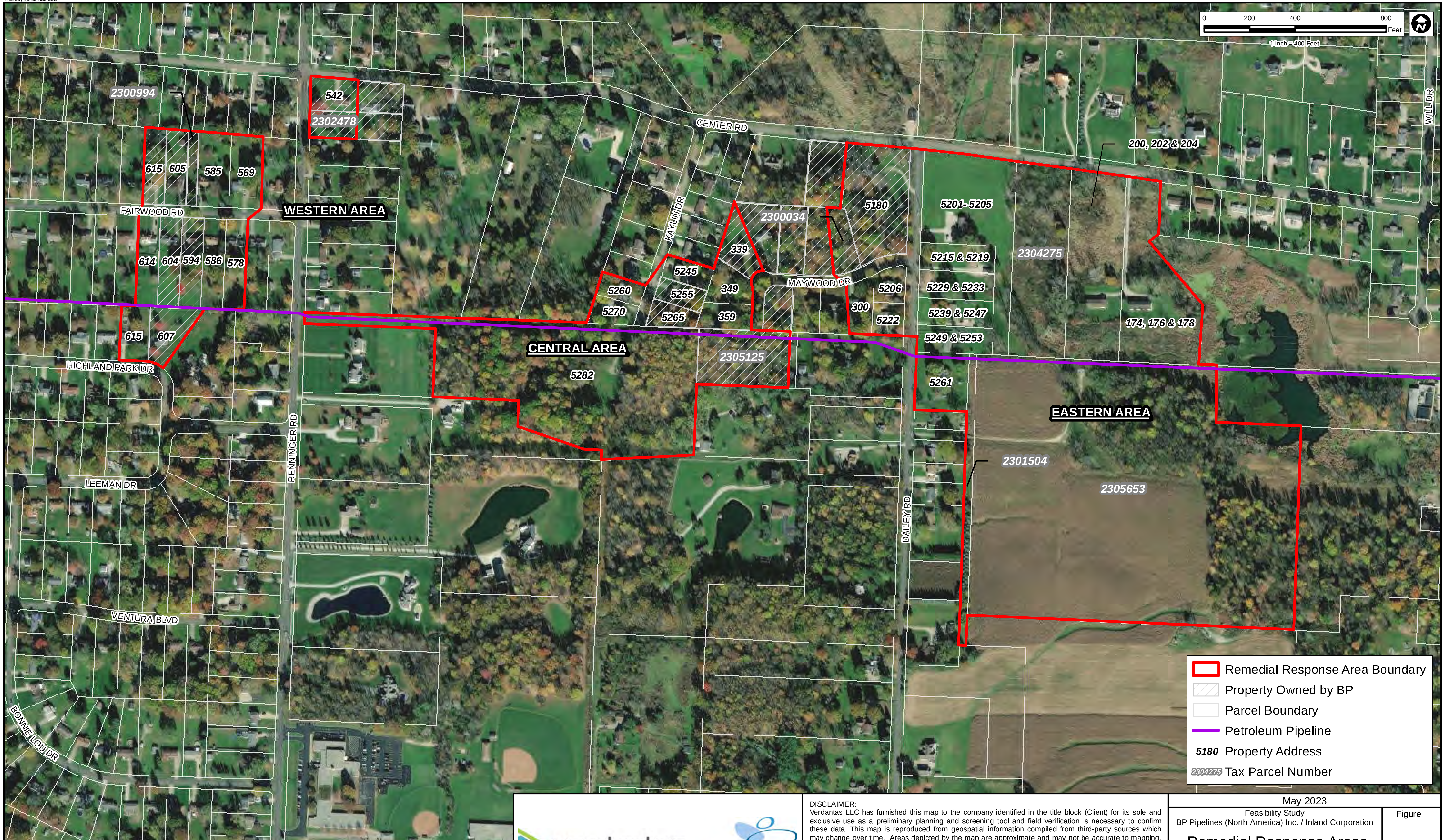
Date: May 2023

File Name: OHFranklin_13_Fig01-1_SLM.mxd

Edited: 2/24/2022 By: dreed

Figure 1-1

Produced Using Esri's ArcGIS Software



Notes:
1) All property boundaries shown acquired from the Summit County GIS Department.
2) The aerial photo was acquired through the Esri Imagery Web Service. Aerial photography dated 11/8/2021.

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BP Pipelines (North America) Inc. / Inland Corporation

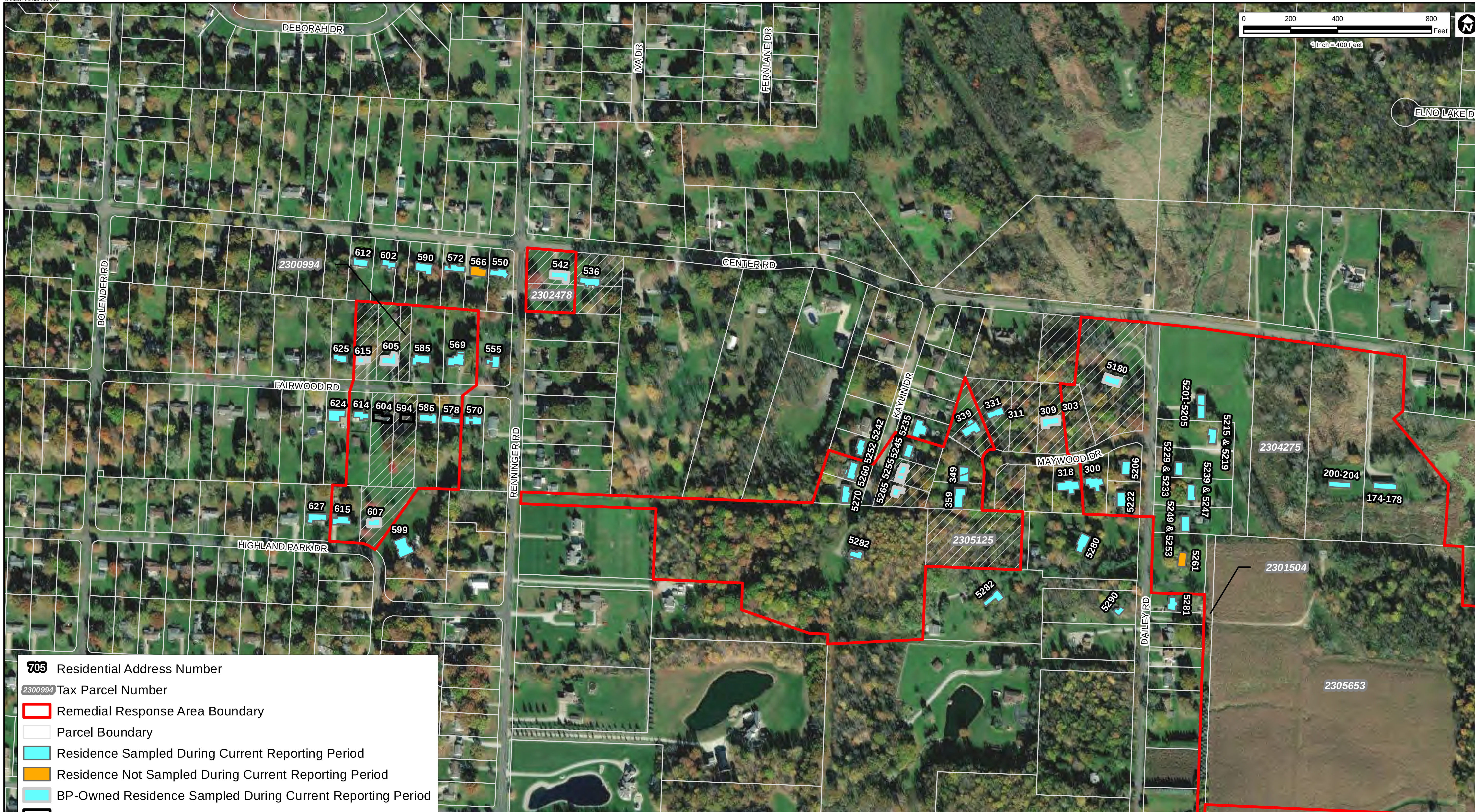
Remedial Response Areas and Exposure Units Retained

Weaver Woodlands Allotment
New Franklin, Summit County, Ohio

Figure 1-2

Produced Using Esri's ArcGIS Software

File Name: OHFranklin_20_Fig01-2_RemedialAreasExposureUnits.mxd Edited: 5/11/2023 By: dreed



Notes:
1) All property boundaries shown acquired from the Summit County GIS Department.
2) The aerial photo was acquired through the Esri Imagery Web Service. Aerial photography dated 11/8/2021.

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2022 Drinking Water Sampling Location Map

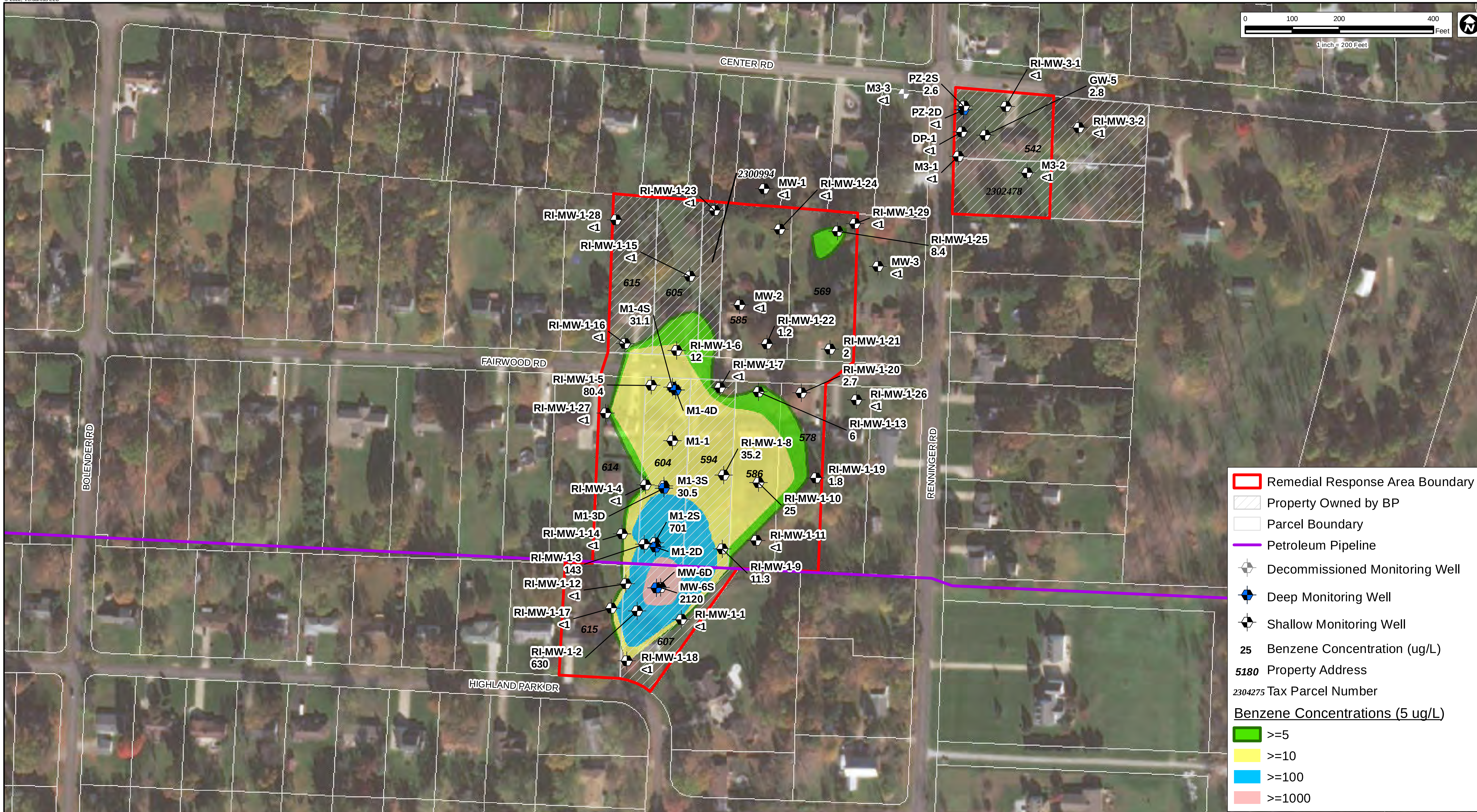
Weaver Woodlands Allotment
New Franklin, Summit County, Ohio

Figure
1-3

Produced Using Esri's ArcGIS Software

File Name: OHFranklin_20_Fig01-3_DrinkingWaterSampling2022.mxd

Edited: 5/10/2023 By: dreed



Notes:

1) Benzene concentrations presented are the maximum concentrations for each well location in fractured/weathered Homewood Sandstone (HSU-1) and unconsolidated deposits (HSU-4) groundwater between 2017 and 2021.

2) All property boundaries shown acquired from the Summit County GIS Department.

3) The aerial photo was acquired through the Esri Imagery Web Service.

Aerial photography dated 2020.

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Western Remedial Area Isoconcentration Shallow (Benzene)

Weaver Woodlands Allotment

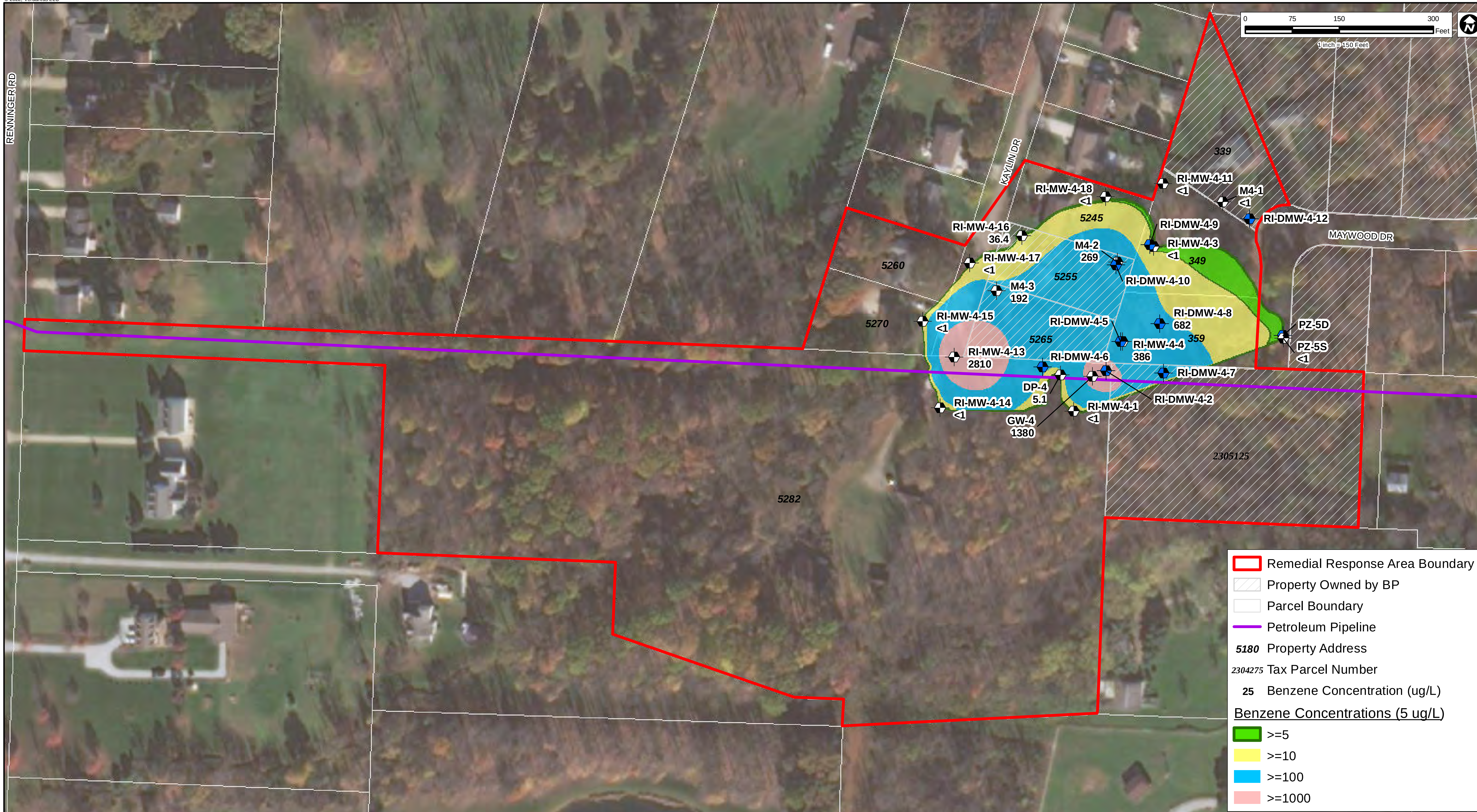
New Franklin, Summit County, Ohio

Figure

1-4

Produced Using Esri's ArcGIS Software

File Name: OHFranklin_13_Fig01-4_WesternRemedialArea_BenzeneShallow.mxd Edited: 2/24/2022 By: dreed



Notes:
1) Benzene concentrations presented are the maximum concentrations for each well location in fractured/weathered Homewood Sandstone (HSU-1) and unconsolidated deposits (HSU-4) groundwater between 2017 and 2021.
2) All property boundaries shown acquired from the Summit County GIS Department.
3) The aerial photo was acquired through the Esri Imagery Web Service. Aerial photography dated 2020.

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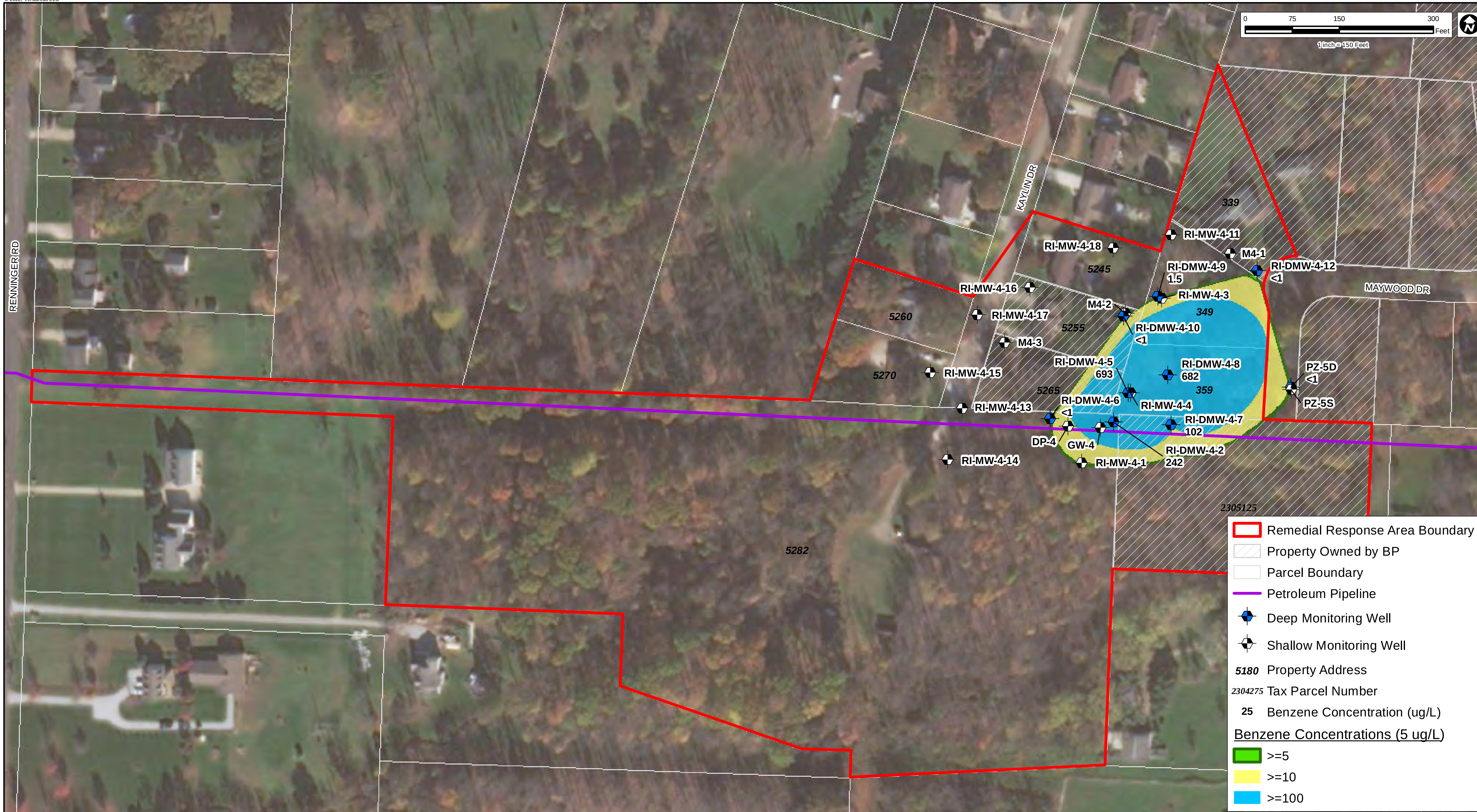
Central Remedial Area Isoconcentration Shallow (Benzene)

Weaver Woodlands Allotment
New Franklin, Summit County, Ohio

Figure **1-5**

Produced Using Esri's ArcGIS Software

File Name: OHFranklin_13_Fig01-5_CentralRemedialArea_BenzeneShallow.mxd Edited: 2/24/2022 By: dreed



Notes:

1) Benzene concentrations presented are the maximum concentrations for each well location in competent Homewood Sandstone (HSU-1) groundwater between 2017 and 2021.
2) All property boundaries shown acquired from the Summit County GIS Department.
3) The aerial photo was acquired through the Esri Imagery Web Service. Aerial photography dated 2020.

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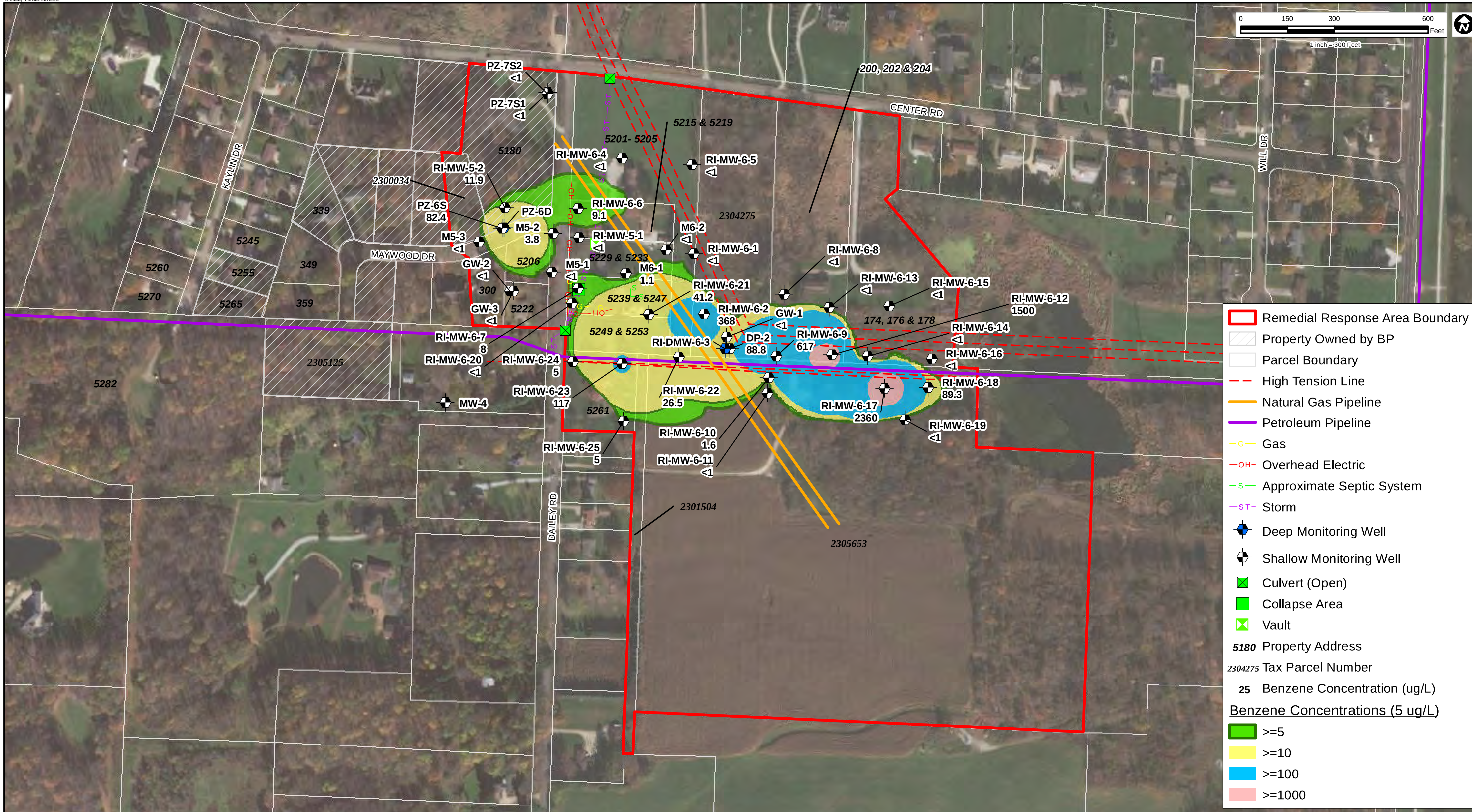
Central Remedial Area Isoconcentration Deep (Benzene)

Weaver Woodlands Allotment
New Franklin, Summit County, Ohio

Figure

1-6



Notes:
1) Benzene concentrations presented are the maximum concentrations for each well location in fractured/weathered Homewood Sandstone (HSU-1) and unconsolidated deposits (HSU-4) groundwater between 2017 and 2021.
2) All property boundaries shown acquired from the Summit County GIS Department.
3) The aerial photo was acquired through the Esri Imagery Web Service.
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May 2023
Feasibility Study
BP Pipelines (North America) Inc. / Inland Corporation

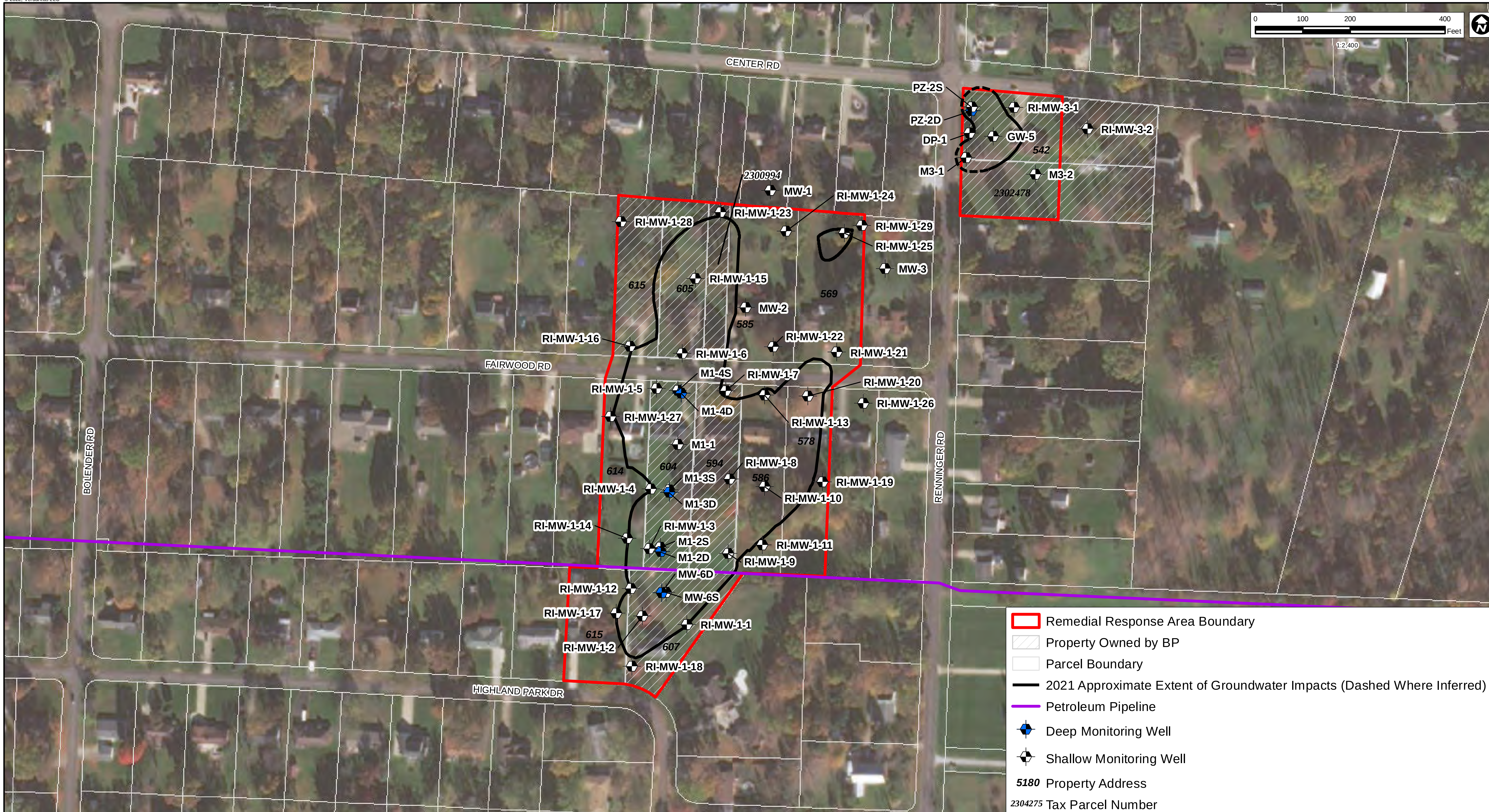
Eastern Remedial Area Isoconcentration Shallow (Benzene)

Weaver Woodlands Allotment
New Franklin, Summit County, Ohio

Figure
1-7

Produced Using Esri's ArcGIS Software

File Name: OHFranklin_13_Fig01-7_EasternRemedialArea_BenzeneShallow.mxd Edited: 2/24/2022 By: dreed



Notes:
1) Groundwater analytical data for fractured/weathered Homewood Sandstone (HSU-1) and unconsolidated deposits (HSU-4) groundwater zones from 2017 through 2021 were used to generate figure. Maximum concentration from each monitoring well was used to compare to Maximum Contaminant Level (MCL) or Naphthalene Regional Screening Level (RSL) and the Vapor Intrusion Screening Level (VISL).
2) All property boundaries shown acquired from the Summit County GIS Department.
3) The aerial photo was acquired through the Esri Imagery Web Service.
Aerial photography dated 2020.

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May 2023

Feasibility Study
BP Pipelines (North America) Inc. / Inland Corporation

Western Remedial Area

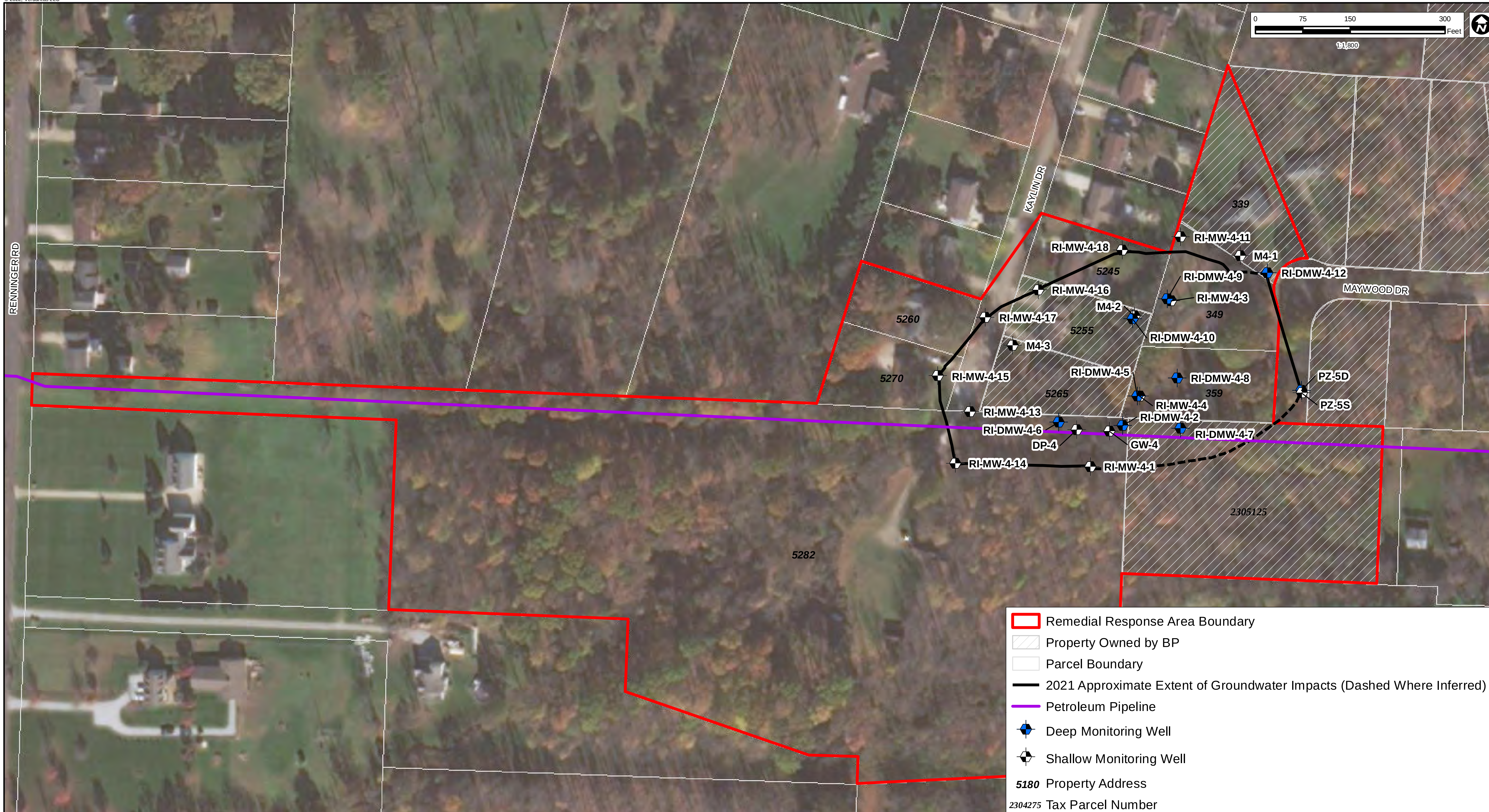
Weaver Woodlands Allotment
New Franklin, Summit County, Ohio

Figure
1-8

Produced Using Esri's ArcGIS Software

File Name: OHFranklin_13_Fig01-8_WesternRemedialArea.mxd

Edited: 2/24/2022 By: dreed



Notes:
1) Groundwater analytical data for fractured/weathered Homewood Sandstone (HSU-1) and unconsolidated deposits (HSU-4) groundwater zones from 2017 through 2021 were used to generate figure. Maximum concentration from each monitoring well was used to compare to Maximum Contaminant Level (MCL) or Naphthalene Regional Screening Level (RSL) and the Vapor Intrusion Screening Level (VISL).
2) All property boundaries shown acquired from the Summit County GIS Department.
3) The aerial photo was acquired through the Esri Imagery Web Service.
Aerial photography dated 2020.

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Feasibility Study
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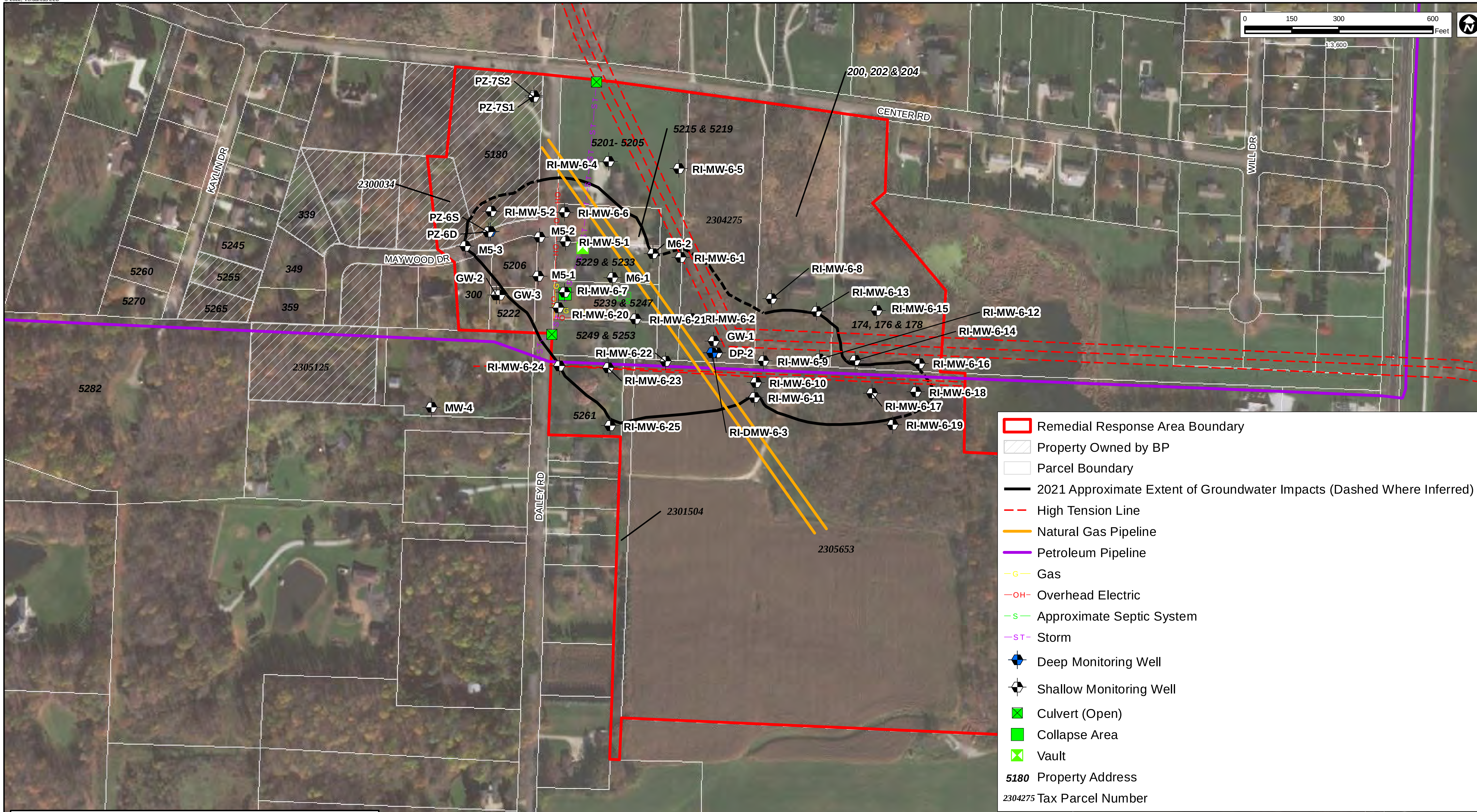
Central Remedial Area

Weaver Woodlands Allotment
New Franklin, Summit County, Ohio

Figure
1-9

Produced Using Esri's ArcGIS Software
File Name: OHFranklin_13_Fig01-9_CentralRemedialArea.mxd
Edited: 2/24/2022 By: dreed



Notes:
1) Groundwater analytical data for fractured/weathered Homewood Sandstone (HSU-1) and unconsolidated deposits (HSU-4) groundwater zones from 2017 through 2021 were used to generate figure. Maximum concentration from each monitoring well was used to compare to Maximum Contaminant Level (MCL) or Naphthalene Regional Screening Level (RSL) and the Vapor Intrusion Screening Level (VISL).
2) All property boundaries shown acquired from the Summit County GIS Department.
3) The aerial photo was acquired through the Esri Imagery Web Service.
Aerial photography dated 2020.

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Feasibility Study
BP Pipelines (North America) Inc. / Inland Corporation

Eastern Remedial Area

Weaver Woodlands Allotment
New Franklin, Summit County, Ohio

Figure
1-10

APPENDIX A

Ohio EPA Letter - Receipt of RI Report and Next Steps, November 25, 2019

Ohio Environmental Protection Agency

Mike DeWine, Governor
Jon Husted, Lt. Governor
Laurie A. Stevenson, Director

November 25, 2019

RE: Weaver Woodlands, Franklin Twp
Remediation Response
Correspondence
Remedial Response
Summit County
ID # 277001207005

Ms. Erin Burke
BP Operations Project Manager
BP Remediation Management
150 W. Warrenville Road MC600-1014G
Naperville, IL 60563

Subject: Report for Weaver Woodlands Allotment, New Franklin Remedial Investigation/Feasibility Study – Next Steps

Dear Ms. Burke:

The Ohio Environmental Protection Agency (Ohio EPA), Northeast District Office (NEDO), Division of Environmental Response and Revitalization (DERR) acknowledges receipt, on October 8, 2019, of the approved Final Remedial Investigation Report (RI Report) for the Weaver Woodlands Allotment site (Site), located in New Franklin, Summit County. The RI Report was submitted by Remediation Management Services Company/ BP Oil Pipeline/Inland Corporation (BP) to fulfill the requirements of the 2007 Director's Final Findings and Orders (DFFOs). The RI Report has been uploaded to the Agency's electronic document retrieval portal ("eDOC") and can be retrieved using the document handle number 1167145 or the following link: http://edocpub.epa.ohio.gov/publicportal/ViewDocument.aspx?docid=1167145.

Next Steps:

Based on the information collected during the RI, the properties/exposure units identified in RI Table 7-1 and Table 7-3 should be carried forward, into the Feasibility Study (FS) process. The properties/exposure units identified in RI Table 7-2 are beyond the limits of Site-related contamination (*i.e.*, ground water and/or soil gas that has been impacted by the Site). No further evaluation of the properties listed in Table 7-2 is necessary, unless additional information is brought to the Agency's attention indicating otherwise. The RI tables in question (Tables 7-1, 7-2 and 7-3) are attached to this correspondence, for completeness.

Please move forward with the FS per the schedule in the approved (May 2009) RI/FS Work Plan. Please respond setting up a meeting to discuss the FS outline within 14 days (December 9, 2019).

Informational Meeting:

BP had proposed to conduct an Information Meeting for the local community, once the RI Report was approved. If BP wishes to move forward with the Information Meeting, please advise Ohio EPA with enough advance notice to have the appropriate staff participate.

As previously communicated, the Site is being transitioned to Dr. Sheila Abraham. She can be reached at (330) 963-1290, or via email at Sheila.Abraham@epa.ohio.gov. Please continue to copy me on emails and other correspondence until further notice, to support the transition.

If you have any questions related to this or other Site correspondence, please feel free to contact me at (330) 963-1109. Please cite Ohio EPA's number for the Site, 277001207005, in all correspondence.

Sincerely,

Michael Bolas
Project Coordinator
Division of Environmental Response and Revitalization

MB/sc

Attachment

ec: Erin Burke, BP Remediation Management
William R. Barth, Sunoco Inc.
Mark Schmidt, Anthea Hull
Sheila Abraham, Ohio EPA, DERR, NEDO
Michael Bolas, Ohio EPA, DERR, NEDO
Mark Caetta, Ohio EPA, DERR, NEDO
Megan Oravec, Ohio EPA, DERR, NEDO
Natalie Oryshkewych, Ohio EPA, DERR, NEDO
Bob Princic, Ohio EPA, DERR, NEDO

BP WEAVER WOODLANDS ALLOTMENT
NEW FRANKLIN, OHIO

TABLE 7-1

PROPERTIES (EUS) RETAINED FOR FURTHER EVALUATION

Property Identification		Data Collected on Property						
Street No.	**Street Name**	**Monitoring Well**	**Soil Boring**	**Exterior Soil Vapor**	**Subslab Vapor**	**Drinking Water**	**Rationale**	**Monitoring Wells on Property**
200 / 202 / 204	Center Rd.	●				●	Groundwater exceeds MCL based on MW data. Groundwater exceeds VISL based on MW data. Vapor sampling not conducted because home is >100 feet from impacted well. No detections of COCs in drinking water. Soil meets risk-based criteria.	MW-6-8, 6-9, 6-12, 6-13
Parcel 2304275	Center Rd.	●	●			●	Groundwater exceeds MCL based on MW data. Groundwater exceeds VISL based on MW data (no residence located on the property). No detections of COCs in drinking water. Soil meets risk-based criteria.	MW-6-2, 6-3, GW-1, DP-2
542 (and adjacent parcel 2302478)	Center Rd.	●				●	Groundwater exceeds MCL based on MW data. No detections of COCs in drinking water.	M3-1, M3-2, DP-1, PZ-2S, MW-3-1, GW-5
5180	Dailey Rd.	●	●			●	Groundwater exceeds MCL based on MW data. Groundwater exceeds VISL based on MW data. Subslab sampling not conducted because home is >100 feet from impacted well. No detections of COCs in drinking water. Soil meets risk-based criteria.	MW-5-2, PZ-6S/D, PZ-7S1/S2
5206	Dailey Rd.	●	●		●	●	Groundwater exceeds MCL based on MW data. Groundwater exceeds VISL based on MW data. No exceedances of screening levels in subslab vapor. No detections of COCs in drinking water. Soil meets risk-based criteria.	M5-1, M5-2
5215 / 5219	Dailey Rd.	●				●	Groundwater exceeds MCL based on MW data. Groundwater exceeds VISL based on MW data. Vapor sampling not conducted because home is >100 feet from impacted well. No detections of COCs in drinking water.	MW-6-6
5229 / 5233	Dailey Rd.	●	●			●	Groundwater exceeds MCL based on MW data. Groundwater likely to exceed VISL based on exceedances of VISL on adjacent properties at MWs within 100 feet of the residence. Subslab sampling not authorized by property owner. No detections of COCs in drinking water. Soil meets risk-based criteria.	MW-5-1, M6-1, M6-2
5239	Dailey Rd.	●				●	Groundwater exceeds MCL based on MW data. Groundwater exceeds VISL based on MW data. Subslab sampling not authorized by property owner. No detections of COCs in drinking water.	MW-6-7, 6-20, 6-21

TABLE 7-1

PROPERTIES (EUS) RETAINED FOR FURTHER EVALUATION

Property Identification		Data Collected on Property						
Street No.	**Street Name**	**Monitoring Well**	**Soil Boring**	**Exterior Soil Vapor**	**Subslab Vapor**	**Drinking Water**	**Rationale**	**Monitoring Wells on Property**
5261	Dailey Rd.	●			●	●	Groundwater exceeds MCL based on MW data. Groundwater exceeds VISL based on MW data. Subslab vapor meets VISL. No detections of COCs in drinking water.	MW-6-23, 6-24, 6-25
569	Fairwood Rd.	●				●	Groundwater exceeds MCL based on MW data. Groundwater likely to exceed VISL based on exceedances of VISL on adjacent property to the west at MW within 100 feet of the residence. Subslab sampling not authorized by property owner. No detections of COCs in drinking water.	MW-1-21, 1-25, 1-29
578	Fairwood Rd.	●				●	Groundwater exceeds MCL based on MW data. Groundwater meets VISL based on MW data. No detections of COCs in drinking water.	MW-1-20, 1-19
585	Fairwood Rd.	●			●	●	Groundwater exceeds MCL based on MW data. Groundwater exceeds VISL based on MW data. No exceedances of screening levels in subslab vapor. No detections of COCs in drinking water.	MW-1-24, 1-22, MW-2
586	Fairwood Rd.	●			●	●	Groundwater exceeds MCL based on MW data. Groundwater exceeds VISL based on MW data. No exceedances of screening levels in subslab vapor. No detections of COCs in drinking water	MW-1-10, 1-11, 1-13
594	Fairwood Rd.	●	●		●	●	Groundwater exceeds MCL based on MW data. Groundwater exceeds VISL based on MW data. Subslab vapor exceeds VISL. No detections of COCs in drinking water. Soil meets risk-based criteria.	MW-1-7, 1-8
604	Fairwood Rd.	●	●		●	●	Groundwater exceeds MCL based on MW data. Groundwater exceeds VISL based on MW data. No exceedances of screening levels in subslab vapor. No detections of COCs in drinking water. Soil meets risk-based criteria.	MW-1-3, 1-4, 1-5, 1-4S/D, 1-3S/D, 1-2S/D
605 (and adjacent parcel 23000994)	Fairwood Rd.	●	●		●	●	Groundwater exceeds MCL based on MW data. Groundwater exceeds VISL based on MW data. Subslab vapor exceeds VISL. No detections of COCs in drinking water. Soil meets risk-based criteria.	MW-1-6, 1-15, 1-23

BP WEAVER WOODLANDS ALLOTMENT
NEW FRANKLIN, OHIO

TABLE 7-1

PROPERTIES (EUS) RETAINED FOR FURTHER EVALUATION

Property Identification		Data Collected on Property						
Street No.	**Street Name**	**Monitoring Well**	**Soil Boring**	**Exterior Soil Vapor**	**Subslab Vapor**	**Drinking Water**	**Rationale**	**Monitoring Wells on Property**
614	Fairwood Rd.	●			●	●	Groundwater exceeds MCL based on MW data. Groundwater likely to exceed VISL based on exceedances of VISL on adjacent property to the east. No detections of COCs in subslab vapor. No detections of COCs in drinking water.	MW-1-14, 1-27
607	Highland Park	●	●		●	●	Groundwater exceeds MCL based on MW data. Groundwater exceeds VISL based on MW data. No exceedances of screening levels in subslab vapor. No detections of COCs in drinking water. Soil meets risk-based criteria.	MW-1-1, 1-2, 1-12, 1-18, MW-6S/D
5255	Kaylin Dr.	●		●	●	●	Groundwater exceeds MCL based on MW data. Groundwater exceeds VISL based on MW data. Exterior soil vapor exceeds VISL; no exceedances in subslab vapor (one sampling event). No detections of COCs in drinking water.	DMW4-10, 4-16, M4-2
5265	Kaylin Dr.	●		●	●	●	Groundwater exceeds MCL based on MW data. Groundwater exceeds VISL based on MW data. Exterior soil vapor exceeds VISL; subslab vapor exceeded VISL in 2012, did not exceed when resampled in 2017. No detections of COCs in drinking water.	M4-3, 4-13
5282	Kaylin Dr.	●	●			●	Groundwater exceeds MCL based on MW data. Groundwater exceeds VISL based on MW data. Vapor sampling not conducted because home is >100 feet from impacted well, and no detections of COCs in groundwater in closest well (RI-MW-4-14, >100 feet from home). No detections of COCs in drinking water. Soil meets risk-based criteria.	DMW-4-6, DMW-4-2, DP-4, GW-4, MW-4-1, 4-14
349	Maywood Dr.	●	●	●	●	●	Plume mapping indicates groundwater exceeding MCLs/RSL likely extends onto property. No exceedances of MCL, RSL, or VISL in monitoring wells on the property. Exterior soil vapor exceeds VISL; no exceedances in subslab vapor (one sampling event). No detections of COCs in drinking water. Soil meets risk-based criteria.	DMW-4-9, MW-4-3, 4-11

BP WEAVER WOODLANDS ALLOTMENT
NEW FRANKLIN, OHIO

TABLE 7-1

PROPERTIES (EUS) RETAINED FOR FURTHER EVALUATION

Property Identification		Data Collected on Property						
Street No.	Street Name	Monitoring Well	Soil Boring	Exterior Soil Vapor	Subslab Vapor	Drinking Water	Rationale	Monitoring Wells on Property
359	Maywood Dr.	●	●	●		●	Groundwater exceeds MCL based on MW data. Groundwater exceeds VISL based on MW data. Exterior soil vapor exceeds VISL; subslab sampling not authorized by resident. No detections of COCs in drinking water. Soil meets risk-based criteria.	DMW-4-6, MW-4-4
Parcel 2305125	Maywood Dr.	●					Groundwater exceeds MCL based on MW data. Groundwater exceeds VISL based on MW data. Subslab sampling not performed due to absence of a structure on the property.	DMW-4-7

BP WEAVER WOODLANDS ALLOTMENT
NEW FRANKLIN, OHIO

TABLE 7-1

PROPERTIES (EUS) RETAINED FOR FURTHER EVALUATION

Property Identification		Data Collected on Property						
Street No.	Street Name	Monitoring Well	Soil Boring	Exterior Soil Vapor	Subslab Vapor	Drinking Water	Rationale	Monitoring Wells on Property
Parcel 2305653 (Wisdom Woods Property)	S. Main Street	●					Groundwater exceeds MCL based on MW data. Groundwater exceeds VISL based on MW data. Subslab sampling not performed due to absence of a structure on the property.	MW-6-10, 6-11, 6-17, 6-18, 6-19, 6-22

Notes:

1) MCL - Maximum Contaminant Level for Benzene, Ethylbenzene, Toluene, and Total Xylenes. USEPA Regional Screening Level (RSL, June 2017) used for naphthalene since no MCL exists.

2) VISL - Vapor Intrusion Screening Level (USEPA, June 2017).

3) MW - Monitoring Well
4) COC - Chemical of Concern

BP WEAVER WOODLANDS ALLOTMENT
NEW FRANKLIN, OHIO

TABLE 7-2

PROPERTIES (EUS) NOT RETAINED FOR FURTHER EVALUATION

Property Identification		Data Collected on Property					
Street No.	Street Name	Monitoring Well	Soil Boring	Exterior Soil Vapor	Subslab Vapor	Drinking Water	Rationale
334	Center Rd.					●	Property is beyond limits of impacts in groundwater. No detections of COCs in drinking water.
346	Center Rd.					●	Property is beyond limits of impacts in groundwater. No detections of COCs in drinking water.
384	Center Rd.					●	Property is beyond limits of impacts in groundwater. No detections of COCs in drinking water.
408	Center Rd.					●	Property is beyond limits of impacts in groundwater. No detections of COCs in drinking water.
438	Center Rd.					●	Property is beyond limits of impacts in groundwater. No detections of COCs in drinking water.
498	Center Rd.					●	Property is beyond limits of impacts in groundwater. No detections of COCs in drinking water.
536	Center Rd.	●				●	Property is beyond limits of impacts in groundwater. No detections of COCs in groundwater (well RI-MW-3-2). No detections of COCs in drinking water.
550	Center Rd.	●				●	Property is beyond limits of impacts in groundwater. No detections of COCs in groundwater since 2009 (well M3-3). No detections of COCs in drinking water.
566	Center Rd.					●	Property is beyond limits of impacts in groundwater. No detections of COCs in drinking water.
572	Center Rd.					●	Property is beyond limits of impacts in groundwater. No detections of COCs in drinking water.
590	Center Rd.	●				●	Property is beyond limits of impacts in groundwater. No detections of COCs in groundwater (well MW-1). No detections of COCs in drinking water.
602	Center Rd.					●	Property is beyond limits of impacts in groundwater. No detections of COCs in drinking water.
612	Center Rd.					●	Property is beyond limits of impacts in groundwater. No detections of COCs in drinking water.

BP WEAVER WOODLANDS ALLOTMENT
NEW FRANKLIN, OHIO

TABLE 7-2

PROPERTIES (EUS) NOT RETAINED FOR FURTHER EVALUATION

Property Identification		Data Collected on Property					
Street No.	Street Name	Monitoring Well	Soil Boring	Exterior Soil Vapor	Subslab Vapor	Drinking Water	Rationale
622	Center Rd.					●	Property is beyond limits of impacts in groundwater. No detections of COCs in drinking water.
632	Center Rd.					●	Property is beyond limits of impacts in groundwater. No detections of COCs in drinking water.
640	Center Rd.					●	Property is beyond limits of impacts in groundwater. No detections of COCs in drinking water.
652	Center Rd.					●	Property is beyond limits of impacts in groundwater. No detections of COCs in drinking water.
664	Center Rd.					●	Property is beyond limits of impacts in groundwater. No detections of COCs in drinking water.
674	Center Rd.					●	Property is beyond limits of impacts in groundwater. No detections of COCs in drinking water.
686	Center Rd.					●	Property is beyond limits of impacts in groundwater. No detections of COCs in drinking water.
708	Center Rd.					●	Property is beyond limits of impacts in groundwater. No detections of COCs in drinking water.
716	Center Rd.					●	Property is beyond limits of impacts in groundwater. No detections of COCs in drinking water.
5280	Dailey Rd.					●	Property is beyond limits of impacts in groundwater. No detections of COCs in drinking water.
5282	Dailey Rd.					●	Property is beyond limits of impacts in groundwater. No detections of COCs in drinking water.
5290	Dailey Rd.					●	Property is beyond limits of impacts in groundwater. No detections of COCs in drinking water.
5300	Dailey Rd.						Property is outside the groundwater impact area. No sampling conducted.
555	Fairwood Rd.	●				●	Property is beyond limits of impacts in groundwater. No detections of COCs in groundwater (well MW-3). No detections of COCs in drinking water.
556	Fairwood Rd.					●	Property is beyond limits of impacts in groundwater. No detections of COCs in drinking water.

BP WEAVER WOODLANDS ALLOTMENT
NEW FRANKLIN, OHIO

TABLE 7-2

PROPERTIES (EUS) NOT RETAINED FOR FURTHER EVALUATION

Property Identification		Data Collected on Property					
Street No.	Street Name	Monitoring Well	Soil Boring	Exterior Soil Vapor	Subslab Vapor	Drinking Water	Rationale
570	Fairwood Rd.	●				●	Property is beyond limits of impacts in groundwater. No detections of COCs in groundwater (well RI-MW-1-26). No detections of COCs in drinking water.
624	Fairwood Rd.					●	Property is beyond limits of impacts in groundwater. No detections of COCs in drinking water.
625	Fairwood Rd.					●	Property is beyond limits of impacts in groundwater. No detections of COCs in drinking water.
628	Fairwood Rd.					●	Property is beyond limits of impacts in groundwater. No detections of COCs in drinking water.
629	Fairwood Rd.					●	Property is beyond limits of impacts in groundwater. No detections of COCs in drinking water.
638	Fairwood Rd.					●	Property is beyond limits of impacts in groundwater. No detections of COCs in drinking water.
639	Fairwood Rd.					●	Property is beyond limits of impacts in groundwater. No detections of COCs in drinking water.
657	Fairwood Rd.					●	Property is beyond limits of impacts in groundwater. No detections of COCs in drinking water.
658	Fairwood Rd.					●	Property is beyond limits of impacts in groundwater. No detections of COCs in drinking water.
667	Fairwood Rd.					●	Property is beyond limits of impacts in groundwater. No detections of COCs in drinking water.
668	Fairwood Rd.					●	Property is beyond limits of impacts in groundwater. No detections of COCs in drinking water.
677	Fairwood Rd.					●	Property is beyond limits of impacts in groundwater. No detections of COCs in drinking water.
678	Fairwood Rd.					●	Property is beyond limits of impacts in groundwater. No detections of COCs in drinking water.
687	Fairwood Rd.					●	Property is beyond limits of impacts in groundwater. No detections of COCs in drinking water.
688	Fairwood Rd.					●	Property is beyond limits of impacts in groundwater. No detections of COCs in drinking water.

BP WEAVER WOODLANDS ALLOTMENT
NEW FRANKLIN, OHIO

TABLE 7-2

PROPERTIES (EUS) NOT RETAINED FOR FURTHER EVALUATION

Property Identification		Data Collected on Property					
Street No.	Street Name	Monitoring Well	Soil Boring	Exterior Soil Vapor	Subslab Vapor	Drinking Water	Rationale
697	Fairwood Rd.					●	Property is beyond limits of impacts in groundwater. No detections of COCs in drinking water.
698	Fairwood Rd.					●	Property is beyond limits of impacts in groundwater. No detections of COCs in drinking water.
708	Fairwood Rd.					●	Property is beyond limits of impacts in groundwater. No detections of COCs in drinking water.
717	Fairwood Rd.					●	Property is beyond limits of impacts in groundwater. No detections of COCs in drinking water.
718	Fairwood Rd.					●	Property is beyond limits of impacts in groundwater. No detections of COCs in drinking water.
585	Highland Park					●	Property is beyond limits of impacts in groundwater. No detections of COCs in drinking water.
599	Highland Park					●	Property is beyond limits of impacts in groundwater. No detections of COCs in drinking water.
627	Highland Park					●	Property is beyond limits of impacts in groundwater. No detections of COCs in drinking water.
639	Highland Park					●	Property is beyond limits of impacts in groundwater. No detections of COCs in drinking water.
649	Highland Park					●	Property is beyond limits of impacts in groundwater. No detections of COCs in drinking water.
661	Highland Park					●	Property is beyond limits of impacts in groundwater. No detections of COCs in drinking water.
671	Highland Park					●	Property is beyond limits of impacts in groundwater. No detections of COCs in drinking water.
683	Highland Park					●	Property is beyond limits of impacts in groundwater. No detections of COCs in drinking water.
695	Highland Park					●	Property is beyond limits of impacts in groundwater. No detections of COCs in drinking water.
705	Highland Park						Property is outside the groundwater impact area. No sampling conducted (vacant lot).
715	Highland Park					●	Property is beyond limits of impacts in groundwater. No detections of COCs in drinking water.

BP WEAVER WOODLANDS ALLOTMENT
NEW FRANKLIN, OHIO

TABLE 7-2

PROPERTIES (EUS) NOT RETAINED FOR FURTHER EVALUATION

Property Identification		Data Collected on Property					
Street No.	Street Name	Monitoring Well	Soil Boring	Exterior Soil Vapor	Subslab Vapor	Drinking Water	Rationale
5195	Kaylin Dr.					●	Property is beyond limits of impacts in groundwater. No detections of COCs in drinking water.
5205	Kaylin Dr.					●	Property is beyond limits of impacts in groundwater. No detections of COCs in drinking water.
5210	Kaylin Dr.					●	Property is beyond limits of impacts in groundwater. No detections of COCs in drinking water.
5215	Kaylin Dr.					●	Property is beyond limits of impacts in groundwater. No detections of COCs in drinking water.
5220	Kaylin Dr.					●	Property is beyond limits of impacts in groundwater. No detections of COCs in drinking water.
5225	Kaylin Dr.					●	Property is beyond limits of impacts in groundwater. No detections of COCs in drinking water.
5235	Kaylin Dr.					●	Property is beyond limits of impacts in groundwater. No detections of COCs in drinking water.
5242	Kaylin Dr.					●	Property is beyond limits of impacts in groundwater. No detections of COCs in drinking water.
5252	Kaylin Dr.					●	Property is beyond limits of impacts in groundwater. No detections of COCs in drinking water.
309	Maywood Dr.					●	Property is beyond limits of impacts in groundwater. No detections of COCs in drinking water.
311	Maywood Dr.						Property is outside the groundwater impact area. No drinking water well (vacant lot).
318	Maywood Dr.					●	Property is beyond limits of impacts in groundwater. No detections of COCs in drinking water.
331	Maywood Dr.					●	Property is beyond limits of impacts in groundwater. No detections of COCs in drinking water.
Parcel 2301214	Maywood Dr.						Property is outside the groundwater impact area. No sampling conducted (vacant lot).

BP WEAVER WOODLANDS ALLOTMENT
NEW FRANKLIN, OHIO

TABLE 7-2

PROPERTIES (EUS) NOT RETAINED FOR FURTHER EVALUATION

Property Identification		Data Collected on Property					
Street No.	**Street Name**	**Monitoring Well**	**Soil Boring**	**Exterior Soil Vapor**	**Subslab Vapor**	**Drinking Water**	**Rationale**
Parcel 2301171	Maywood Dr.	●					Property is beyond limits of impacts in groundwater. No detections of COCs in well PZ-5S; single low-level anomalous detection of naphthalene in well PZ-5D since 2008 (no other COCs detected). No drinking water well (vacant lot).
5971	Renninger Rd.					●	Property is beyond limits of impacts in groundwater. No detections of COCs in drinking water.
5983	Renninger Rd.					●	Property is beyond limits of impacts in groundwater. No detections of COCs in drinking water.
5995	Renninger Rd.					●	Property is beyond limits of impacts in groundwater. No detections of COCs in drinking water.
6005	Renninger Rd.					●	Property is beyond limits of impacts in groundwater. No detections of COCs in drinking water.
6015	Renninger Rd.					●	Property is beyond limits of impacts in groundwater. No detections of COCs in drinking water.
6025	Renninger Rd.					●	Property is beyond limits of impacts in groundwater. No detections of COCs in drinking water.

BP WEAVER WOODLANDS ALLOTMENT
NEW FRANKLIN, OHIO

TABLE 7-2

PROPERTIES (EUS) NOT RETAINED FOR FURTHER EVALUATION

Property Identification		Data Collected on Property					
Street No.	Street Name	Monitoring Well	Soil Boring	Exterior Soil Vapor	Subslab Vapor	Drinking Water	Rationale
6035	Renninger Rd.					●	Property is beyond limits of impacts in groundwater. No detections of COCs in drinking water.
6061	Renninger Rd.						Property is outside the groundwater impact area. No sampling conducted.
6068	Renninger Rd.					●	Property is beyond limits of impacts in groundwater. No detections of COCs in drinking water.
6079	Renninger Rd.						Property is outside the groundwater impact area. No sampling conducted.
6095	Renninger Rd.						Property is outside the groundwater impact area. No sampling conducted.
Parcel 2303596	Renninger Rd.						Property is outside the groundwater impact area. No sampling conducted.

Notes:

1) MCL - Maximum Contaminant Level for Benzene, Ethylbenzene, Toluene, and Total Xylenes. USEPA Regional Screening Level (RSL, June 2017) used for naphthalene since no MCL exists.

2) VISL - Vapor Intrusion Screening Level (USEPA, June 2017).

3) COC - Chemical of Concern

BP WEAVER WOODLANDS ALLOTMENT
NEW FRANKLIN, OHIO

TABLE 7-3

PROPERTIES (EUS) RETAINED PENDING ADDITIONAL DATA COLLECTION

Property Identification		Data Collected on Property						
Street No.	**Street Name**	**Monitoring Well**	**Soil Boring**	**Exterior Soil Vapor**	**Subslab Vapor**	**Drinking Water**	**Rationale**	**Monitoring Wells on Property**
174 / 176 / 178	Center Rd.	●				●	Plume mapping indicates groundwater impacts may extend onto property. No detections of COCs in the three monitoring wells on the property. Subslab sampling not conducted because home is >100 feet from impacted well. No detections of COCs in drinking water.	MW-6-14, 6-15, 6-16
5201 / 5203 / 5205	Dailey Rd.	●	●			●	Plume mapping indicates groundwater impacts may extend onto property. No detections of COCs in MW-6-4 and 6-5; sporadic low-level detections in MW-6-1 (naphthalene >RSL once since 2011). Subslab sampling not conducted because home is >100 feet from impacted well. No detections of COCs in drinking water.	MW-6-1, 6-4, 6-5
5222	Dailey Rd.	●				●	Plume mapping indicates groundwater impacts may extend onto property. No detections of COCs in the two monitoring wells on the property since 2010. No detections of COCs in drinking water.	GW-2, GW-3
5249	Dailey Rd.				●	●	Groundwater impacts are likely to extend onto property (exceedances of RSL and VISL on properties to the north and south at MWs within 100 feet of the residence). Subslab sampling not authorized by property owner. No detections of COCs in drinking water.	None
Parcel 2301504	Dailey Rd. (vacant parcel)						Groundwater impacts are assumed to extend onto property (exceedances of RSL and VISL on properties to the north and east). No sampling conducted. Subslab sampling not performed due to absence of a structure on the property.	None
615	Fairwood Rd.	●				●	Plume mapping indicates groundwater impacts may extend onto property. No detections of COCs in the two monitoring wells on the property. No detections of COCs in drinking water.	RI-MW-1-16, 1-28
615	Highland Park	●				●	Plume mapping indicates groundwater impacts may extend onto property. No detections of COCs in the monitoring well on the property. No detections of COCs in drinking water.	RI-MW-1-17
5245	Kaylin Dr.	●		●		●	Plume mapping indicates groundwater impacts may extend onto property. No detections of COCs in the monitoring well on the property. No exceedances of screening levels in exterior soil vapor. No detections of COCs in drinking water.	MW-4-18

BP WEAVER WOODLANDS ALLOTMENT
NEW FRANKLIN, OHIO

TABLE 7-3

PROPERTIES (EUS) RETAINED PENDING ADDITIONAL DATA COLLECTION

Property Identification		Data Collected on Property						
Street No.	Street Name	Monitoring Well	Soil Boring	Exterior Soil Vapor	Subslab Vapor	Drinking Water	Rationale	Monitoring Wells on Property
5260	Kaylin Dr.	●				●	Plume mapping indicates groundwater impacts may extend onto property. No detections of COCs in groundwater. No detections of COCs in drinking water.	RI-MW-4-17
5270	Kaylin Dr.	●				●	Plume mapping indicates groundwater impacts may extend onto property. No exceedances of MCLs/RSL in the monitoring well on the property. No detections of COCs in drinking water.	RI-MW-4-15
300	Maywood Dr.					●	Plume mapping indicates groundwater impacts may extend onto property. No monitoring well on the property. No detections of COCs in drinking water.	
303	Maywood Dr. (vacant parcel)	●					Plume mapping indicates groundwater impacts may extend onto property. Single low-level detection of naphthalene >RSL in M5-3 once since 2011; no detections of other COCs.	M5-3
339	Maywood Dr.	●				●	Plume mapping indicates groundwater impacts may extend onto property. Sporadic low-level detections historically in both wells; single low-level detection of naphthalene >RSL once in each well in 2015. No detections of COCs in drinking water.	M4-1, RI-DMW-4-12

Notes:

1) MCL - Maximum Contaminant Level for Benzene, Ethylbenzene, Toluene, and Total Xylenes. USEPA Regional Screening Level (RSL, June 2017) used for naphthalene since no MCL exists.

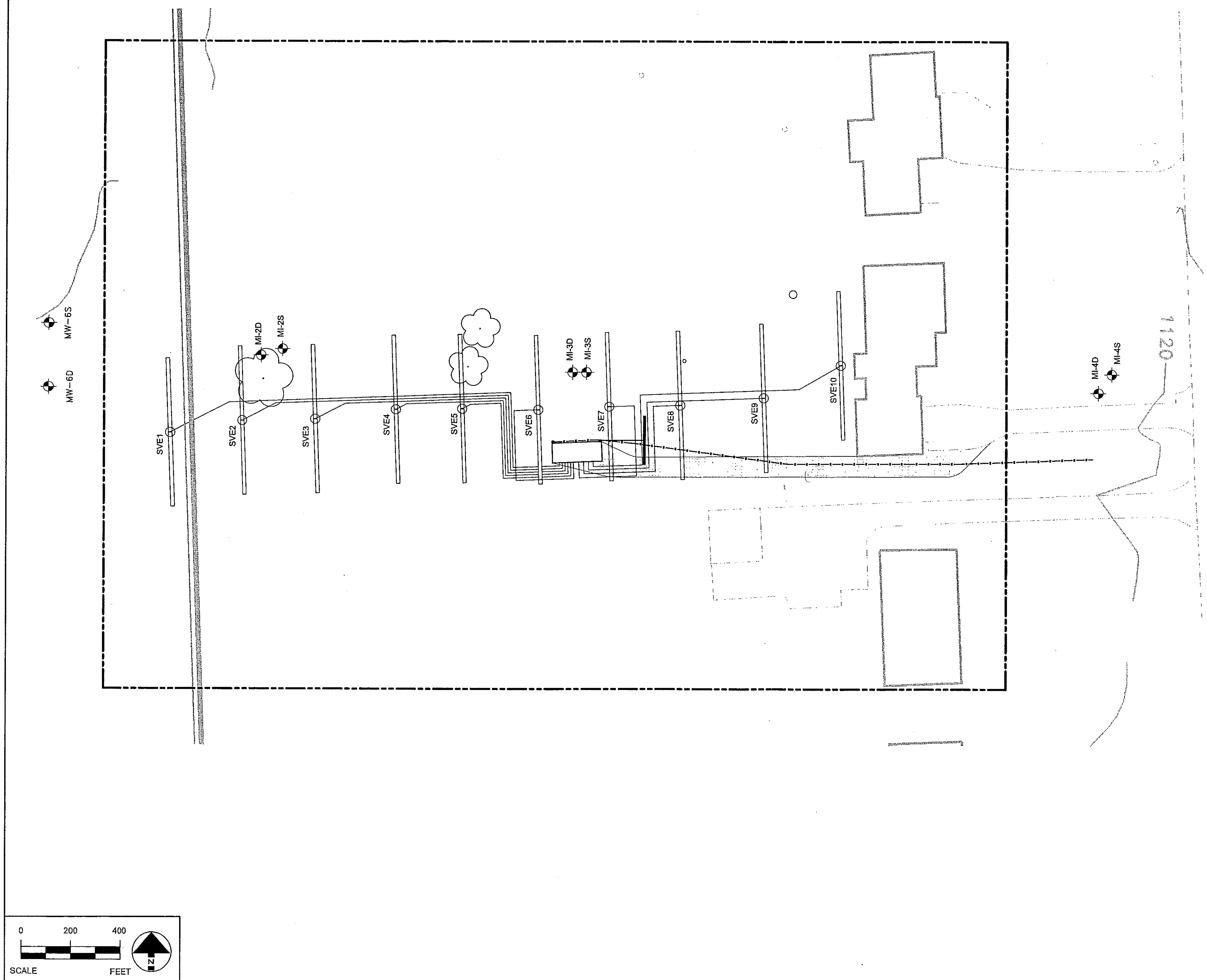
2) VISL - Vapor Intrusion Screening Level (USEPA, June 2017).

3) MW - Monitoring Well

4) COC - Chemical of Concern

APPENDIX B

Source Reduction Remediation System Layouts



LEGEND

- EXISTING TREE
- TRANSFER PIPING
- EXTRACTION TRENCH
- SVE10 RISER PIPE LOCATION
- ELECTRICAL CONDUIT
- DRY WELL FOR INCIDENTAL WATER
- EXISTING MONITORING WELL

URS

BP OIL PIPELINE / INLAND COORPORATION

FRANKLIN TOWNSHIP, SUMMIT COUNTY, OHIO

GENERAL REMEDIATION SYSTEM LAYOUT AC-1

DRAWN BY:	CHECKED BY:	PROJECT NO:	DATE:	FIGURE NO:
YRC	DE	13811639	10/22/07	3-14A

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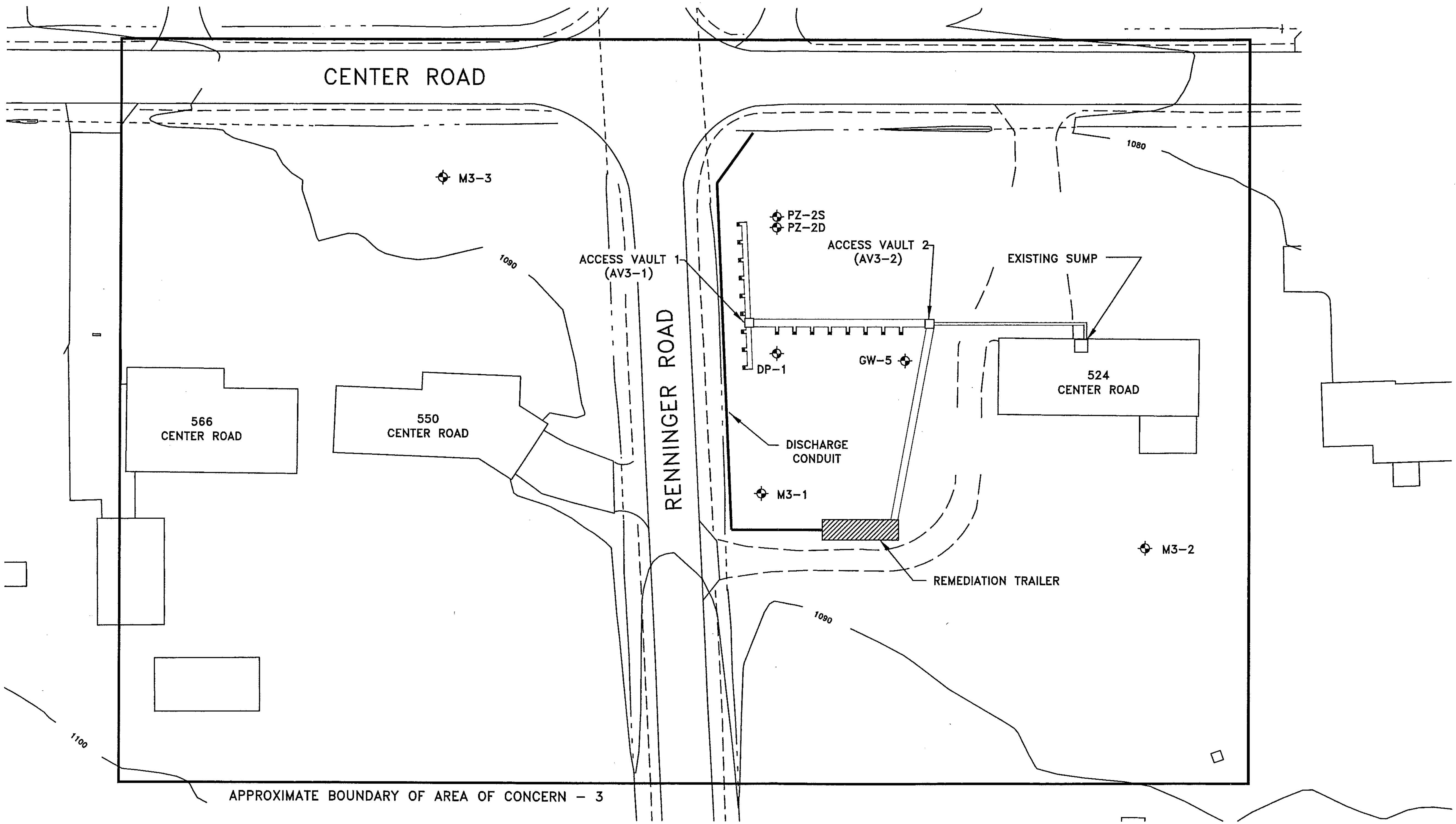
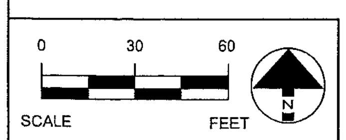


LEGEND

GW-1 ⌖ GROUNDWATER MONITORING WELL



URS

BP OIL PIPELINE / INLAND COORPORATION

FRANKLIN TOWNSHIP, SUMMIT COUNTY, OHIO

GENERAL REMEDIATION SYSTEM
LAYOUT AC-3

DRAWN BY:	CHECKED BY:	PROJECT NO:	DATE:	FIGURE NO:
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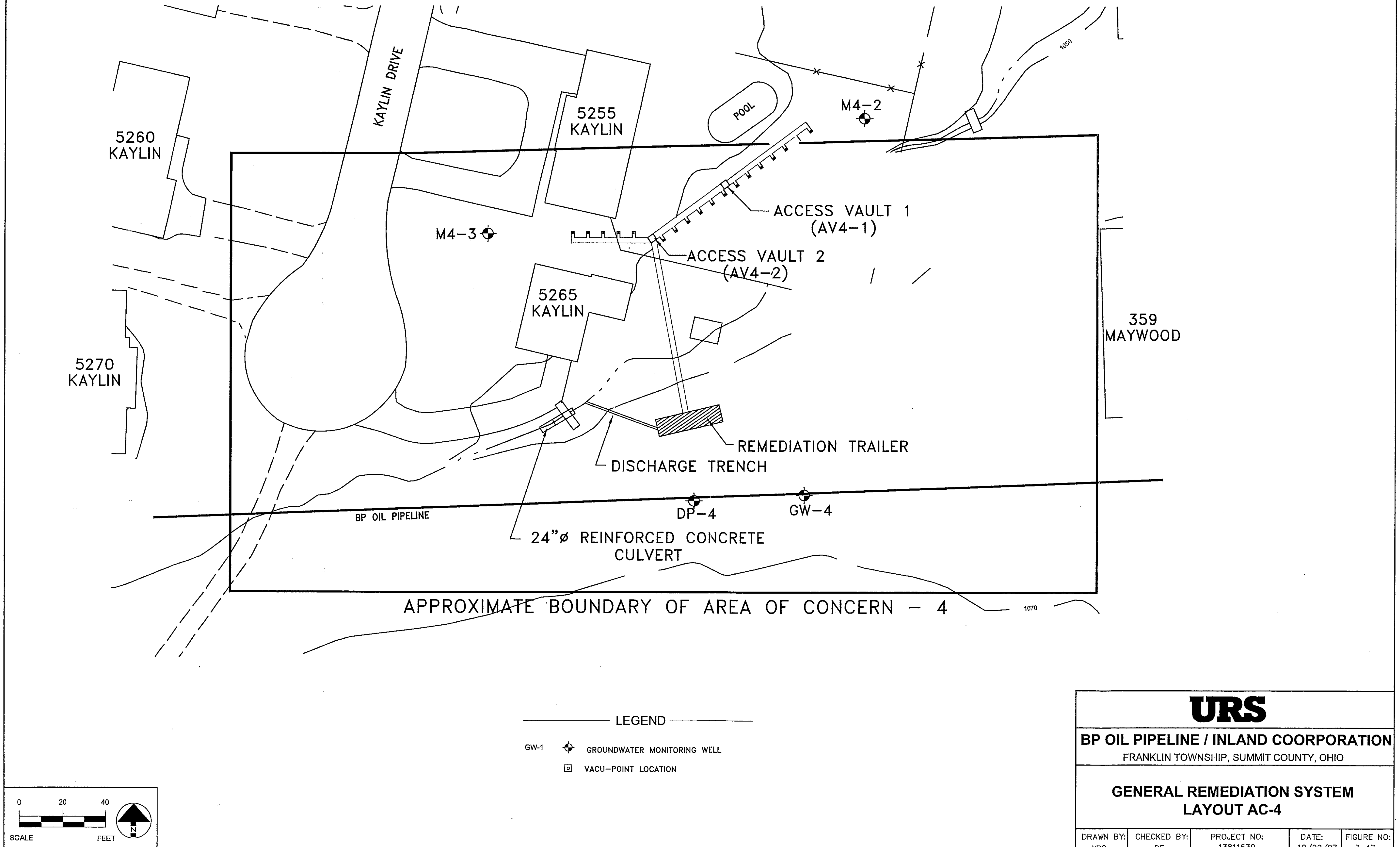

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BP OIL PIPELINE / INLAND COORPORATION

FRANKLIN TOWNSHIP, SUMMIT COUNTY, OHIO

GENERAL REMEDIATION SYSTEM LAYOUT AC-4

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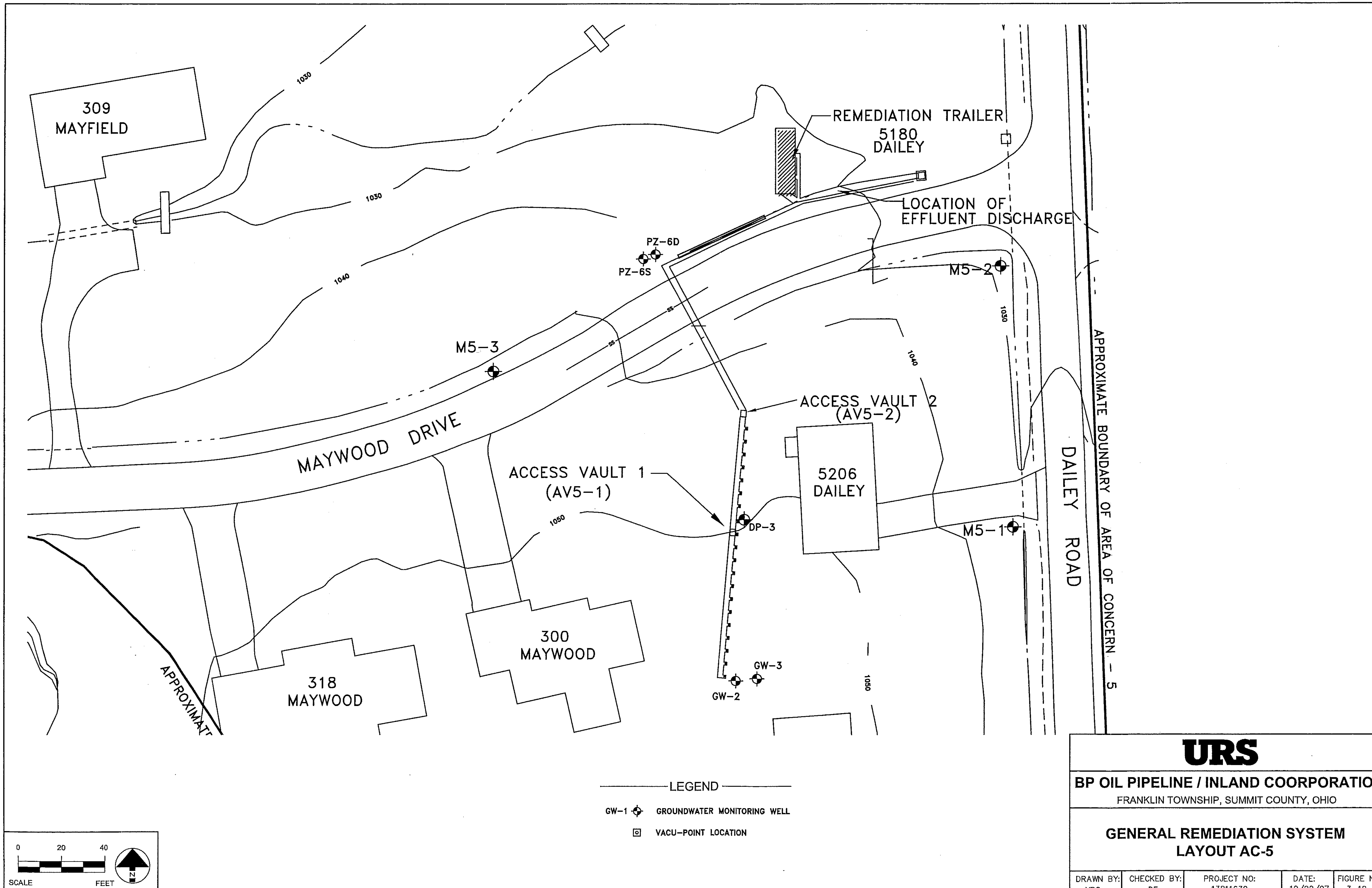

URS

BP OIL PIPELINE / INLAND COORPORATION

FRANKLIN TOWNSHIP, SUMMIT COUNTY, OHIO

GENERAL REMEDIATION SYSTEM
LAYOUT AC-5

DRAWN BY:	CHECKED BY:	PROJECT NO:	DATE:	FIGURE NO:
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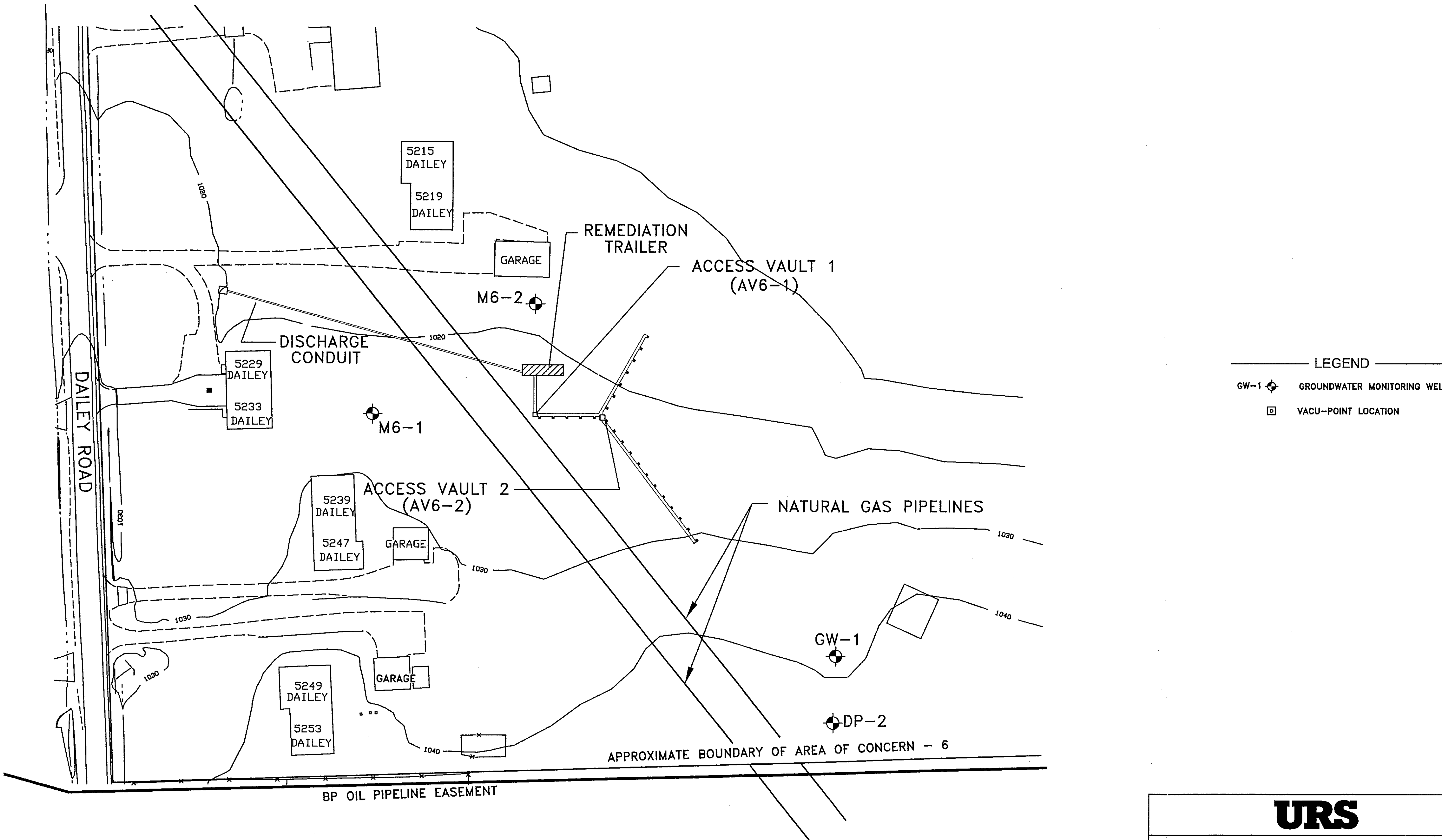

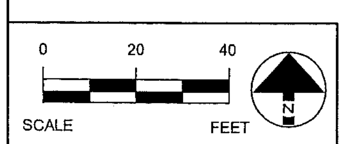

URS

BP OIL PIPELINE / INLAND COORPORATION

FRANKLIN TOWNSHIP, SUMMIT COUNTY, OHIO

GENERAL REMEDIATION SYSTEM LAYOUT AC-6

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APPENDIX C

Resolving Petroleum Vapor Intrusion Concerns

Memorandum

To: Greg Frisch, Remediation Management Services Company

From: Eric Nichols, Substrata LLC

Subject: Resolving Petroleum Vapor Intrusion Concerns at the Weaver Woodlands Franklin Township Site

Date: September 14, 2021

cc: Leslie Steele, Andrew Kirkman

This memorandum documents the proposed approach for resolving concerns related to the potential for volatile petroleum constituents to migrate from dissolved or LNAPL subsurface petroleum hydrocarbons (PHC) sources into overlying or nearby buildings or structures, a process known as petroleum vapor intrusion (PVI). This memorandum constitutes Appendix C for the site Feasibility Study. The objectives of the proposed approach are to:

- Identify areas where PVI concerns exist,
- Further assess those areas to determine whether a compete PVI pathway exists, and
- For locations where PVI exposures are likely to occur, develop and implement mitigation measures or other corrective actions to prevent PVI exposures.

Ohio EPA guidance recommends a stepwise approach to evaluate the significance of vapor intrusion, using multiple lines of evidence, as illustrated in Figure C-1 (Ohio EPA 2020). This approach summarized in this appendix uses concepts and methods consistent with state guidance.

Identifying Areas with PVI Concerns

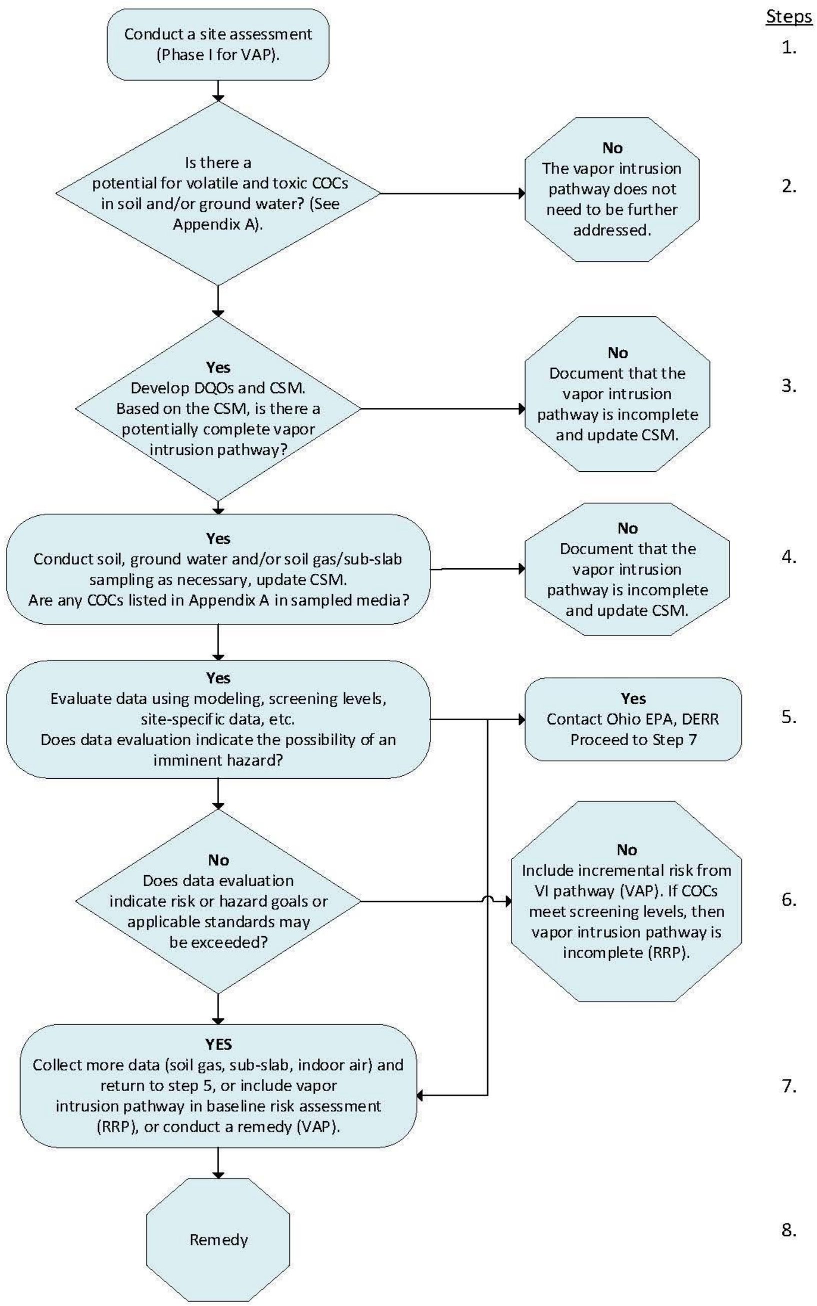
The potential for a complete vapor intrusion pathway depends on factors such as current or future land use, distance between contamination and existing or proposed buildings, preferential migration pathways, and whether contaminant plumes are stable (Ohio EPA 2020). A vapor intrusion concern generally exists where there is: 1) a potential or confirmed source of a sufficiently volatile and toxic chemical or chemicals; 2) a current or future mechanism to transport the chemical; and 3) a current or future human receptor.

In contrast to chlorinated solvents that degrade slowly under anaerobic conditions, PHCs generally biodegrade rapidly under aerobic conditions (U.S. EPA 2015). Due to the effectiveness and speed of aerobic biodegradation in biologically active soils, Ohio EPA Division of Environmental Response and Revitalization (DERR) recommends the use of lateral and vertical separation distances for PVI sites with relatively small petroleum releases such as underground storage tank (UST) sites, to streamline the VI evaluation.

Ohio EPA guidance specifies that:

“For relatively small releases comprised of only petroleum hydrocarbon (PHC), such as underground storage tank (UST) sites, a lateral separation distance of 30 feet and a vertical separation distance of 15 feet (above LNAPL) or 6 feet (above dissolved sources) can be applied instead of the default 100 feet. Sites with a potential for larger petroleum releases, such as bulk plants, refineries, petrochemical plants, or pipelines, or sites where lead scavengers were used or stored should use the 100 feet lateral separation distance recommended for non-PHC VOCs." (Ohio EPA 2020)

Figure C-1. Stepwise Approach for Evaluation the Vapor Intrusion Pathway (Ohio EPA 2020)



For petroleum contamination at sites with a potential for larger releases[1], the State recommends that VI concerns be addressed under the State's more general vapor intrusion guidance, or by using U.S. EPA PVI guidance (U.S. EPA 2015). For larger petroleum release sites, the State recommends that vapor concerns be identified using a default 100-foot lateral separation distance, the same distance recommended for non-PHC VOCs.

The subject site is a larger petroleum release under the State guidance. Therefore, for the purpose of identifying areas where PVI concerns may exist, a 100-ft distance from a vapor-intrusion based screening level will be used.

The applicable screening levels under Ohio EPA guidance are the U.S. EPA Vapor Intrusion Screening Levels (VISLs) for residential receptors. Table C-1 lists the VISLs for key volatile petroleum chemicals of potential concern.

Table C-1. Vapor Intrusion Screening Levels (VISLs) for Selected Volatile Petroleum Hydrocarbons

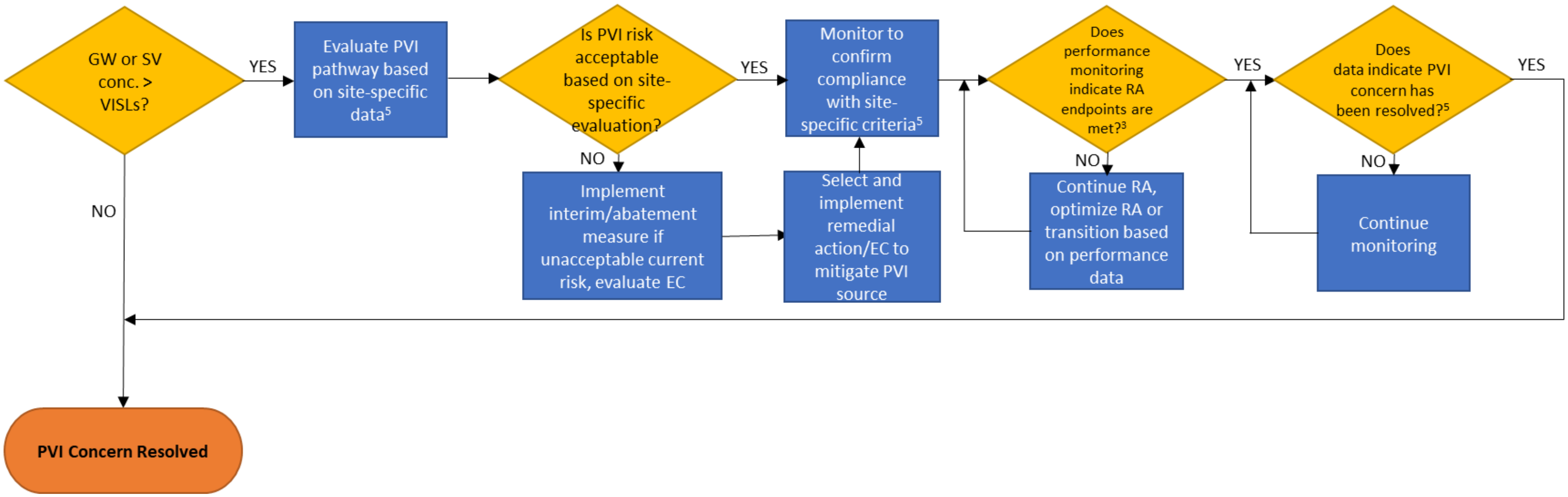
Chemical	Target Indoor Air Concentration (µg/m³)	Toxicity Basis	Target Sub-Slab and Near-source Soil Gas Concentration (µg/m³)	Target Groundwater Concentration (µg/L)	Target Groundwater Concentration < MCL?
Benzene	3.60	NC	120	29.7	No (5)
Ethylbenzene	11.2	CA	374	77.2	Yes (700)
Naphthalene	0.826	NC	27.5	127	--
Toluene	5,210	NC	174,000	39,200	No (1000)
Xylene, m-	104	NC	3,480	794	--
Xylene, o-	104	NC	3,480	1,110	--
Xylene, p-	104	NC	3,480	825	--

Notes:
VISL values based on target individual excess cancer risk of $1x10^{-5}$ and target hazard quotient of 1.0, whichever is lower.
Temperature assumed to be 11°C.
NC = noncancer
CA = cancer

[1] Ohio EPA (2020) cites examples of such sites as "refineries, petrochemical plants, terminals, aboveground storage tank farms, bulk plants, pipelines, and large scale fueling and storage operations at federal facilities, sites where lead scavengers were used or stored, or sites with releases of non-petroleum chemicals including comingled plumes of petroleum and chlorinated solvents regardless of the source".

For parcels where VISLs are exceeded in soil gas or groundwater samples, and where occupied structures exist within 100 ft, the following process will be used to verify and address PVI concerns. The general approach is summarized in the flowchart shown in Figure C-2.

Figure C-2. Decision Process for Resolving Vapor Intrusion Concerns



Notes:

[3] Performance metrics and remediation technology endpoints to be established during remedy design

[5] Process for parcel-specific PVI evaluation & metrics for demonstrating compliance with site-specific criteria /RAO as outlined in this appendix

EC = engineering control

RA = remedial action

Assessing PVI Pathway Completeness

The process described in Ohio EPA guidance to address large potential petroleum releases is similar to the process used for non-petroleum vapor intrusion concerns. Non-petroleum vapor intrusion concerns often include recalcitrant volatile chemicals, such as certain chlorinated solvents. Because volatile petroleum constituents tend to aerobically biodegrade and attenuate in the subsurface, the approach outlined in this appendix also makes use of methods and concepts contained in PVI-specific guidance from the U.S. EPA and ITRC (U.S. EPA 2015; ITRC 2014).

Due to the demonstrated tendency for petroleum vapors to bioattenuate in the subsurface, the use of VISLs to identify locations with potential PVI concerns is very conservative. An exceedance of a VISL only indicates a *potential* PVI concern, rather than a complete PVI pathway. Bioattenuation often "cuts off" the pathway in the subsurface, eliminating the concern (ITRC 2014).

To evaluate PVI pathway completeness where VISLs are exceeded in soil gas or groundwater samples, and where occupied structures exist within 100 ft, multiple lines of evidence may be considered, including:

- **Soil gas profiling.** As shown in the generalized conceptual model of the PVI pathway (Figure C-3), aerobic biodegradation of methane and other volatile petroleum compounds tends to create a sharp vertical transition between aerobic and anaerobic conditions in the vadose zone. Above this transition, oxygen is present in soil gas, and carbon dioxide tends to be elevated due to production from methane oxidation within and below the transition zone. Methane and other hydrocarbon gases tend to be absent. Below the transition, oxygen tends to be depleted, and methane and other hydrocarbons tend to be enriched, often in concentrations above VISLs.

  Soil gas depth profiles may be generated using multi-level vapor monitoring probes. These profiles would indicate whether an aerobic/anaerobic transition zone exists in the subsurface, and its approximate depth. These soil gas profiles would be compared to vertical screening distances suggested by U.S. EPA and ITRC to evaluate whether these screening distances are appropriately conservative for use at the site (U.S. EPA 2015; ITRC 2014).

  Soil gas probes would be sampled at least semi-annually to evaluate seasonal variability. Analyses would include EPA Method TO-15 for volatile organic chemicals and EPA Method 3C for fixed gases.

- **Sub-slab sampling.** For buildings that overlie petroleum vapor sources, another potential line of evidence is the installation and sampling of sub-slab probes with analysis by EPA Method TO-15 for volatile organic chemicals. Sub-slab probes are more likely to be deployed in buildings that overlie an LNAPL source rather than a dissolved-phase source. Seasonal sampling results from sub-slab soil gas probes would be compared to sub-slab VISLs to evaluate pathway completeness.

- **Indoor air sampling.** Indoor air samples are normally collected after other environmental samples (e.g., sub-slab or near-surface soil gas) indicate the need to conduct an internal building-specific assessment. Indoor air sampling is another potential line of evidence that assess the occurrence of volatile petroleum hydrocarbons above indoor air targets and the need for response actions. Twenty-four-hour time-integrated samples would be collected and analyzed for TO-15 compounds. Because many volatile compounds may occur in indoor air, due to common in-building uses such as fuel storage, hobbies, cleaning agents, etc., indoor air sampling would be preceded by a survey for the presence of source of volatile chemicals within the building. One or more background outdoor air samples would also be collected.

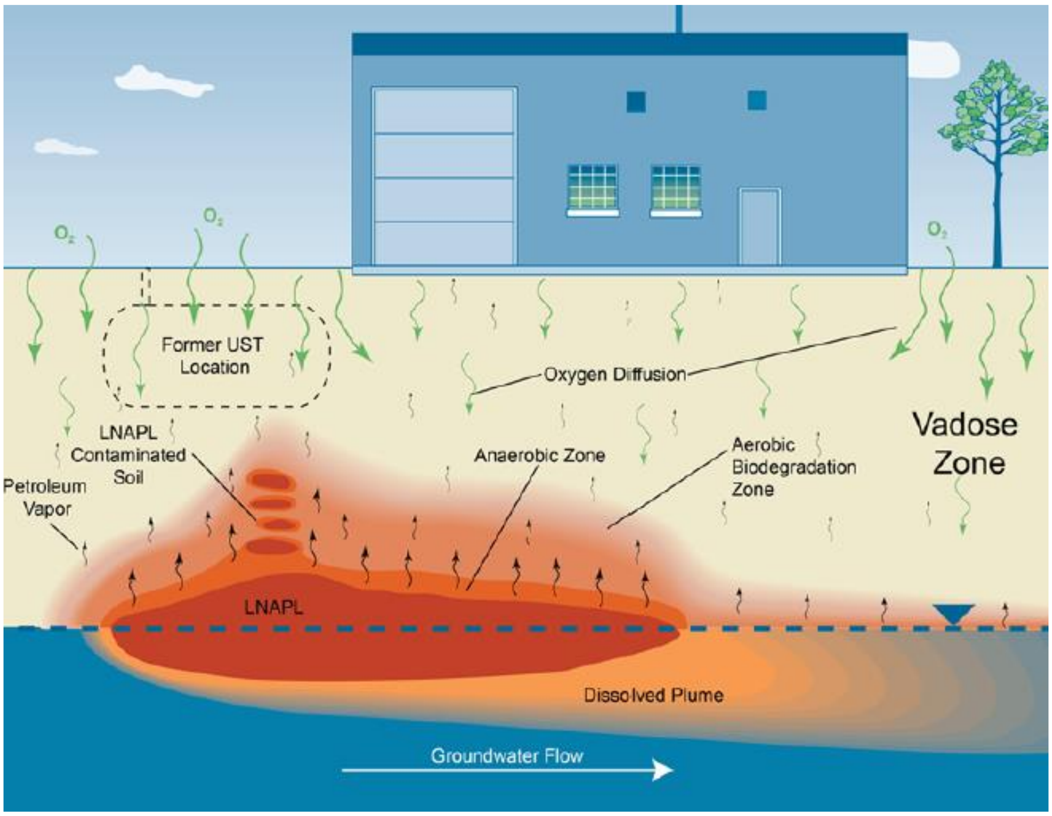


Figure C-3. Generalized conceptual model of the PVI pathway

- **Modeling.** To assist in interpreting the soil gas profiling data, a computational model of subsurface petroleum vapor migration may be used. The model would be calibrated to site-specific soil gas data and would provide supplemental lines of evidence regarding the significance of aerobic bioattenuation and its effect on soil gas depth profiles and potential PVI exposures.

  The proposed model is PVIScreen, developed by the U.S. EPA (2016). PVIScreen extends the concepts of a prior PVI model (BioVapor), which accounted for oxygen-driven biodegradation of multiple constituents of petroleum in the soil above the water table (API 2010). PVIScreen can automatically vary uncertain parameters within expected ranges, providing a range of outcomes and an assessment of the probability of an adverse level of exposure. The model has been tested against the BioVapor code and applied to case examples in Utah and Oklahoma. Model simulations agree with EPA's Petroleum Vapor Intrusion Database, which contains field data that illustrate and document the attenuation of concentrations of petroleum compounds in soil gas with distance above the source of the vapors (U.S. EPA 2013, 2016).

- **Distance-based screening.** If the preceding lines of evidence indicate that distance-based screening is appropriate for the site, PVI concerns may be addressed using vertical screening distances. The selection of appropriate screening distances for LNAPL and dissolved-phase vapor source would consider default values suggested by Ohio EPA, U.S. EPA, and ITRC (Ohio EPA 2020; U.S. EPA 2015; ITRC 2014). If site-specific data indicates that none of these default values are sufficiently conservative, site-specific vertical screening distances would be developed using soil gas profiles supplemented with modeling.

Each of these lines of evidence would be conducted following the methods and procedures discussed in U.S. EPA (2015) and ITRC (2014).

Assessing the Origin of Petroleum Vapors

Other potential sources of petroleum vapors and methane exist within the general site area. Where other nearby sources exist (such as natural gas pipelines and sanitary sewers) the CSM may be refined using forensic analytical methods. These methods may include analyses of light hydrocarbons (including methane, ethane, ethene, and n-propane), mercaptans, non-hydrocarbon volatile organic compounds, and fixed gases.

For example, natural gas is predominantly methane, but may contain detectable concentrations of light hydrocarbons consisting of 2 to 4 carbon atoms (C2-C4), such as ethane, ethene, propane, propene, butane, and butene. In contrast, anaerobic biodegradation of subsurface LNAPL tends to produce predominantly methane and carbon dioxide. Light C2-C4 hydrocarbons are often absent or depleted in weathered subsurface petroleum LNAPL, especially middle distillates such as diesel. The presence of non-methane light hydrocarbons could indicate a potential natural gas source of petroleum vapors. Detectable mercaptans (the odorant used in natural gas) are in indication of a natural gas leak where it is a residential supply line. Elevated soil gas pressures, or nitrogen below typical atmospheric levels, may suggest that soil gas has been displaced by biodegradation gases, sewer gases, or a natural gas leak.

The proportion of methane to ethane, and the proportion of methane to carbon dioxide, can help indicate whether methane in the subsurface is from natural gas or from the biodegradation of refined hydrocarbons.

Design and Implement PVI Mitigation Measures

If the lines of evidence discussed above indicate there are parcels with existing or future buildings where indoor air targets are exceeded, or are likely to be exceeded in the future, response actions will be developed and implemented to prevent adverse PVI exposures.

Response actions may include environmental remediation, building mitigation measures, and institutional controls (ICs) to reduce or prevent PVI from occurring. Site-wide remedies are long-term solutions to PVI; while building mitigation measures are generally used as short-term or interim remedies, implemented until the long-term or site-wide remedy has achieved protective remedial endpoints.

Table C-2 lists a variety of potential PVI mitigation technologies, along with typical applications, challenges, and costs.

Table C-2. Summary of mitigation methods (ITRC 2014)

Technology	Typical applications	Challenges	Range of installation costs (per ft^2) (1)
Active system			
Subslab depressurization (SSD)	Most structures: sumps, drain tiles, aerated floors, and block wall foundations may also be depressurized if present.	Low permeability and wet soils may limit performance; otherwise, highly effective systems; may require a discharge permit	\$2–\$10/ft^2; residential systems typically in the \$2-4/ft^2 range
Subslab ventilation (SSV) or Crawl space venting	New and existing structures relies more on influencing air flow over depressurization.	Low permeability and wet soils may limit performance; otherwise, highly effective systems; may require a discharge permit	\$2–\$10/ft^2; residential systems typically in the \$2-4/ft^2range
Submembrane depressurization (SMD)	Existing structures, crawl spaces	Sealing to foundation wall, pipe penetrations; membranes may be damaged by occupants or trades people accessing crawl space.	\$1–\$6/ft^2; residential systems typically in the \$1.50–\$2/ft^2 range
Subslab pressurization (SSP)	Same as SSD; most applicable to highly permeable soils	Higher energy costs (not included) and less effective than SSD, potential for short-circuiting through cracks	\$1–\$5/ft^2
Building pressurization	Commercial structures that are specifically designed	Requires regular air balancing and maintenance; may not maintain positive pressure when building is unoccupied and may have high O&M costs	\$1–\$15/ft^2; heavily dependent on size and complexity of structure
Passive barrier			
Asphalt/latex membrane	Typically limited to new construction priorto flooring being installed and crawl spaces. Retrofitting abuilding is possible with the installation ofan additional protective barrier.	Preventing tears and holes in the liner during installation; may not suffice as a stand- alone technology; Must be chemically compatible with the COC.	\$3.00–\$7/ft^2 for the system which includes liner costs of \$2.00–\$6/ft^2 and a passive venting system cost of \$0.75–\$2/ft^2 *please see Note (2)

Technology	Typical applications	Challenges	Range of installation costs (per ft^2) [(1)]
Thermoplastic liner	Typically limited to new construction priorto flooring being installed and crawl spaces. Retrofitting abuilding is possible with the installation ofan additional protective barrier.	Preventing tears and holes inthe liner during installation; may require seaming and taping; addressing subsurface penetrations; may not suffice as a stand-alone technology; limited vapor resistance testing avail-able; may not suffice as a stand-alone technology.	\$2.00–\$7/ft^2 for the system which includes liner costs of \$0.50–\$5/ft^2 and a passive venting system cost of \$0.75–\$2/ft^2 *please see Note (2)
Epoxy floor seal-ant system	Retrofitting an existing structural slab in which a spray or roll isapplied to seal floor surfaces	Existing surface preparations (oil and grease free, level, competent); ensuring total or complete coverage; preventing tears, holes by building use; surface wearability and durability depending on application; may require subsurface venting as well as venting during placement.	\$1.00–\$7/ft^2 cost varies on the amount of surface preparations and leveling required. System may also need additional costs of a passive venting system cost (\$0.75–\$2/ft^2)
Passive Venting			
Subslab venting; perforated pipe/low-profile vent and gravel layer	New construction. Existing construction would require additional surface protection	Relies on advective flow of air due to wind and heat stack effects; does not continuously operate; air flows and suction typically far less than achievedby active systems; limited regulatory acceptance.	\$0.75–\$5/ft^2 plus the additional cost of an engineered base consisting of sand or gravel
Aerated flooring	New construction, complete floor replacement or floor overlays.	Relies on advective flow of air due to wind and heat stack effects to increase the oxygen; fans may be required to achieve additional air flows and suctions	New Construction \$2–\$2.75 /ft^2 *please see Note (2)
Other			
Indoor air treatment	For marginal or low impacts, immediate response actions to address vapor (short term) and/or expected short time frames for a completed remedial action.	Typically generates a waste disposal stream; effective capture of air contaminants may be difficult; energy-intensive, with significant O&M burden	Costs are highly variable dependent upon the building layout, number of rooms, contaminant, concentration, and overall size in addition tothe type of technology employed. \$15,000–\$25,000 per application is not atypical for treatment of a single 2,000 square foot area.

Technology	Typical applications	Challenges	Range of installation costs (per ft^2) [(1)]
Sealing the building envelope		May not be effective long term	\$2.50–\$6/ft^2; cost varies depending on surface preparations

Notes:

(1) Costs for many of these technologies may be outside the ranges listed above due to many factors (i.e.,regional contractor rates, regulatory review, access issues, O&M, etc.)

(2) Estimated costs do not include the cost of any required additional protective barriers or construction overlays (\$2.00–\$4 /ft^2) not anticipated through normal construction practices

The most likely mitigation technology that would be applied at this site is active subslab depressurization. This technology is readily retrofitted to existing structures, is relatively unintrusive, and has been proven to be effective at many sites, including the sump venting / depressurization system at 5239/5247 Dailey Road at the subject site, as discussed in Feasibility Study Section 1.2.4.2 to which this appendix memo is attached.

Active mitigation would continue until near-surface and subslab soil gas concentrations remain below VISLs (the endpoints for PVI mitigation). Indoor air and soil gas monitoring would continue for at least two monitoring periods after active mitigation has ceased, to confirm that protective endpoints are maintained.

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APPENDIX D

Hydrographs for Monitoring Wells RI-MW-1-20 and M4-3

BP WEAVER WOODLANDS ALLOTMENT
NEW FRANKLIN, OHIO

APPENDIX D

LNAPL GAUGING DATA, MONITORING WELL M4-3

LOCATION	Coordinates		ELEVATION AT TOP OF CASING (Feet MSL)[1]	Date	DEPTH TO LNAPL (Feet)[2]	DEPTH TO WATER (Feet)[3]	LNAPL THICKNESS (Feet)	LNAPL ELEVATION (Feet MSL)	LNAPL/ GROUNDWATER INTERFACE ELEVATION (Feet MSL)	CORRECTED GROUNDWATER ELEVATION (Feet MSL)[5]
	X	Y								
M4-3	2231492.7500	468209.8200	1064.24	Nov-15	NMI[4]	9.56	0.00	1054.68	1054.68	1054.68
				Apr-16	NMI	6.60	0.00	1057.64	1057.64	1057.64
				Aug-16	NMI	9.63	0.00	1054.61	1054.61	1054.61
				Sep-16	NMI	9.95	0.00	1054.29	1054.29	1054.29
				Nov-16	NMI	9.63	0.00	1054.61	1054.61	1054.61
				Mar-17	NMI	7.67	0.00	1056.57	1056.57	1056.57
				Apr-17	NMI	8.00	0.00	1056.24	1056.24	1056.24
				Oct-17	NMI	11.11	0.00	1053.13	1053.13	1053.13
				Apr-18	6.27	9.00	2.73	1057.97	1055.24	1057.23
				Jun-18	9.28	9.38	0.10	1054.96	1054.86	1054.93
				Sep-18	9.56	9.79	0.23	1054.68	1054.45	1054.62
				Oct-18	NMI	9.55	0.00	1054.69	1054.69	1054.69
				3/15/19	NMI	7.82	0.00	1056.42	1056.42	1056.42
				4/18/19	NMI	7.77	0.00	1056.47	1056.47	1056.47
				6/20/19	NMI	5.90	0.00	1058.34	1058.34	1058.34
				10/17/19	12.11	12.68	0.57	1052.13	1051.56	1051.98
				10/22/19	12.12	12.21	0.09	1052.12	1052.03	1052.10
				11/14/19	NMI	11.74	0.00	1052.50	1052.50	1052.50
				12/16/19	NMI	10.91	0.00	1053.33	1053.33	1053.33
				6/10/20	NMI	8.57	0.00	1055.67	1055.67	1055.67
				6/15/21	NMI	9.70	0.00	1054.54	1054.54	1054.54

1. Elevations referenced to Mean Sea Level (MSL)
2. LNAPL - Light non-aqueous phase liquid
3. Depth to fluids measured from the north side of the top of well casing.
4. NMI - No measurable interface
5. Groundwater elevation corrected for the presence of LNAPL, where appropriate (API Publication 1628, 3rd Ed., Washington D.C., July 1996)

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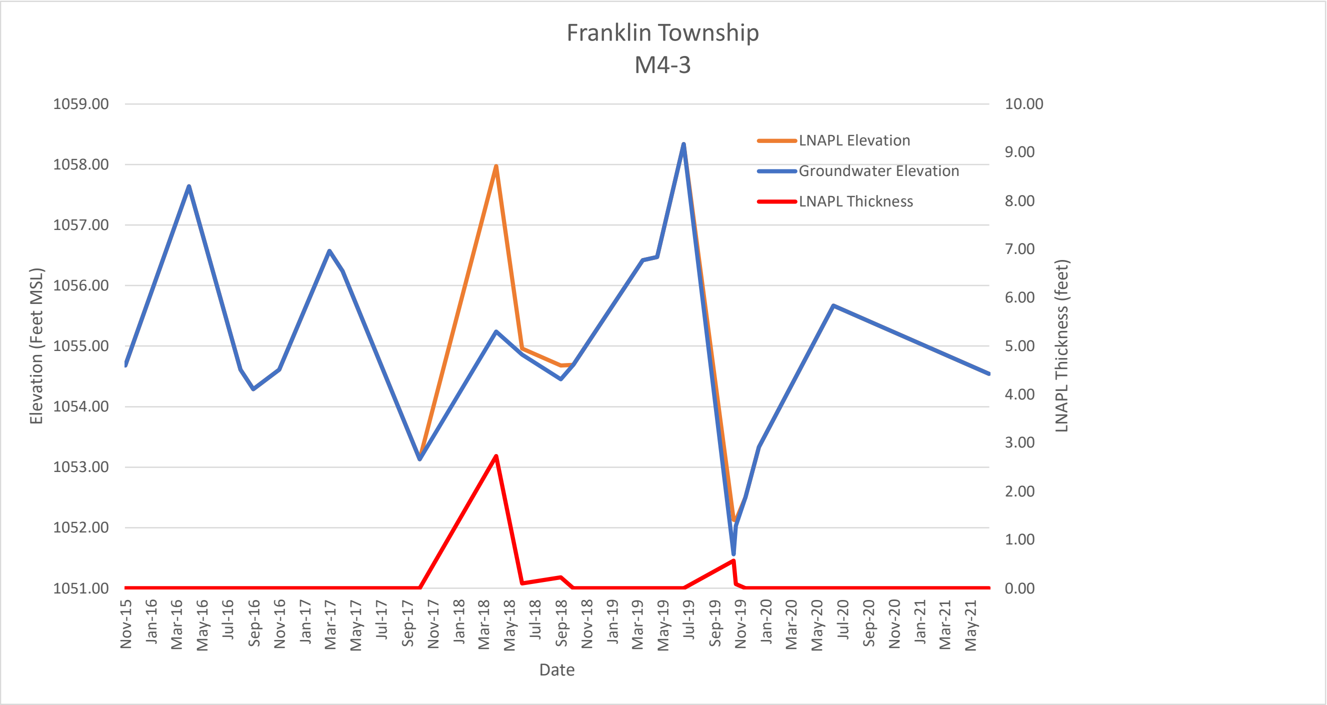
LNAPL GAUGING DATA, MONITORING WELL M4-3



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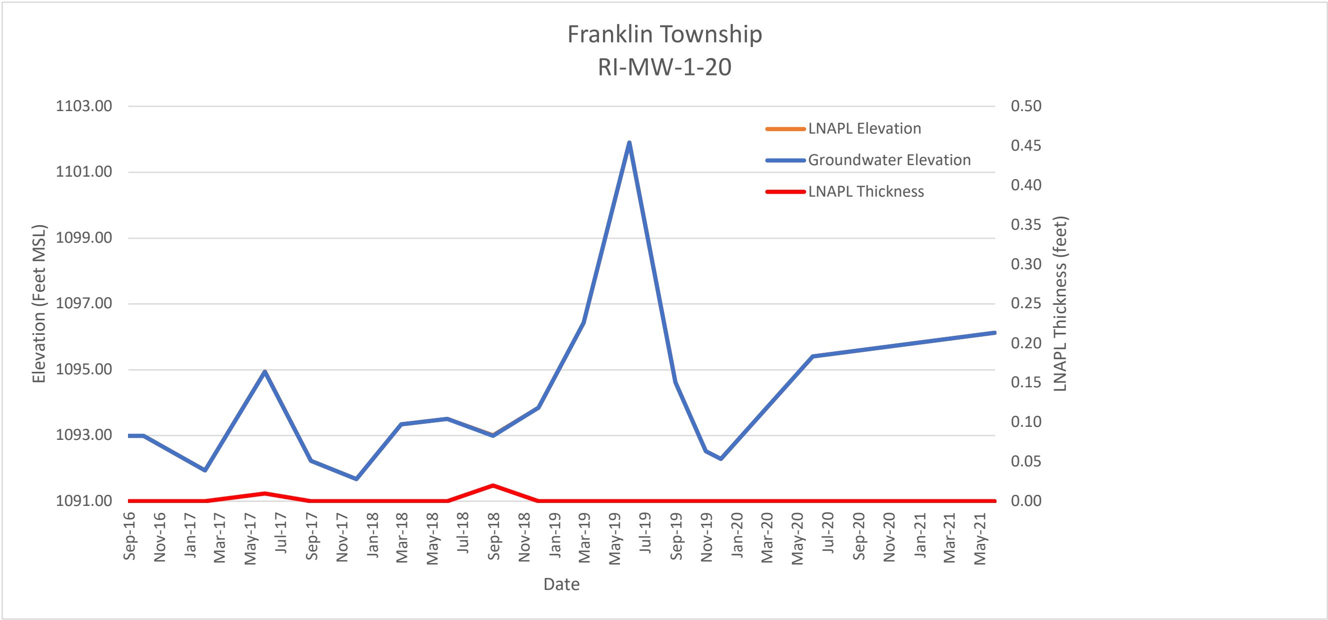
LNAPL GAUGING DATA, MONITORING WELL RI-MW-1-20

LOCATION	Coordinates		ELEVATION AT TOP OF CASING (Feet MSL)[1]	Date	DEPTH TO LNAPL (Feet)[2]	DEPTH TO WATER (Feet)[3]	LNAPL THICKNESS (Feet)	LNAPL ELEVATION (Feet MSL)	LNAPL/ GROUNDWATER INTERFACE ELEVATION (Feet MSL)	CORRECTED GROUNDWATER ELEVATION (Feet MSL)[5]
	X	Y								
RI-MW-1-20	2229641.1290	468554.3770	1116.40	Sep-16	NMI[4]	23.41	0.00	1092.99	1092.99	1092.99
				Oct-16	NMI	23.41	0.00	1092.99	1092.99	1092.99
				Feb-17	NMI	24.46	0.00	1091.94	1091.94	1091.94
				Jun-17	21.45	21.46	0.01	1094.95	1094.94	1094.95
				Sep-17	NMI	24.17	0.00	1092.23	1092.23	1092.23
				Dec-17	NMI	24.73	0.00	1091.67	1091.67	1091.67
				Mar-18	NMI	23.06	0.00	1093.34	1093.34	1093.34
				Jun-18	NMI	22.89	0.00	1093.51	1093.51	1093.51
				Sep-18	23.39	23.41	0.02	1093.01	1092.99	1093.01
				Dec-18	NMI	22.55	0.00	1093.85	1093.85	1093.85
				Mar-19	NMI	19.97	0.00	1096.43	1096.43	1096.43
				Jun-19	NMI	14.50	0.00	1101.90	1101.90	1101.90
				Sep-19	NMI	21.79	0.00	1094.61	1094.61	1094.61
				Nov-19	NMI	23.88	0.00	1092.52	1092.52	1092.52
				Dec-19	NMI	24.11	0.00	1092.29	1092.29	1092.29
				Jun-20	NMI	21.00	0.00	1095.40	1095.40	1095.40
				Jun-21	NMI	20.28	0.00	1096.12	1096.12	1096.12

1. Elevations referenced to Mean Sea Level (MSL)
2. LNAPL - Light non-aqueous phase liquid
3. Depth to fluids measured from the north side of the top of well casing.
4. NMI - No measurable interface
5. Groundwater elevation corrected for the presence of LNAPL, where appropriate (API Publication 1628, 3rd Ed., Washington D.C., July 1996)

APPENDIX D

LNAPL GAUGING DATA, MONITORING WELL RI-MW-1-20



APPENDIX E

Compositional Evolution of the Petroleum Hydrocarbon Impacts at the Weaver Woodlands Allotment

Appendix E

Compositional Evolution of Petroleum Hydrocarbon Impacts and Applicability to the Weaver Woodlands Allotment Site, New Franklin, Summit County, Ohio

Active remedie(s) will be implemented in target areas of the Weaver Woodlands Allotment (Site) to address recalcitrant concentrations of constituents of interest. Additionally, natural degradation processes will supplement active remedies to achieve remedial objectives. While certain areas of the Site indicate hydrocarbon concentration trends that warrant active remediation, overall groundwater trends at the Site are consistent with Natural Source Zone Depletion (NSZD) as evidenced by reductions in groundwater hydrocarbon concentrations and generally stable / shrinking plume footprint since remediation system operation has ceased, as detailed within this Appendix. Future assessments at the Site may evaluate additional aspects of NSZD including bioattenuation of soil vapor, bulk hydrocarbon losses and compositional changes in the light non-aqueous phase liquid (LNAPL) source, observed indirectly through changes in dissolved phase concentrations. The NSZD evaluations will be utilized to refine the target areas where active remediation is warranted, and areas where active remediation would not be expected to improve upon remedial benefits already provided by ongoing natural processes, as well as providing a baseline for considering when to transition active remedies to NSZD / Monitored Natural Attenuation (MNA). This Appendix provides an overview of natural attenuation, NSZD and petroleum hydrocarbon physical and compositional changes which are documented at similar sites, in addition to discussion of how these phenomena are relevant to the continuing remediation at the Site, based on review of COC trends at select wells and plume evolution across the three project areas.

Overview of MNA and NSZD

MNA represents the natural processes that reduce mass, toxicity, concentration, or volume of contaminants in soil or groundwater. MNA is appropriate for sites with low potential for migration. MNA reduces the risk of harm through 1) transformation of contaminants to a less toxic form, 2) reduction of concentration and/or 3) reduction of contaminant mobility and bioavailability (U.S. EPA OSWER Directive 1999). NSZD (ITRC 2018; Garg et al. 2017) is consistent with MNA and describes the mass loss processes that occur within subsurface regions of soil and groundwater that contain petroleum LNAPL and incorporates the significance of recently identified biodegradation of petroleum vapors within soil (U.S. EPA 2015). While groundwater, soil vapor and LNAPL may be perceived as different concerns and risks, NSZD concepts identify how soil vapor is generated, biodegraded and depleted from the original source along with how groundwater concentrations of benzene or other constituents of interest reduce over time because of biodegradation and other loss mechanisms, changing the composition of the LNAPL source as it weathers (depletes).

While dissolved phase hydrocarbon mass and concentration decrease with distance from the source due to volatilization and biodegradation, changes in concentration at individual points over time represent changes more closely related to total plume mass over time (Newell et al., 2002). Depletion in vapor and dissolved phase components and mass are linked ultimately to source depletion as the origin of the hydrocarbons. This concept is illustrated in Figure E-1 which originated from a 2010 workshop provided by the U.S. EPA to China (Wilson, 2021). Sources that do not attenuate result in the concentration remaining the same, once the maximum concentration at that point is reached (Figure E-1 a,b). Where sources do attenuate, the concentration at a given point will decrease once a maximum concentration is reached. Therefore, decreases in point over time concentration trends are indicative of source zone depletion. This is true for active remedies (e.g., enhanced biodegradation, sparging) and natural attenuation remedies (i.e., MNA, NSZD). These patterns represent the basis for aspects of performance monitoring and decision making in remedy selection and optimization.

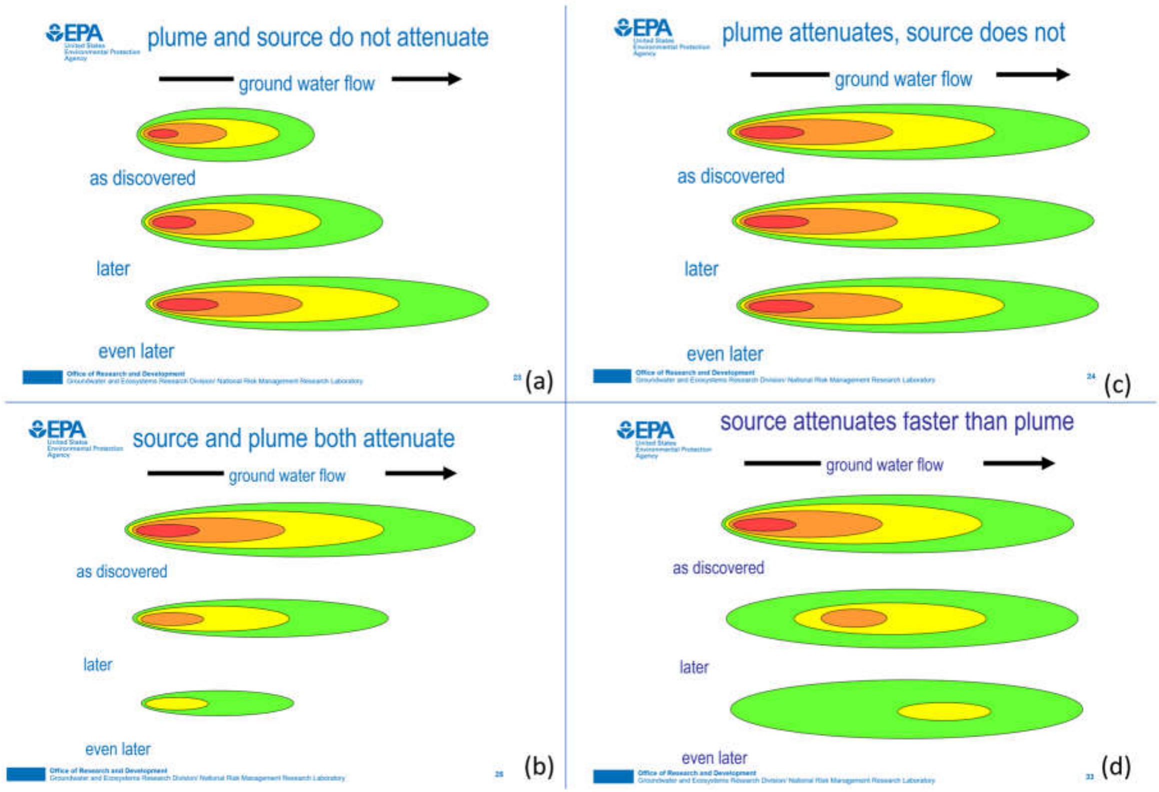


Figure E-1 Source Depletion and Natural Attenuation

<u>Residual and Mobile LNAPL</u>

Mobile versus residual (immobile) LNAPL is an important concept for understanding efficacy of petroleum remediation. Wells with mobile LNAPL also have an associated residual LNAPL source. Residual LNAPL in soil is like the water that will not drain out of a sponge. The smear zone is comprised up of residual LNAPL and mobile LNAPL and represents the source of petroleum constituents to the dissolved phase and to soil vapor. An illustration of residual LNAPL used by ITRC is provided as Figure E-2 and represents a well screen adjacent to sand. where the LNAPL fluoresces yellow and the non-yellow pores are water filled. As can be seen in the Figure, residual LNAPL can be observed below the oil/water interface in the well. Mobile LNAPL in the well corresponds to generally higher saturations of LNAPL in the adjacent sand. However, if this mobile LNAPL were removed, the saturations would only decline to a magnitude similar to the areas of residual LNAPL observed below.

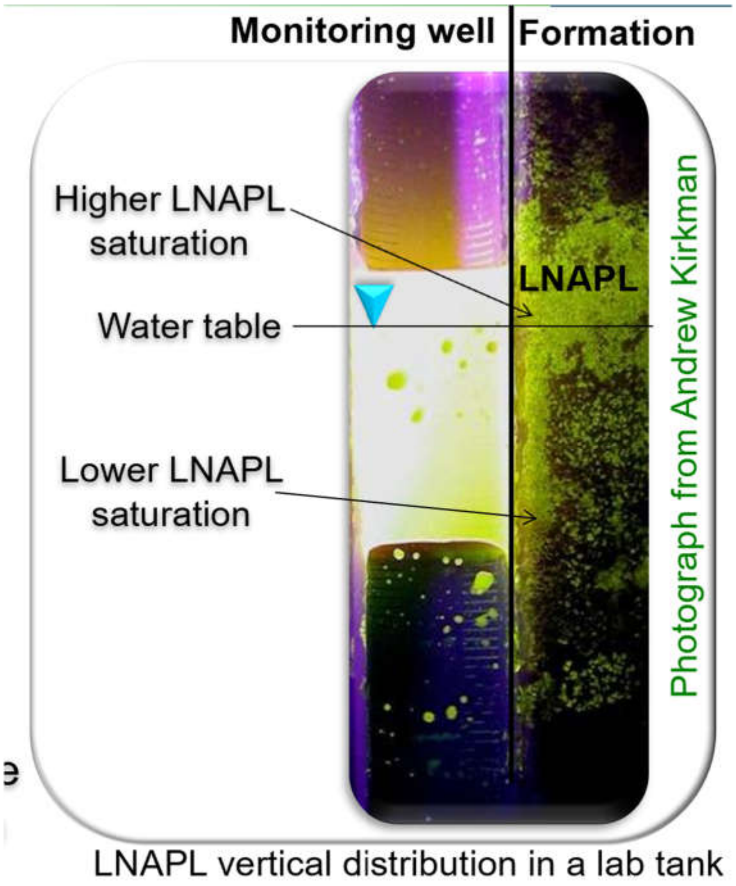


Figure E-2 LNAPL distributed across the water-table in a sand filled tank with a well screen, photograph taken by Andrew Kirkman, Figure from ITRC LNAPL-3 Web training 2020.

Both residual and mobile LNAPL result in groundwater impacts. The magnitude of these impacts is not controlled by whether the LNAPL is mobile or residual, rather by the composition of the LNAPL (ITRC, 2018).

LNAPL transmissivity is a measure of the mobility of LNAPL (ASTM, 2013 and ITRC, 2018). LNAPL transmissivity values below 0.8 ft2/day represent hydrocarbon sources that are dominated by residual LNAPL (ITRC, 2018). As LNAPL is recovered, the saturation is reduced and this in turn reduces the effective permeability of the LNAPL. The resulting reduction in transmissivity reduces the rate at which LNAPL is recovered for a given drawdown induced. This results in the LNAPL recovery rate declining, with zero recovery representing an asymptote rather than a practically achieved endpoint. As importantly, the LNAPL saturation that recovery drives towards does not asymptote at zero saturation, but rather at residual saturation value. LNAPL recovery reduces LNAPL saturation towards residual but the composition of the LNAPL and thickness of entire smear zone are unaffected by this effort.

Wells that are already close to residual saturation often exhibit intermittent LNAPL occurrences, where water-table fluctuations redistribute LNAPL vertically and LNAPL transitions from mobile under low-water table (lower water saturations) to residual under high water-table (higher water saturation conditions). At the Franklin Township site, intermittent mobile LNAPL occurs in one well in the Western Area and in two wells in the Central Area. For example, Central Area monitoring well M4-3 represents a well that is likely dominated by residual LNAPL based on the hydrograph behavior (Figure E-3 below), where mobile LNAPL is observed in the well during or following periods of low-water table. The nature of the LNAPL at well M4-3 and any other areas of intermittent mobile LNAPL occurrence will be confirmed via LNAPL transmissivity testing if measurable LNAPL thickness recurs, as well as other predesign investigation activities such as LNAPL composition analysis.

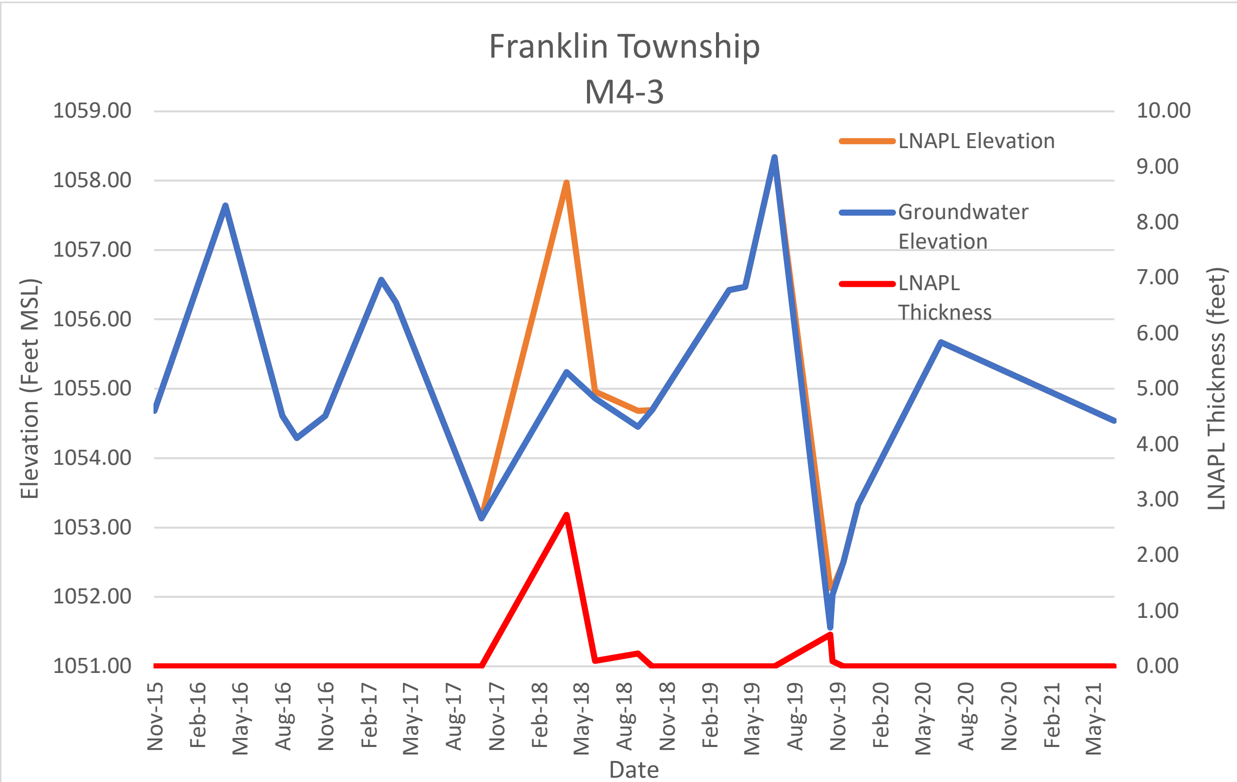


Figure E-3 M4-3 Hydrograph

NSZD

Microbes in direct contact with LNAPL can metabolize LNAPL constituents without transfer of the LNAPL to groundwater or soil gas. This is illustrated where low solubility, low volatility alkanes at the United States Geological Survey Bemidji Research site were preferentially degraded over more soluble components (Bekins et al., 2005). The microbes emit enzymes or biosurfactants that target the preferred substrates in the LNAPL itself. Microbes are also known to degrade dissolved hydrocarbons, based on MNA literature, as well as to degrade hydrocarbon vapors, based on petroleum vapor intrusion literature (EPA, 2015). The bulk of NSZD is expressed in terms of vertical transport of biodegradation reaction products (Garg et al., 2017). Hydrocarbon in LNAPL is anaerobically degraded to CO_2 and methane. Methane rises vertically in the vadose zone via diffusion and in the saturated zone via ebullition. Upon reaching oxygen in the vadose zone, the methane is then consumed by methanotrophs producing more carbon dioxide as well as a local increase in temperature. NSZD can be measured based on the efflux of CO_2, consumption of oxygen, magnitude of the heat signature, as well as the compositional change of the LNAPL (CRCcare, 2018).

The typical rates for NSZD measured at various sites are on the order of 700 gal/acre/year (Garg et al., 2017). In comparison using an example for vacuum truck removal from wells, ITRC estimates that approximately 36 gallons/year could be recovered with monthly events from a well with 2 $ft^{2/}$day LNAPL transmissivity (ITRC, 2020). In general, LNAPL recovery is not sustainable. As LNAPL is recovered, the saturation and mobility decreases, resulting in decreased recovery rates. Therefore, these initial recovery rates and the efficacy of LNAPL recovery would decrease as LNAPL is removed.

NSZD degrades both mobile and residual LNAPL, and enhanced biodegradation via bioventing or biosparging can enhance degradation of both mobile and residual LNAPL resulting in LNAPL compositional change. Therefore, these technologies do not asymptote towards zero mobility, but rather continue beyond zero LNAPL transmissivity to further treat residual LNAPL. Biodegradation enhanced or natural likely asymptotes towards zero saturation.

LNAPL baildown tests or other LNAPL transmissivity testing using ASTM methods will be used to assess mobile LNAPL occurrences for LNAPL transmissivity. If there are areas where the majority of LNAPL is practicably recoverable, recovery options such as skimming or multiphase extraction will be considered. Once LNAPL transmissivity has been reduced to a point where mobile LNAPL no longer represents the majority of the source and residual LNAPL initially dominates the LNAPL source zone, other technologies including biodegradation, sparging, and soil vapor extraction will be considered. This represents a treatment train approach that is scaled to the recoverability of the LNAPL source and quantified in terms of transmissivity. Transmissivity has been used for decades to represent the producibility of aquifers and is consistent with its application towards LNAPL recoverability assessment.

The behavior described above and documented in guidance will be used to identify the appropriate remedy for both mobile and residual LNAPL. If there are measurable LNAPL occurrences, LNAPL transmissivity will be tested at wells and compared to soil boring profile data to evaluate if the source is dominated by mobile or residual LNAPL. Alternative remedial approaches to treat mobile LNAPL with intermittent occurrence and low LNAPL transmissivity include natural and enhanced biodegradation.

Compositional Change

While the vertical expression and then measurement of CO_2, methane and oxygen utilization can be used to quantify the NSZD bulk rate, the compositional changes in LNAPL over time and location also represent the effects of NSZD. These effects have been documented historically as weathering (Galperin and Kaplan, 2011, Kaplan et al., 1996, and Douglas et al., 1996) where the order in which compounds degraded was documented and where it was identified that hydrocarbon chemical structure was more important than carbon number (molecular weight). In addition, the preference for certain compounds over others allowed for some estimates of fraction degraded and first order loss rates. Recently, these concepts have been incorporated into methods for estimating NSZD for individual LNAPL constituents (DeVaull et al., 2020 and Kirkman, 2021).

Two examples of this behavior are provided below. The first shows how gasoline may weather due to evaporation without biodegradation (Figure E-4). Note how toluene, trimethylbenzenes and naphthalene increase in relative concentration as other constituents are depleted through volatilization. This is similar to soil vapor extraction (SVE); however, SVE also enhances biodegradation as oxygen is drawn through the soil, so biodegradable compounds such as toluene are also removed.

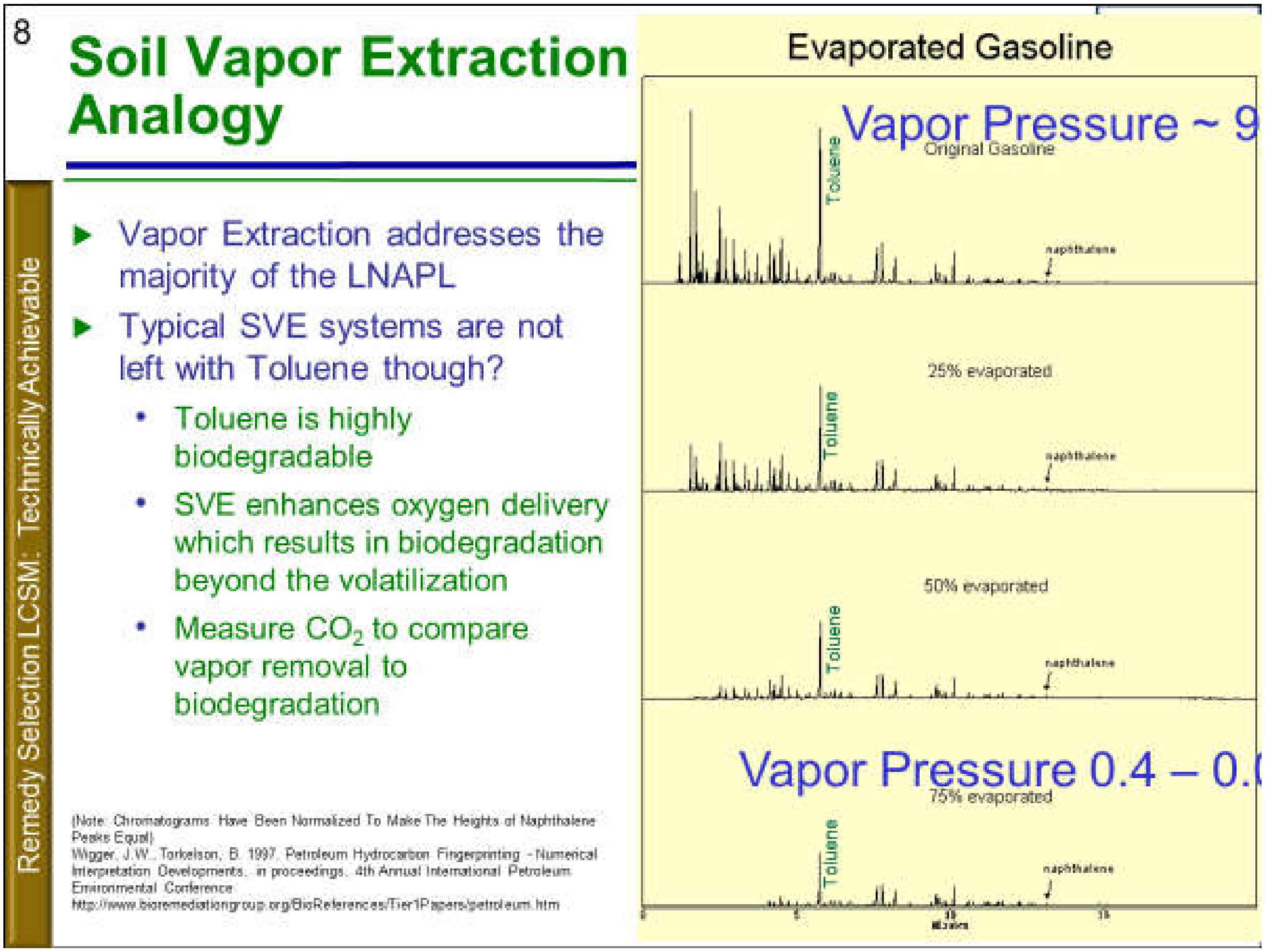


Figure E-4 Slide from ITRC LNAPL-3 training illustrating volatilization patterns in gasoline weathering.

The second example represents a crude oil weathering pattern due to a combination of volatilization, biodegradation, and dissolution naturally occurring at a site (Figure E-5). LNAPL recovery has occurred at this facility, but no other activities have occurred that would affect these processes. LNAPL samples from wells MW-179 in 2003 and HB-005 in 2020 illustrate how LNAPL has weathered over time and location. Isoparrafin-13 has increased in concentration as a result of its loss rate being less than the average of the hydrocarbon as a whole, while the benzene concentration in the LNAPL has decreased, since its loss rate is higher than the average loss of other components. Similarly, for A-041, 2 methyl pentane exhibited a decrease, while isoparrafin-13 increased in concentration. Benzene in the initial sample of this crude oil was already depleted.

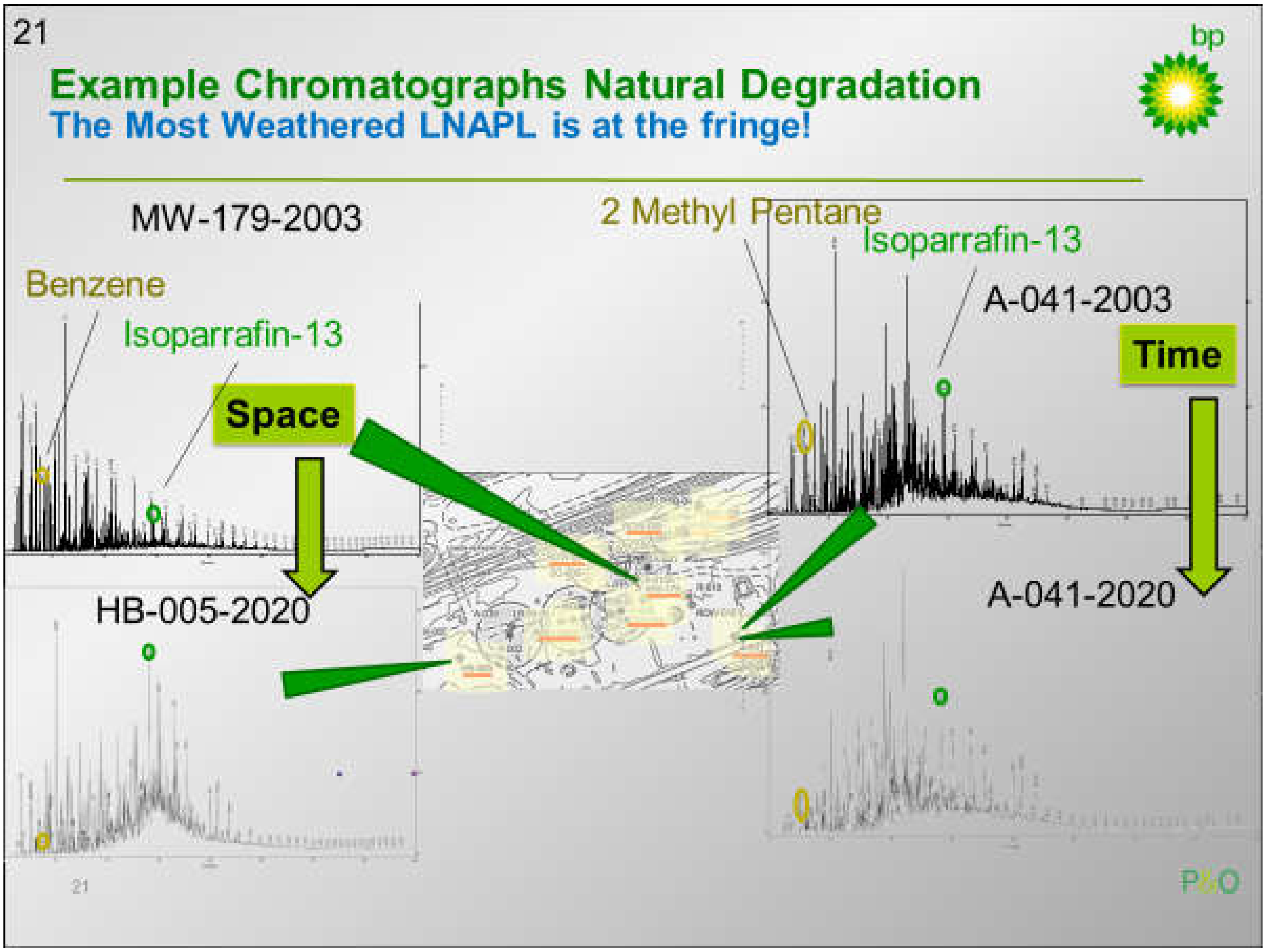


Figure E-5 Example Chromatograms representing weathered crude oil over time and space after Kirkman, 2021.

ITRC acknowledges the inherent physical and biological behaviors that result in certain compounds being depleted faster than others, inherently changing the composition of the LNAPL as it weathers. Figure E-6 represents a slide of documented hydrocarbon compound solubilities, vapor pressure and average measured aerobic biodegradation rates.

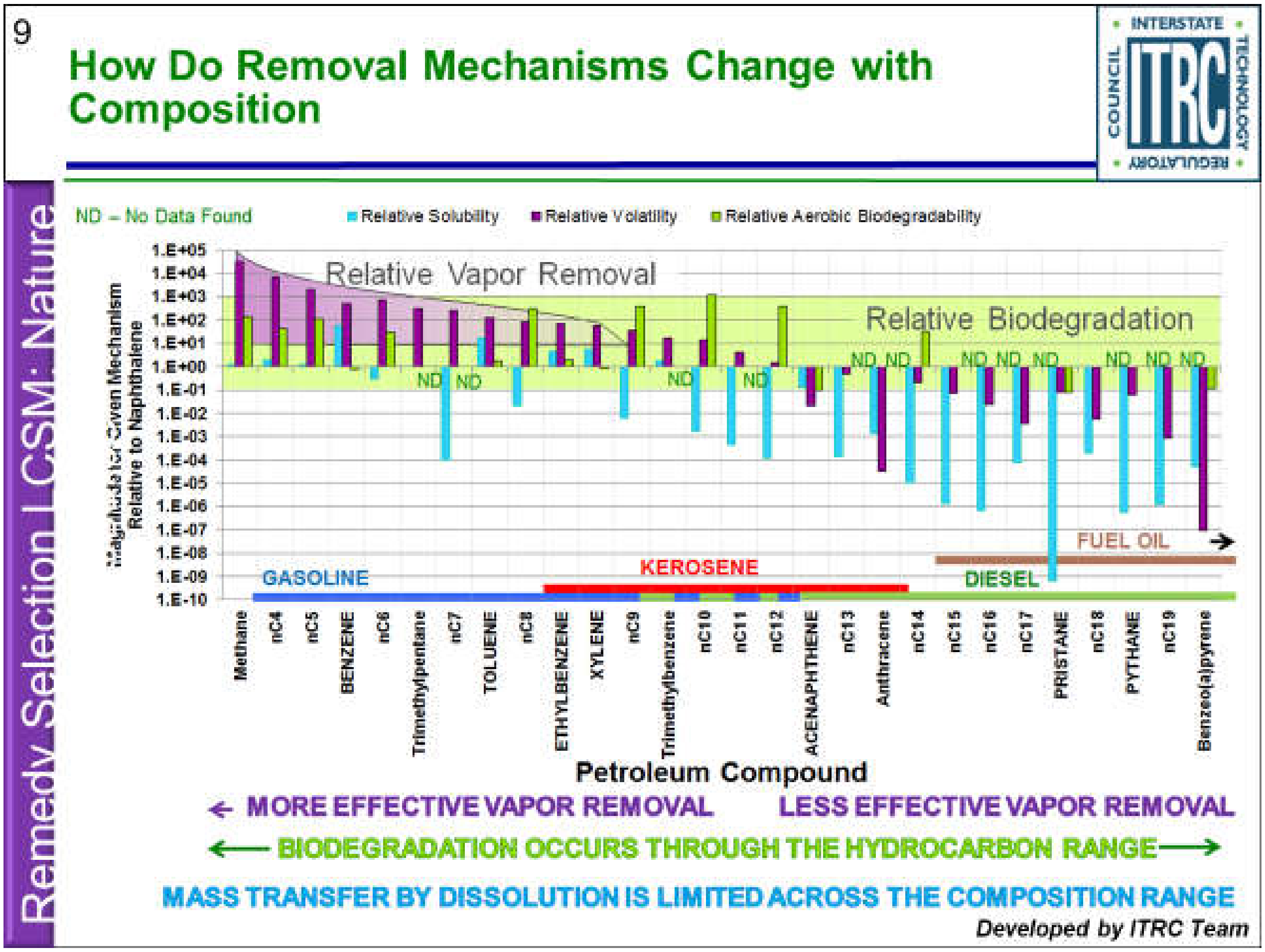


Figure E-6 Example properties related to natural losses for a range of hydrocarbon compounds after ITRC, 2020

NSZD rates for specific hydrocarbon components resulting from the combination of biodegradation, volatilization, and dissolution are summarized below in terms of half lives, based on LNAPL from the USGS Bemidji Research Site (Figure E-7).

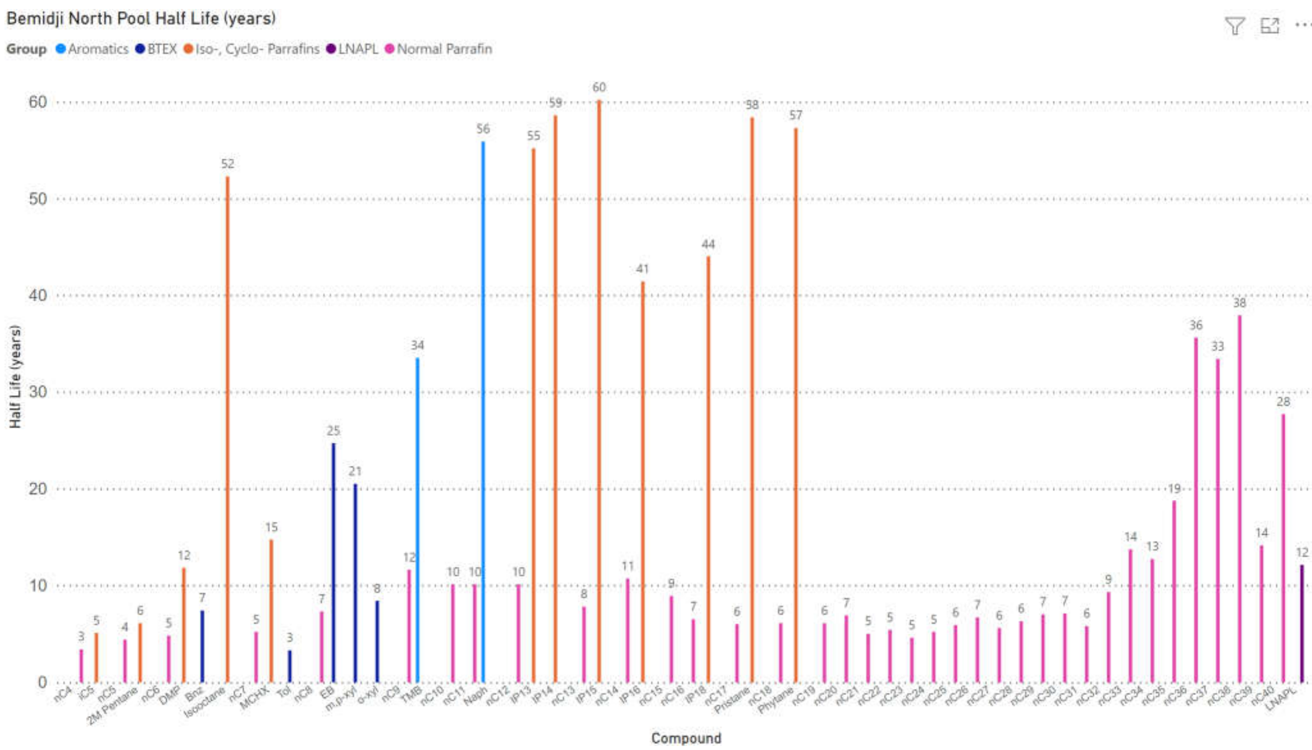


Figure E-7. Observed NSZD Rates for Specific Hydrocarbon Constituents, Bemidji Site (Bekins et al., 2005).

In the Bemidji case, it is useful to consider the benzene half life was 7 years, ethylbenzene was 25 years, and the LNAPL average was 12 years. Therefore, benzene concentrations in the LNAPL were decreasing. This type of effect would theoretically reduce the benzene dissolved phase concentration sourced from the LNAPL. Raoult's law indicates that as the concentration of benzene in the source LNAPL decreases, so does the effective solubility of benzene in water. This is why benzene concentrations in groundwater sourced from gasoline are typically much lower than the pure phase solubility of benzene, which is approximately 1790 mg/l. Additionally, since the ethylbenzene NSZD rate is slower than the average of the LNAPL, ethylbenzene concentration in LNAPL would likely be increasing and result in a relative increase in dissolved phase ethylbenzene concentrations over time.

Evaluation of Plume Evolution

GWSDAT

GWSDAT is a software package developed by Shell Global Solutions to visualize groundwater monitoring data over time and space. It is an open-source freeware package available on Github or through other websites such as American Petroleum Institute. The software provides visualization of plume evolution over space and time in two-dimensional areal plots as well as time series graphs for individual wells for a given constituent. GWSDAT has been used to evaluate spatial COC distribution as well as time-series trends in the Western, Central and Eastern areas of the Site, as presented herein.

__**Western Area**__

Time series representations of benzene, toluene, ethylbenzene, and naphthalene in groundwater have been reviewed that include an initial time interval from 2008 and time series from 2016 through 2021.

This time series data is summarized in Figure E-8 below. The SVE system in the Western Area shut down in May 2004. The Western Area was partially delineated in 2008; complete delineation occurred in 2016. Therefore, the plume evolution focused on dates following cessation of remediation system operation and following complete delineation in 2016. The time series pattern observed in Figure E-8 is consistent with a decreasing concentration trend over time and source attenuation. A closer review of individual wells can be completed using time series graphs (Figure E-9). The Time series graphs support generally decreasing concentrations, except for wells such as MW-6S and RI-MW-1-10. Well MW-6S exhibits large fluctuations potentially associated with bedrock geology, where RI-MW-1-10 does not exhibit a clear decline in concentrations.

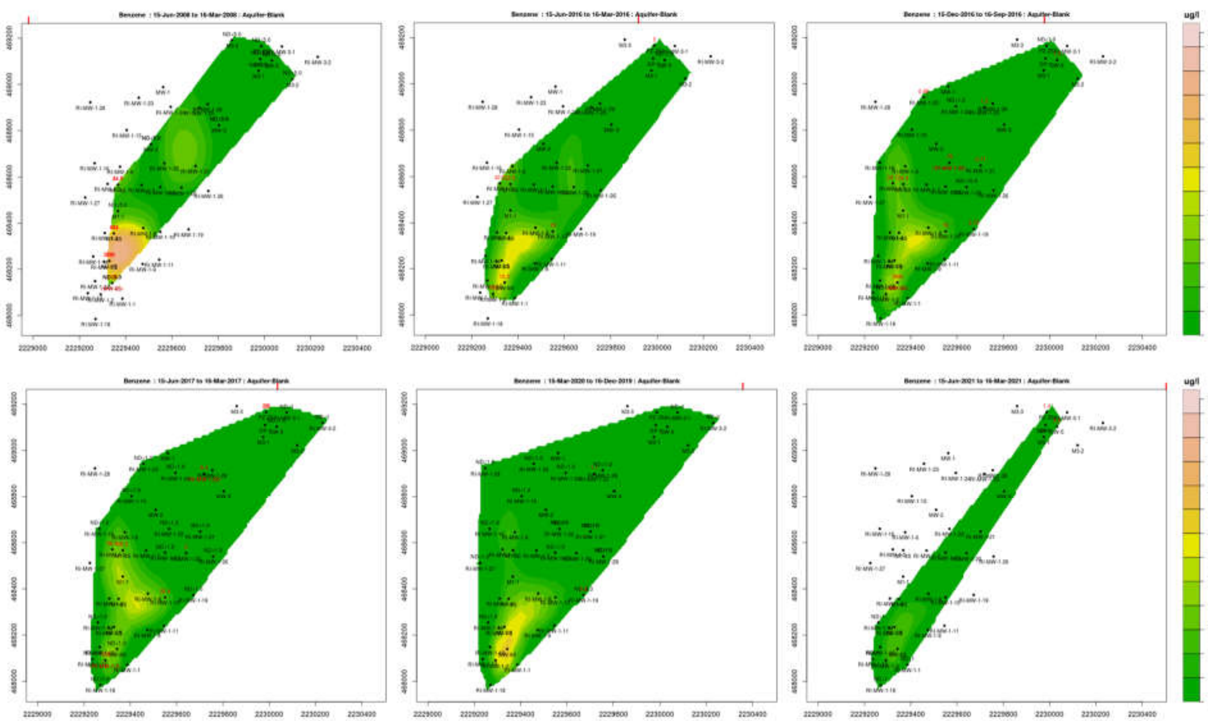


Figure E-82 Benzene Concentration in Groundwater from 2006 to 2021, Western Area.

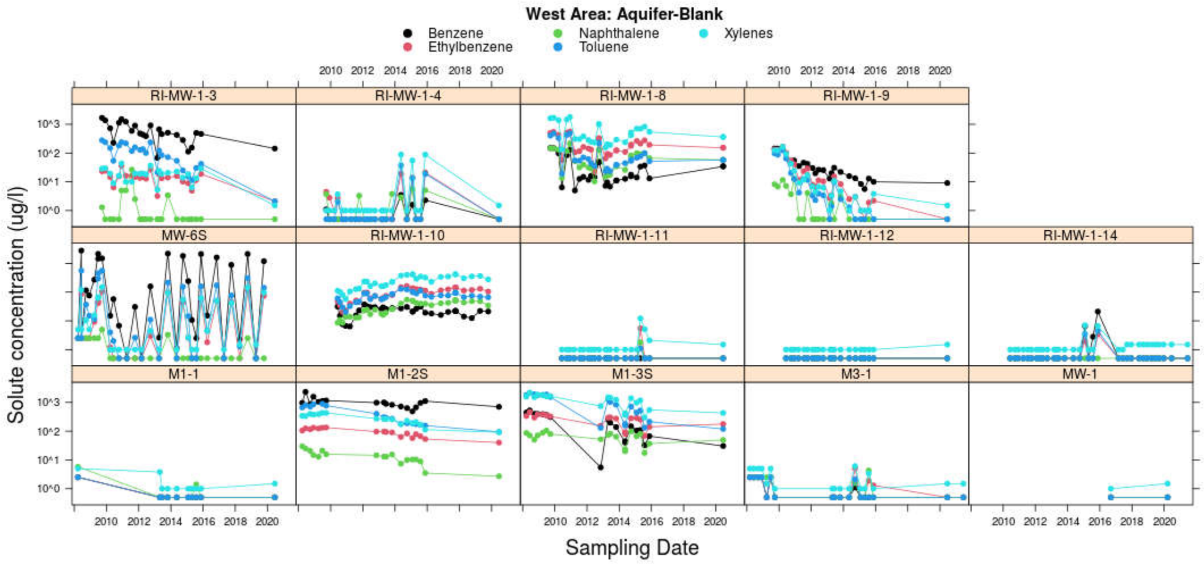


Figure E-93 Trends in Chemical Concentrations in Specific Monitoring Wells, Western Area

Both review of spatial plots over time and qualitative analysis of individual well concentration-time trends will be used to evaluate the performance of natural mechanisms in source attenuation to distinguish areas where natural degradation may be sufficient as the primary remedy, from target areas where an active remedy will be implemented as the primary remedy before transition to natural degradation may occur as the source is depleted, with examples provided below.

Declining concentrations with time are illustrated in time series graphs for benzene for wells M1-2S, M1-3S, RI-MW-1-3, RI-MW-1-9, therefore natural degradation may be occurring at a sufficient rate to be selected as the primary remedy in the vicinity of these and other wells with similar trends. Figure E-10 shows the time series logarithmic scale graph for benzene concentrations at M1-3S which exemplifies this behavior, showing a half-life of less than 3 years, and indicating the location of the well on the benzene spatial plot from first quarter 2020.

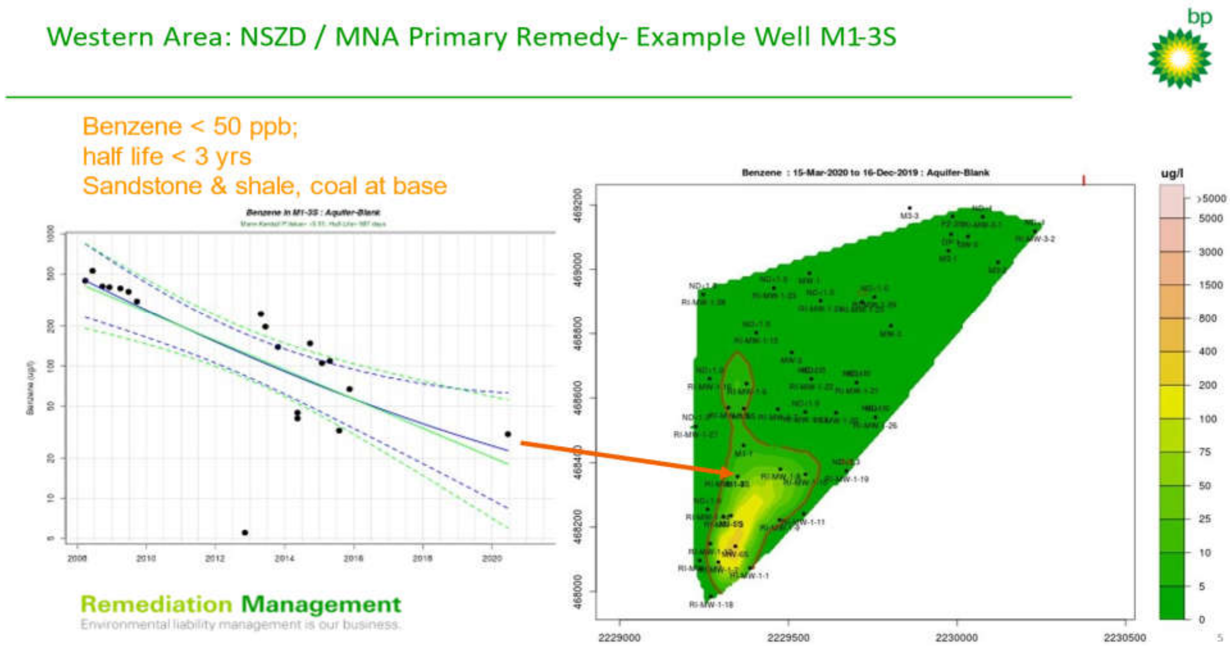


Figure E-10 Trends in Benzene Concentrations in Monitoring Well M1-3S, Western Area

Wells not exhibiting clear declines over time for benzene include RI--MW-1-10, RI-MW-1-8, and MW-6S; therefore, these and other wells with similar concentrations and trends are considered target areas for active remedies. Figure E-11 shows the time series logarithmic scale graph for benzene concentrations at MW-6S which exemplifies this behavior with a half-life greater than 5 years, and the location of the well on the benzene spatial plot from first quarter 2020.

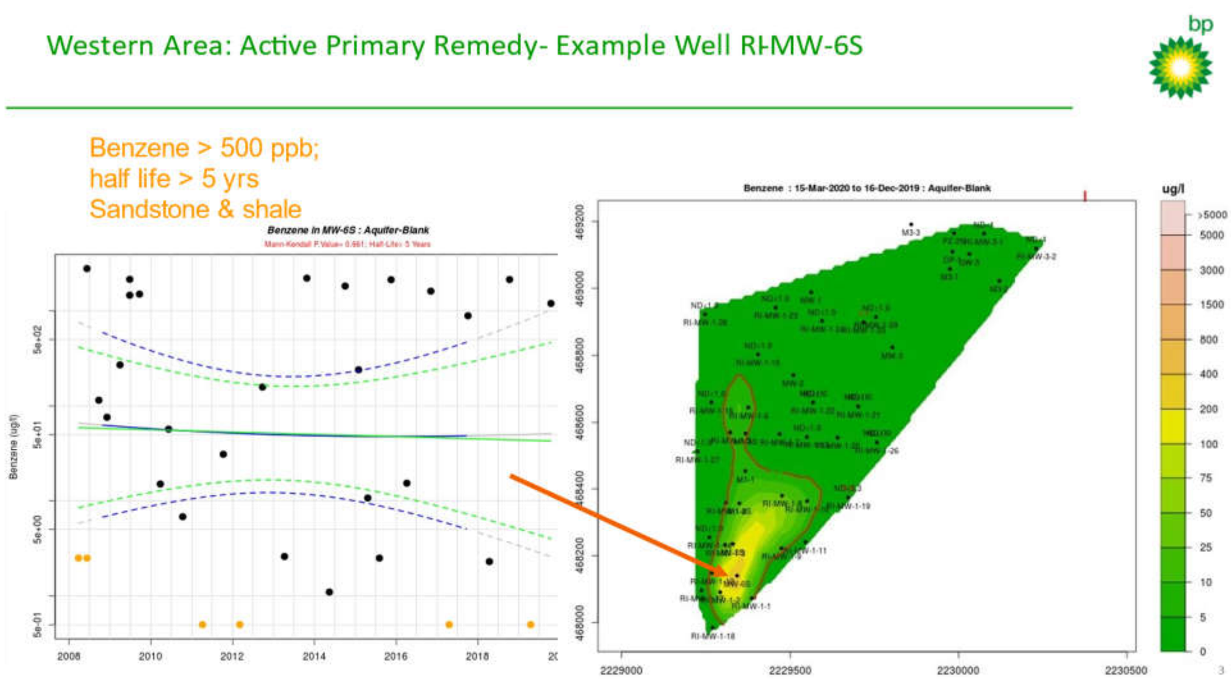


Figure E-11. Trends in Dissolved Benzene Concentrations in Monitoring Well RI-MW-6S, Western Area

Trends for ethylbenzene and naphthalene are similar. None of these wells had toluene nor xylene exceedances of VISLs or MCLs and were not included in the time series graphs for individual wells.

Monitoring results such as those shown above will be used to inform remedial technology selection as well as to design a sequential treatment approach, where areas exhibiting little or no improvement via natural mechanisms will be targeted with an active remedy until impacts are sufficiently reduced below remedial objectives, or until natural mechanisms are sufficient to continue reducing the impacts towards the remedial objectives. While the example evaluation shown above focused on the southern portion of the Western Area, remedial technology selection would utilize a similar approach for all of the Western, Central and Eastern Areas. Example evaluations for portions of the Central and Eastern Areas are presented below.

Central Area

Hydrocarbon compositional change is likely occurring, resulting in the observed dissolved phase behavior illustrated in the Central Area at monitoring well RI-DMW-4-5. Figures E-12 and E-13 below provide time series concentrations for benzene and ethylbenzene. Benzene exhibits a decreasing trend while ethylbenzene concentrations are increasing. This is consistent with historic studies where alkylbenzene compounds such as ethylbenzene were categorized to degrade after benzene (Kaplan et al., 1996). There are no suspected new sources of ethylbenzene at the Site. Compositional change due to NSZD is the likely explanation. This is an important example illustrating that despite a lack of decreasing concentrations across all hydrocarbon components, biological and other loss mechanisms are still active. Predesign investigation efforts will be proposed for Ohio EPA review in a subsequent work plan to further evaluate the effect of NSZD at the Site to ensure appropriate application.

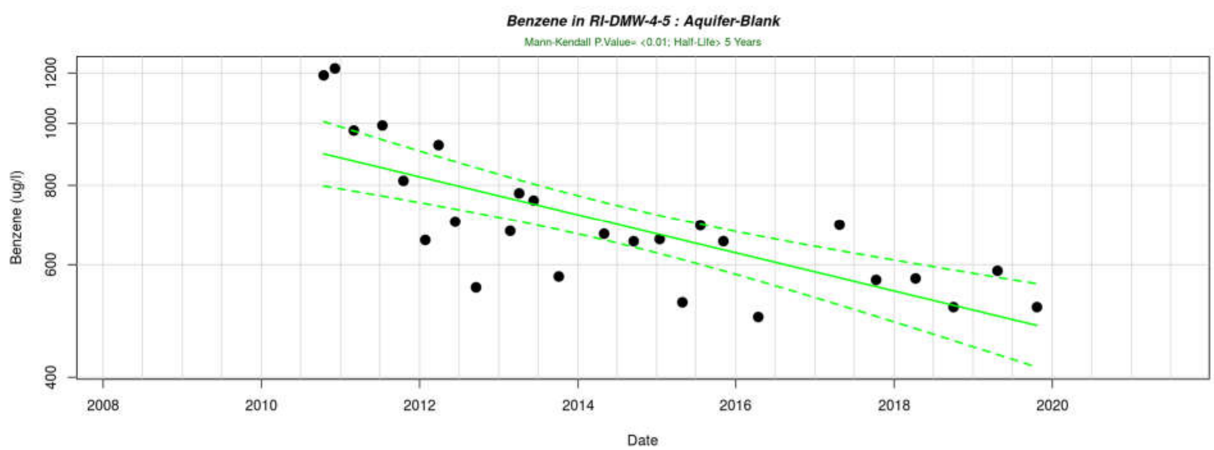


Figure E-12 Trends in Dissolved Benzene Concentrations in Monitoring Well RI-DMW-4-5, Central Area

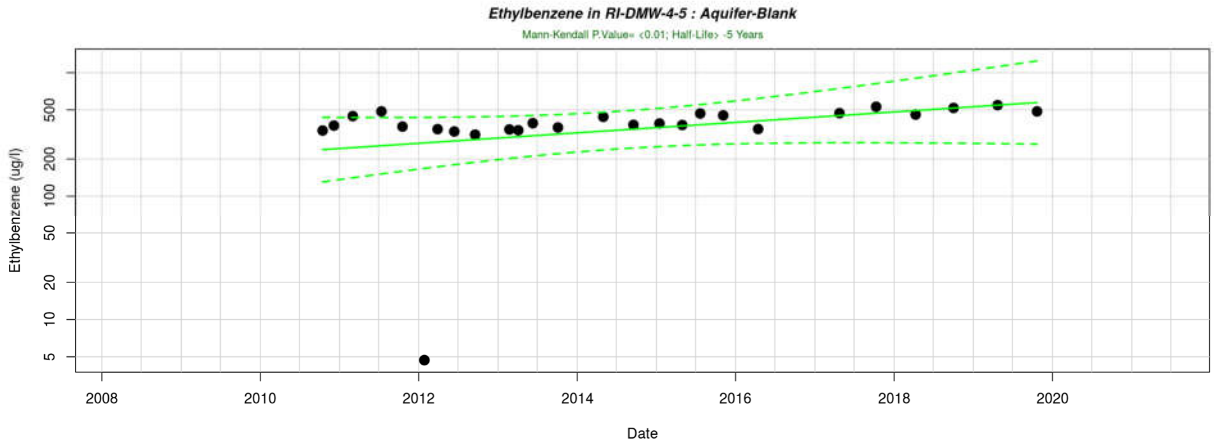


Figure E-13 Trends in Dissolved Ethylbenzene Concentrations in Monitoring Well RI-DMW-4-5, Central Area

In terms of remedial technology selection, it is important to have confidence that the biological mechanisms are active in multiple site conditions as it points to robustness of this approach. However, similar to the discussion in the Western Area, monitoring results such as those shown above will be used to inform remedial technology selection as well to design a sequential treatment approach, where target areas exhibiting little or no improvement via natural mechanisms will be targeted with an active remedy until impacts are sufficiently reduced below remedial objectives, or until natural mechanisms are sufficient to continue reducing the impacts towards the remedial objectives.

Central Area spatial plot representations of benzene in groundwater are provided in Figure E-14 below that include an initial time interval from 2008 prior to when delineation was completed, through 2020. The Central Area remediation system ceased operation in May 2004; the Central Area was partially delineated in 2008; additional delineation occurred through 2016. The time series pattern observed in Figure E-14 is consistent with a decreasing concentration trend over time and source attenuation. A summary of time-series graphs for individual Central Area wells is provided below as Figure E-15.

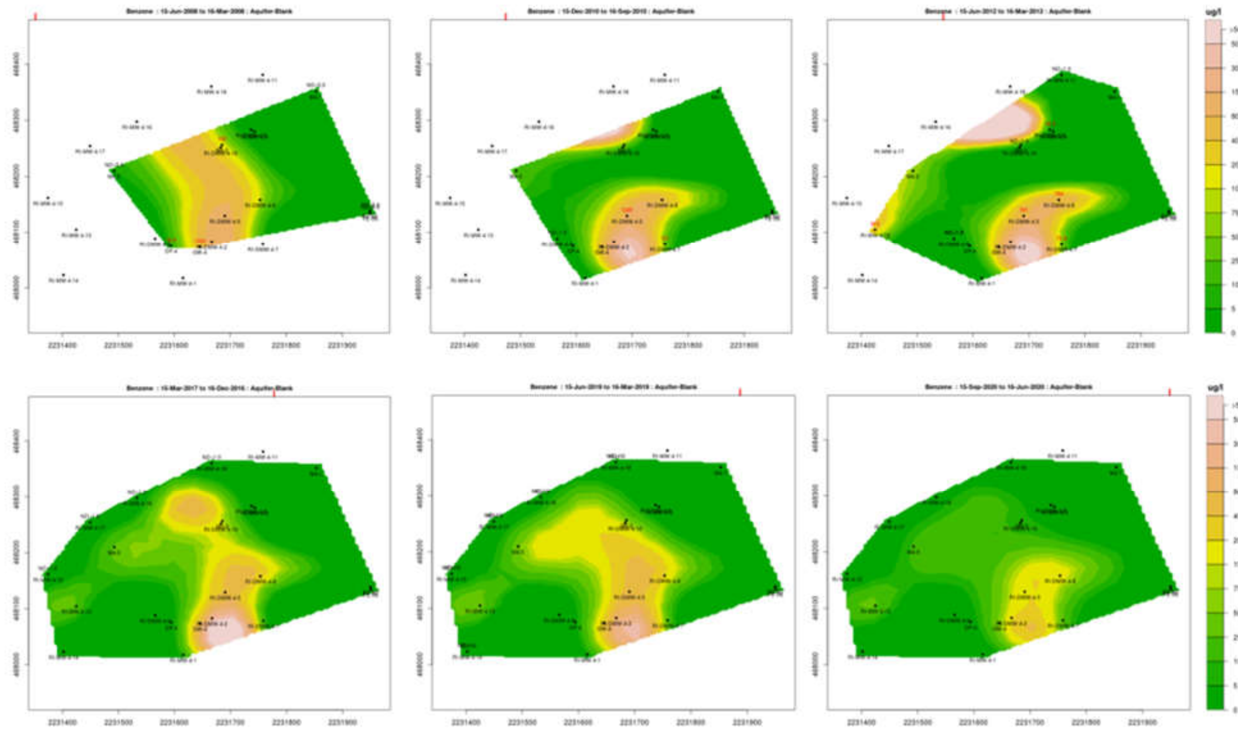


Figure E-14 Benzene Concentration in Groundwater from 2006 to 2020, Central Area.

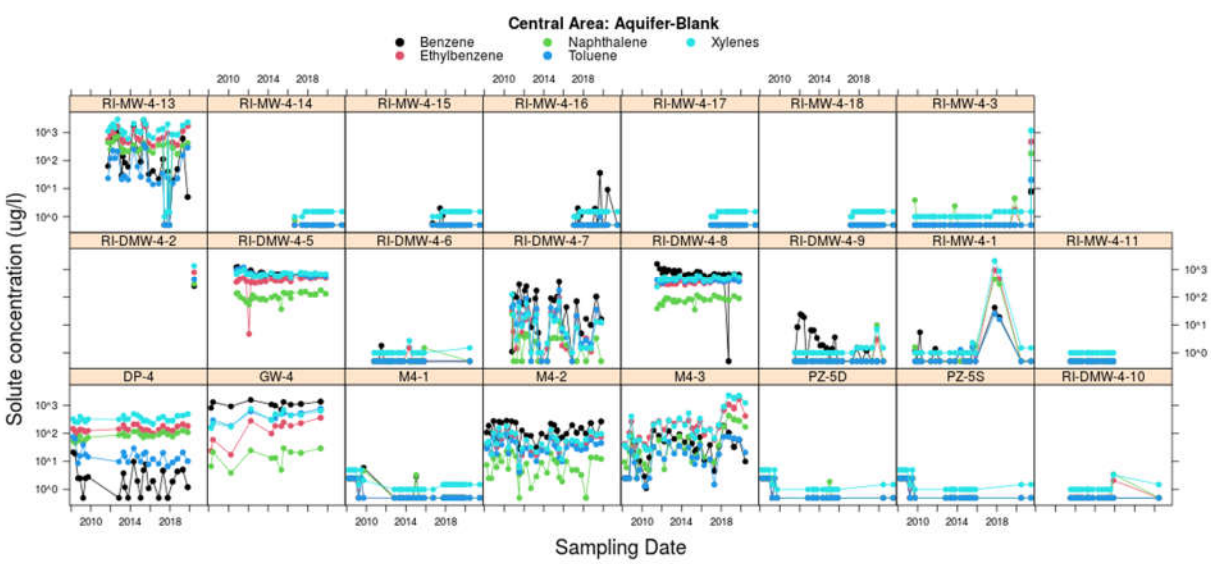


Figure E-15. Trends in Chemical Concentrations in Specific Monitoring Wells, Central Area

Declining concentrations with time are illustrated in time series graphs for benzene for wells such as RI-DMW-4-9 and RI-MW-4-13, therefore natural degradation may be occurring at a sufficient rate to be selected as the primary remedy in the vicinity of these and other wells with similar trends. Figure E-16 shows the time series logarithmic scale plot for benzene concentrations at these wells which exemplifies this behavior with half-lives less than 2.5 years, along with the location of the well on the benzene spatial plot from first quarter 2020.

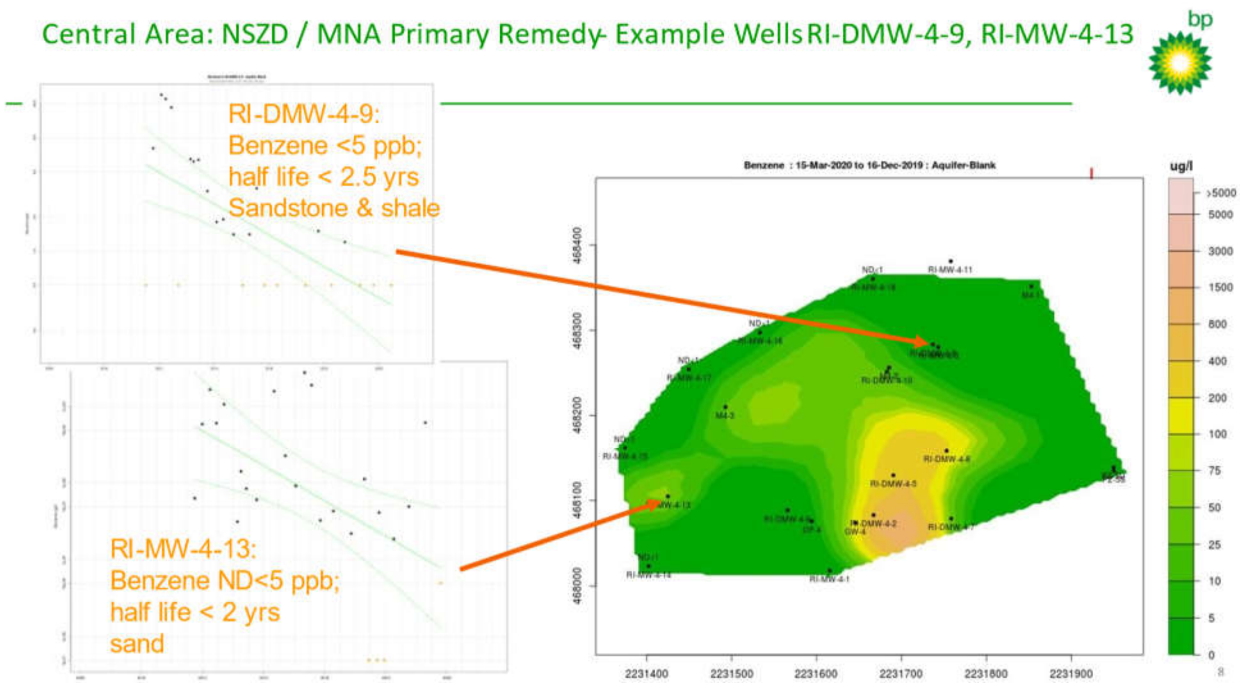


Figure E-16. Trends in Dissolved Benzene Concentrations in Monitoring Wells RI-DMW-4-9 and RI-MW-4-13, Central Area

Central Area monitoring wells that do not exhibit consistently declining trends for one or more compounds exceeding remedial goals include DP-4, GW-4, M4-2, M4-3, RI-DMW-4-7, RI-DMW-4-8, RI-DMW-4-5 and RI-MW-4-13, therefore these and other wells with similar concentrations and trends are considered target areas for active remedies. Figure E-17 shows the time series logarithmic scale graphs for benzene concentrations at GW-4 and RI-DMW-4-5 which exemplify this behavior with potentially increasing tends and a half-life greater than 5 years, respectively.

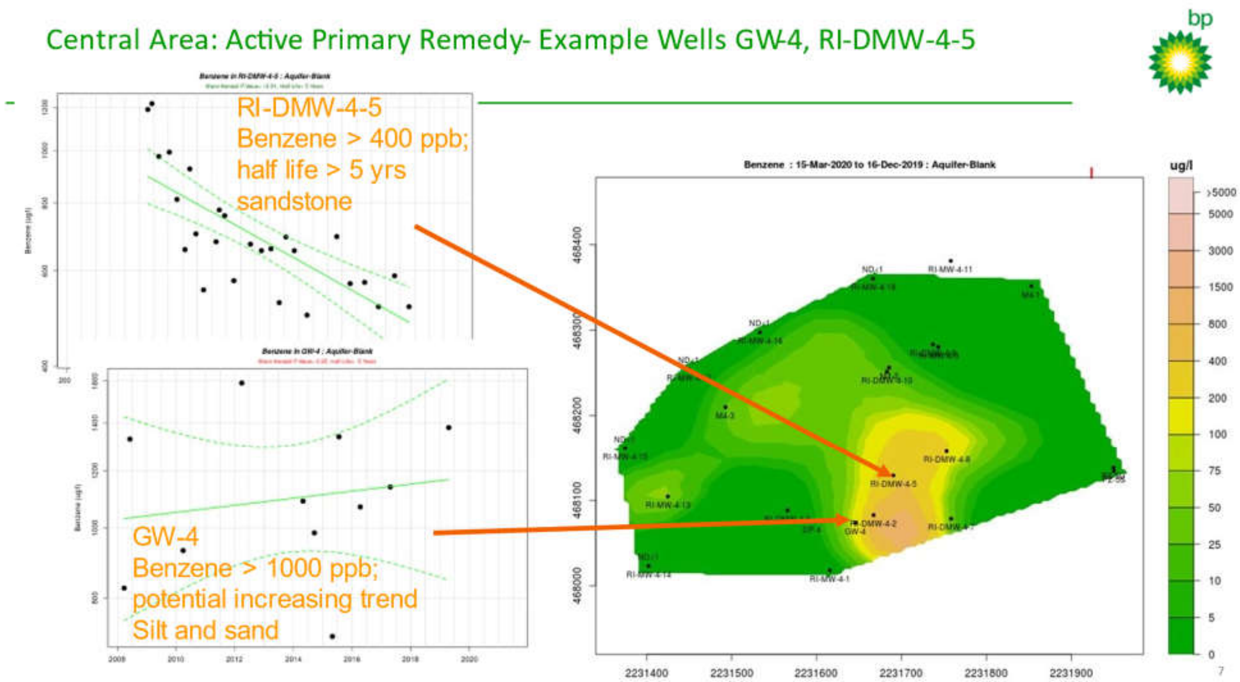


Figure E-17. Trends in Dissolved Benzene Concentrations in Wells RI-DMW-4-5 and GW-4, Central Area

Eastern Area

Eastern Area spatial plot representations of benzene in groundwater are provided in Figure E-18 below that include an initial time interval from 2015, prior to when delineation was completed in the Eastern Area, through 2020. The Eastern Area remediation systems ceased operation in May 2004; the Eastern Area was partially delineated in 2015; additional delineation occurred through 2018. As a result, the plume evolution focused on dates following complete delineation in 2018. The time series pattern observed in Figure E-18 is consistent with a decreasing concentration trend over time and source attenuation. A closer review of individual points can be completed using time series graphs (Figure E-19). The time series graphs support generally decreasing concentrations, particularly for benzene, except for wells such as RI-MW-6-2. Some wells, such as RI-MW-6-9 and RI-MW-6-12, exhibit decreasing benzene trends, while concentrations of other COCs such as ethylbenzene and naphthalene are slower to degrade or exhibit potentially increasing trends, likely representing compositional change of residual LNAPL which is sourcing these dissolved phase concentrations, as also described above for certain Central Area wells.

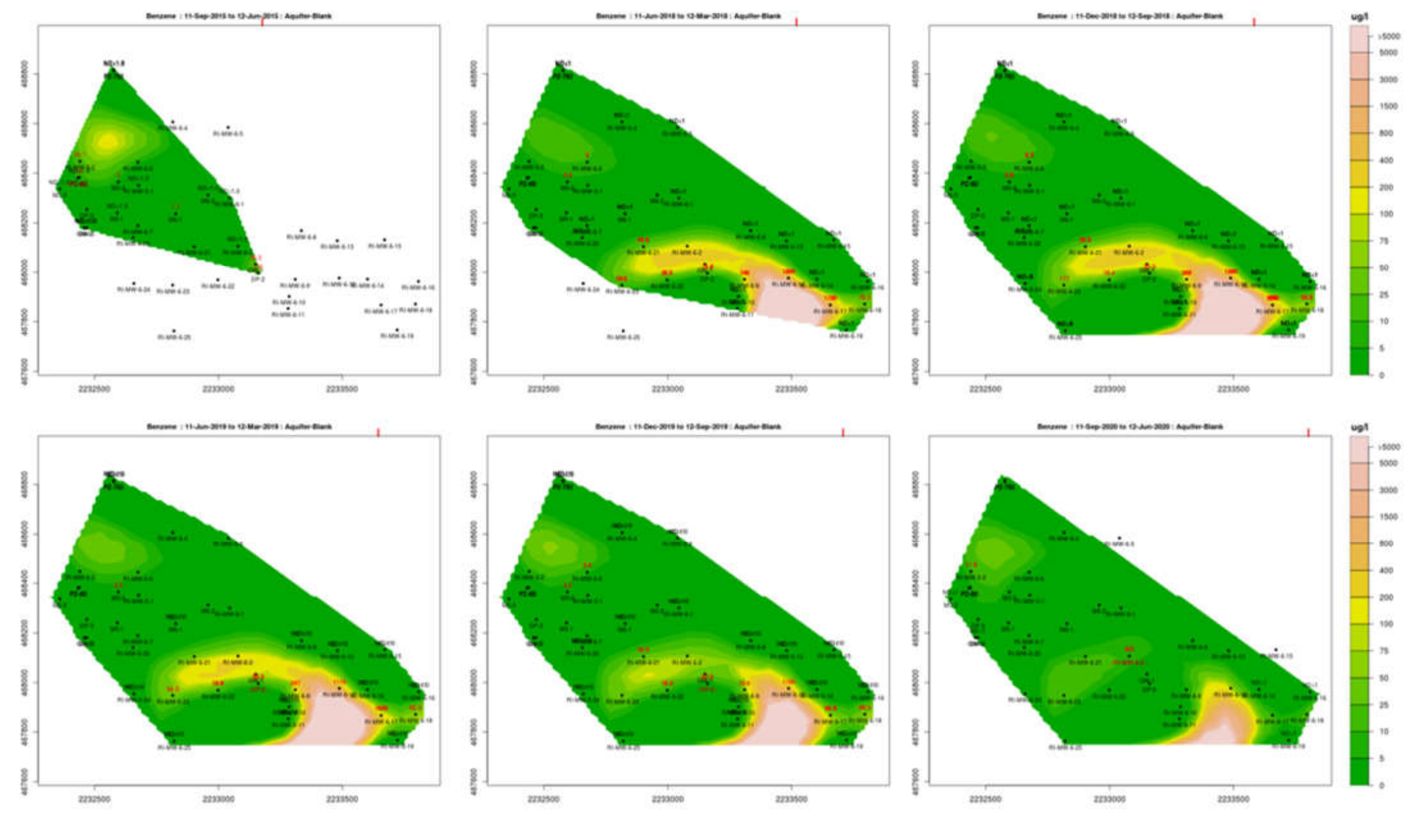


Figure E-18 Benzene Concentration in Groundwater from 2015 to 2020, Eastern Area.

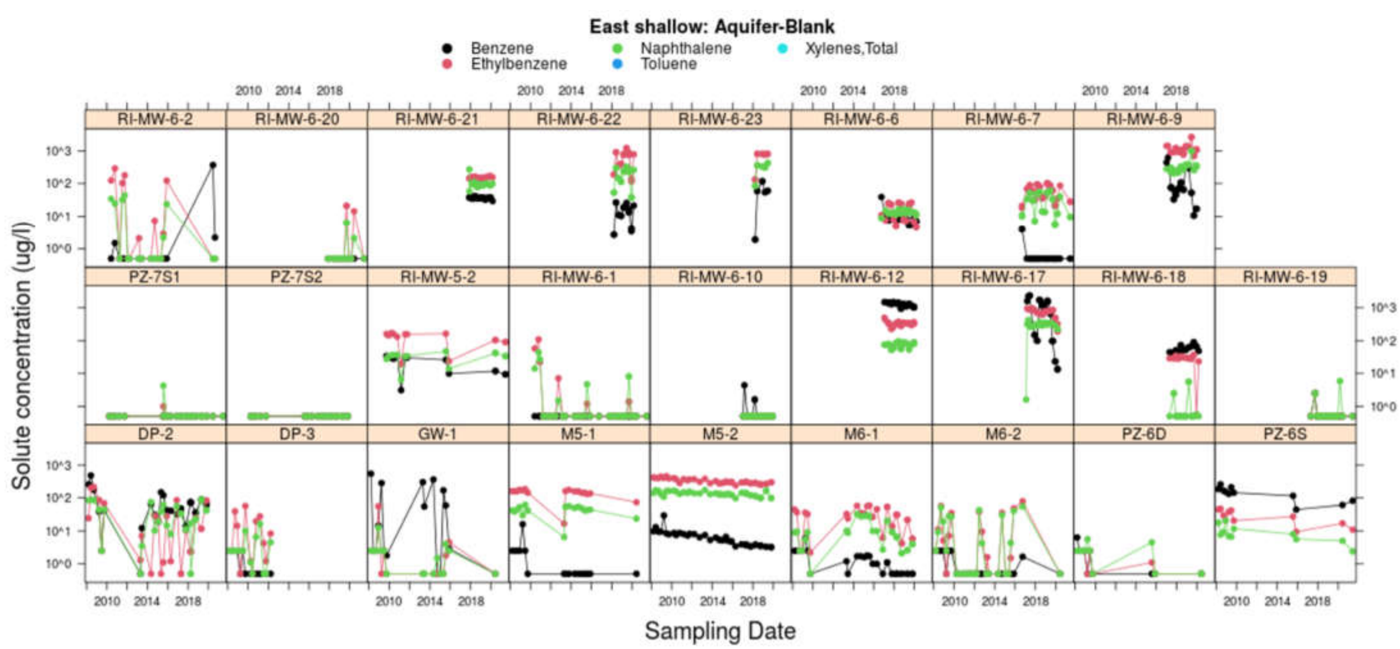


Figure E-19. Trends in Chemical Concentrations in Specific Monitoring Wells, Eastern Area

Declining concentrations with time are illustrated in time series graphs for benzene for wells RI-MW-6-6, RI-MW-6-9, RI-MW-6-17, and M5-2, therefore natural degradation may be evaluated as the primary remedy in the vicinity of these and other wells with similar trends. Figure E-20 shows the time series logarithmic scale graph for benzene concentrations at RI-MW-6-9, RI-MW-6-17 which exemplify this behavior with half-lives less than 2 years, along with the location of the wells on the benzene spatial plot from first quarter 2020.

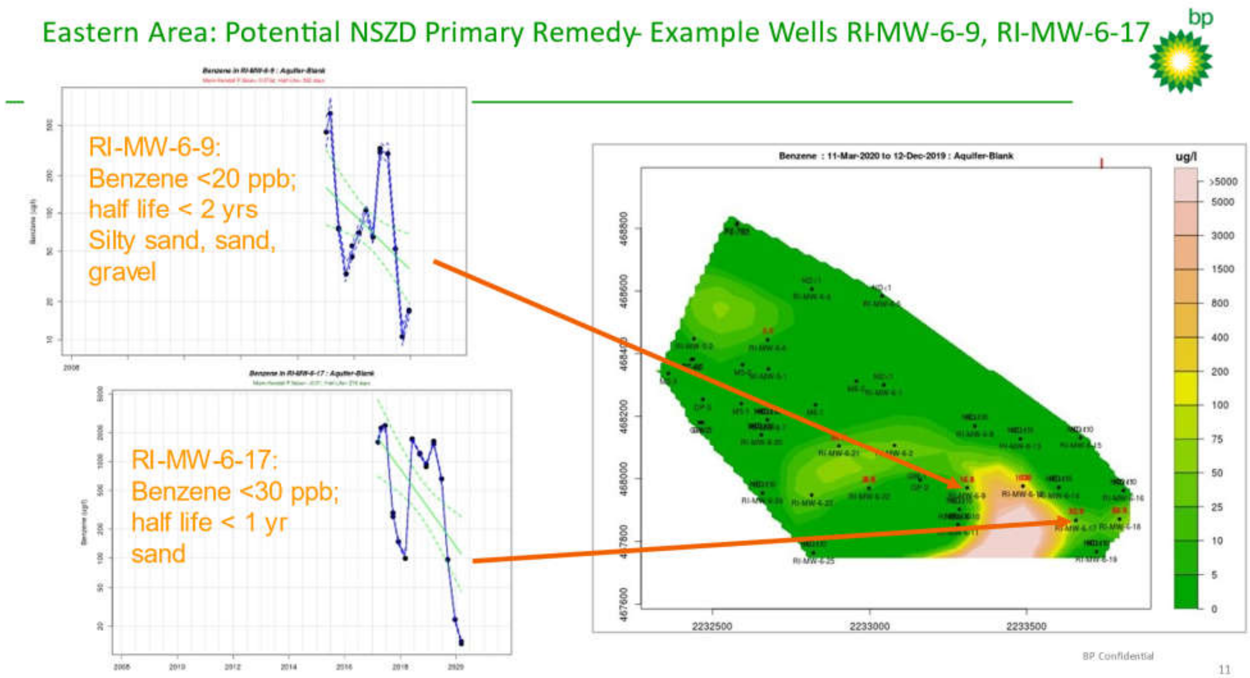


Figure E-20. Trends in Dissolved Benzene Concentrations in Wells RI-DMW-6-9 and RI-MW-6-17, Eastern Area

In contrast, Eastern Area monitoring well RI-MW-6-12 exhibits a slowly declining trend for benzene with a long duration projected before attainment. Therefore, this and other wells with similar concentrations and trends are considered target areas for active remedies. Figure E-21 shows the time series logarithmic scale graph for benzene concentrations at RI-MW-6-12 which exemplifies this behavior with a half-life greater than 5 years.

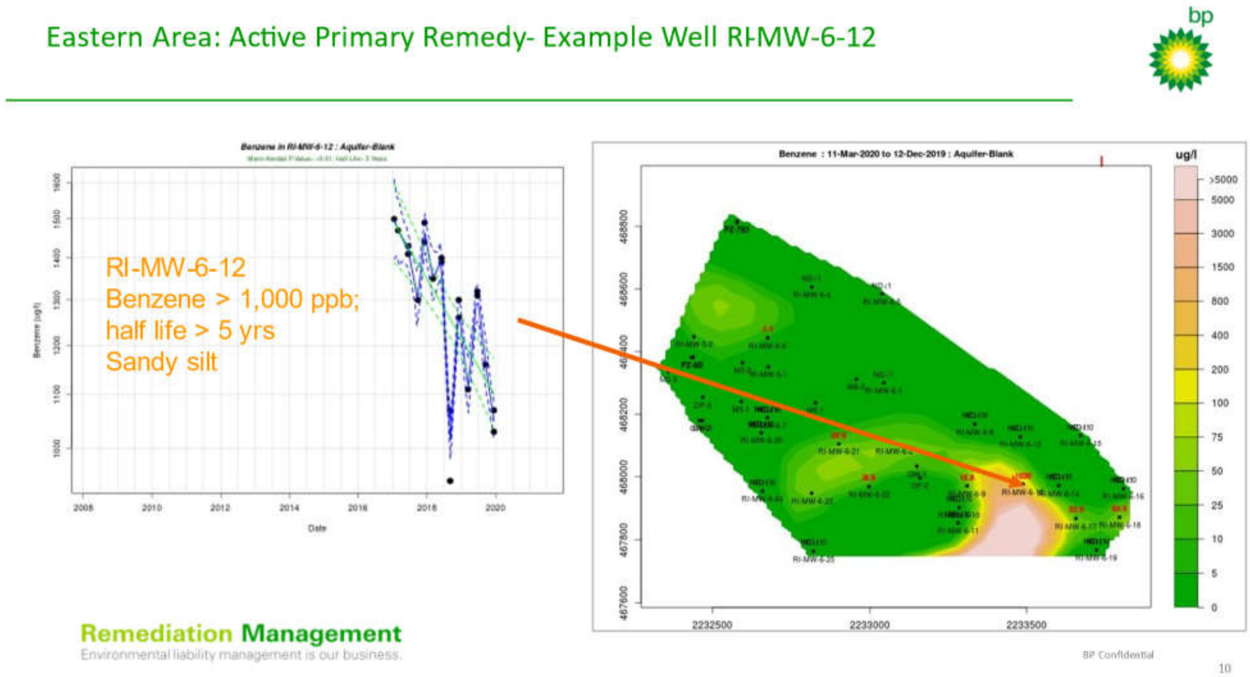


Figure E-21. Trends in Dissolved Benzene Concentrations in Wells RI-DMW-6-12, Eastern Area

Time series graphs for each COC for individual wells and spatial plots will be evaluated further for the Remedial Design to evaluate the performance of natural mechanisms in source attenuation, and target areas where active remediation may benefit naturally occurring COC degradation.

NSZD Applicability

The magnitude of natural source zone depletion represents a viable removal mechanism when considering the context of remaining impacts against appropriate remedial technology selection criteria. The benefits of NSZD include it: 1) does not require an extensive well network to have complete capture or treatment of the impacts; 2) inherently occurs in all soil types, regardless of permeability; 3) is able to address hydrocarbons from the more toxic and typical petroleum site concerns such as BTEX as well as other hydrocarbons such as alkanes, and PAHs and; 4) is conducive as an approach that does not require additional infrastructure or site disturbance. Pending further NSZD data collection and evaluation, NSZD is anticipated to supplement active remedies applied in target areas, with NSZD implemented as a primary remedy in areas where active technologies are not anticipated to provide additional benefit in achieving remedial goals (beyond target areas), as well as NSZD being employed in sequence in target areas when it is appropriate to transition from active remedies providing diminishing returns to natural degradation.

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APPENDIX F

Remedial Alternatives Cost Comparison

BP WEAVER WOODLANDS ALLOTMENT

NEW FRANKLIN, OHIO

TABLE F-1 REMEDIAL ALTERNATIVES ESTIMATED COST COMPARISON SUMMARY TABLE

Description	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Alternative Summary	No Action	Monitoring, NSZD/MNA, and Interim Response Actions	Monitoring, NSZD/MNA, Interim Response Actions & Institutional Controls	Monitoring, NSZD/MNA, Interim Response Actions, Institutional Controls & Alternative Water Supply	Monitoring, NSZD/MNA, Interim Response Actions, Institutional Controls & Targeted Active Remediation
Anticipated Drinking Water Testing 42 third-party wells 11 BP-owned wells (2 BP-owned lack functioning wells) annual costs are the same across Alt 2-5 (assume 50 years for Alt 1-4; 25 years for Alt 5)	NA	$1,200,000	$1,200,000	NA - no testing after alternative water supply (i.e., water line installation)	$600,000
Potential Drinking Water Well Replacement annual costs are the same across Alt 2-5, but Alt 5 has shorter duration (assume 1 every 5 years; assume 50 years for Alt 1-4; 25 years for Alt 5)	NA	$1,060,000	$1,060,000	NA - none after alternative water supply (i.e., water line installation)	$530,000
Potential Interim Responses (assume continued vapor abatement and annual indoor air sampling at 5239 Dailey, plus 1 additional property) LNAPL Characterization (assumed for 3 MWs with historical LNAPL) Assume installation of 1 temporary vapor abatement system Annual indoor air monitoring assumed at 2 properties for 30 years (Alt 2 - 4) or 10 years (Alt 5)	NA	$185,000	$185,000	$185,000	$105,000
Anticipated Groundwater Plume Stability Monitoring (51 wells around perimeters of groundwater plumes) annual costs are the same across Alt 2-5, but Alt 5 has shorter duration (assume 50 years for Alt 1-4; 25 years for Alt 5)	NA	$1,710,900	$1,710,900	$1,710,900	$855,450
Potential Environmental Covenants (assumes that ECs are required for all 38 properties within the Remedial Areas to address VISLs and drinking water impacts for Alt 2-5)	NA	NA	$190,000	$190,000	$190,000
Potential Alternative Water Supply (54 properties)	NA	NA	NA	$3,668,000	NA
Potential Pre-Design Investigation	NA	NA	NA	NA	$693,645
Potential Remedial Action(s) **- Western Area** **- Central Area** **- Eastern Area**	NA	NA	NA	NA	 $1,383,958 $1,463,496 $2,396,337
Anticipated Groundwater Performance Monitoring (assume 60 wells to be selected from plume interiors) either post-remediation or in lieu of remediation assume annual sampling, annual costs are the same for Alt 2 through 5 (assume 50 years for Alt 2-4 and 15 years for Alt 5)	NA	$2,609,400	$2,609,400	$2,609,400	$782,820
Anticipated Decommissioning of Existing Monitoring Wells	NA	$159,000	$159,000	$159,000	$159,000
TOTAL	$0	$6,924,300	$7,114,300	$8,522,300	$9,159,705

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TABLE F-2 NON-REMEDIATION ESTIMATED COST BUILDUP

Item	Description	Quantity	Unit	Unit Rate		Estimate:	
Annual Drinking Water Testing and Reporting							
1	Testing and reporting of 42 3rd-party wells and 11 BP-owned wells:	1	annual event	$24,000	/event	$24,000	
						$24,000	**Total per annual event, presented in Item 1 of Cost Summary multiplied by the assumed number of years of sampling.**
Potential Drinking Water Well Replacement							
2	Decommisison existing drinking water well	1	well	$6,000	/well	$6,000	
3	Install replacement double-cased well	1	well	$100,000	/well	$100,000	
						$106,000	**Total per well replaced, presented in Item 2 of Cost Summary multiplied by assumed number of wells replaced.**
Potential Interim Responses							
4	LNAPL characterization (bail down testing, etc.)	3	wells	$15,000	/well	**$45,000**	**Total LNAPL characterization at the 3 wells where LNAPL was historically present, presented in Item 3 of Cost Summary**
5	Installation of temporary vapor abatement system	1	home	$20,000	/home	**$20,000**	**Assumes installation of vapor abatement system at 1 additional property, presented in Item 3 of Cost Summary.**
6	Annual indoor air sampling and reporting	2	homes	$2,000	/home	**$4,000**	**Assumes continued vapor abatement and annual indoor air sampling at 5239 Dailey and 1 additional property, costs presented in Item 3 of Cost Summary multiplied assumed years of sampling.**
Environmental Covenants							
7	EC - Legal and Recording:	38	ECs	$5,000	/agreement	$190,000	ECs for all properties within the Remedial Areas as listed in Table 1-10
						$190,000	**Total cost to restrict 38 properties with ECs, presented in Item 5 of Cost Summary.**

26 Third-party properties in Remedial Areas to restrict (includes agricultural land in Eastern Area)
12 BP-owned properties to restrict (includes 3 unimproved lots on Maywood)
38 Properties to restrict

Item	Description	Quantity	Unit	Unit Rate		Estimate:	
Alternative Water Supply Costs							
8	Water Main Install:	1	event	$2,800,000	one time	$2,800,000	From Aqua Ohio 8/6/2020 estimate; cost still applicable
9	Home hookups:	55	homes	$10,000	/home	$550,000	Tap-in fee, service line, interior plumbing
10	Drinking water well decommissioning:	53	wells	$6,000	/well	$318,000	Note: 2 BP-owned homes in the Western Area do not have wells
	Total:					**$3,668,000**	**Total estimated cost to install water main and connect homes, presented in Item 6 of Cost Summary.**

33 Homes in the Remedial Areas to connect. (5 properties in the Remedial Areas do not have homes and will not be connected.)
22 Homes adjacent to Remedial Areas to connect (same locations as are included in annual drinking water testing).
55 Total homes to connect to water main

Monitoring Well Decommissioning (114 MWs)

This section addresses decommissioning of existing monitoring wells. Any wells that are installed as part of the PDI or remediation will be decommissioned when systems are decommissioned and those well decommissioning costs are included in remediation costs.

Item	Description	Quantity	Unit	Unit Rate		Estimate:	
11	Well abandonment	114	well	$1,000	/well	$114,000	Eventual decommissioning of all 114 existing monitoring wells, listed in Table 1-6, by sealing in place. Note that two monitoring wells listed in Table 1-5 are already decommissioned (M3-3 and DP-3).
12	Field oversight	20	days	$1,500	/day	$30,000	
13	Project Management	1	LS	$5,000	LS	$5,000	
14	Reporting	1	LS	$10,000	LS	$10,000	
						$159,000	**Total estimated cost to abandon existing monitoring wells, presented in Item 10 of Cost Summary.**

BP WEAVER WOODLANDS ALLOTMENT
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TABLE F-3 PRE-DESIGN INVESTIGATION ACTIVITIES ESTIMATED COST BUILDUP

Item	Description	Western Area				Central Area				Eastern Area					Notes / Assumptions
	EU Specific PVI Evaluation for parcels with GW or SV > VISLs	Quantity	Unit	Unit Rate	Cost	Quantity	Unit	Unit Rate	Cost	Quantity	Unit	Unit Rate	Cost	Total	**Costs are based on preliminary assumptions prior to development of the PDI Work Plan. Actual activities may vary based on conditions encountered.**
	Soil Gas Profiling of COCs, CH4, CO2, O2														
1	Soil Gas Probe Installations	6	probe	$1,255	$7,531	6	probe	$1,255	$7,531	6	probe	$1,255	$7,531	$22,594	Vertical soil probe installations. Assuming 6 in each Remedial Area as a preliminary assumption prior to plan development
2	Soil Gas Probe Sampling (2 events per location)	12	probe	$597	$7,160	12	probe	$597	$7,160	12	probe	$597	$7,160	$21,480	Two sampling events per location to evaluate seasonal variations
	Subtotal				$14,691				$14,691				$14,691	$44,074	
3	Subslab sampling at homes either uncharacterized with GW > VISL or with SV > VISL														Subslab vapor sampling to be conducted at homes with GW > VISL that were not characterized in the RI or have SV > VISL [594 & 605 Fairwood (Western Area), 359 Maywood (Central Area), and 5249 Dailey (Eastern Area)]
4	Sub-Slab Probe Installations	0	probe		$0	3	probe	$550	$1,649	3	probe	$550	$1,649	$3,298	Subslab vapor probes have already been installed at 594 & 605 Fairwood
5	Sub-Slab Sampling (single event)	6	sample	$333	$2,000	3	sample	$333	$1,000	3	sample	$333	$1,000	$4,000	
	Subtotal				$2,000				$2,649				$2,649	$7,298	
6	Natural gas potential source evaluation (groundwater PIANO analysis, single event)	0	wells		$0	0	wells		$0	6	wells	$1,114	$6,682	$6,682	To evaluate potential impacts from natural gas pipeline in Eastern Area
	Evaluate NSZD / MNA Mechanisms and effectiveness														
7	Field monitoring of MW headspace for CH4, CO2, O2 (Single Monitoring Event - Number of wells)	12	wells	$243	$2,916	12	wells	$243	$2,916	12	wells	$243	$2,916	$8,748	Assumes 12 MWs selected in each Remedial Area and one monitoring round for each well
8	Groundwater MNA parameters sampling (single event)	12	wells	$751	$9,013	12	wells	$751	$9,013	12	wells	$751	$9,013	$27,040	Assumes 12 MWs selected in each Remedial Area and one sampling round for each well (COCs and MNA parameters)
	Supplemental COC analysis in proposed treatment areas														To be performed in select portions of Remedial Areas to be determined during work plan development. Assuming 5 boreholes in each Remedial Area.
9	Vertical discrete soil samples or high res in treatment areas (OIHPT or equivalent)	5	borehole	$3,329	$16,643	5	borehole	$3,329	$16,643	5	borehole	$3,329	$16,643	$49,929	
10	Sampling (single event)	10	sample	$30	$300	10	sample	$30	$300	10	sample	$30	$300	$900	
	Subtotal				$16,943				$16,943				$16,943	$50,829	
11	Bedrock Downhole Geophysical Analyses (Single Sampling Event - Number of boreholes)	10	borehole	$1,809	$18,087	15	borehole	$1,809	$27,131	0	borehole	$1,809	$0	$45,218	Will not be performed in Eastern Area because bedrock is not encountered. Costs represent field testing/analysis only. Borehole installation costs are included in the pilot test well installation costs.
	Supplemental Groundwater Delineation (Eastern Area only)														Installation of additional monitoring wells in the Eastern Area to further delineate the southern extent of the plume in the Eastern Area
13	Well Installation	0	wells		$0	0	wells		$0	2	wells	$6,275	$12,549	$12,549	
14	Sampling (single event)	0	wells		$0	0	wells		$0	2	wells	$1,353	$2,706	$2,706	
	Subtotal				$0				$0	2	Wells		$15,255	$15,255	
	AS/SVE Pilot Test														
15	Well Installation	10	well	$5,647	$56,465	15	well	$5,547	$83,205	10	well	$5,647	$56,465	$196,135	Assumes 2 AS/BS test wells, 2 SVE/BV test wells and 6 nested piezometers/monitoring points (West), 3 AS/BS test wells, 3 SVE/BV test wells and 9 nested piezometers/monitoring points (Central), and 2 AS/BS test wells, 2 SVE/BV test wells and 6 nested piezometers/monitoring points (Eastern)
16	Investigative derived waste	15	drum/roll off	$75	$1,125	22.5	drum/roll off	$75	$1,688	15	drum/roll off	$75	$1,125	$3,938	Waste disposal: Soil cuttings from drilling
17	Investigative derived waste	2	unit	$1,500	$3,000	2	unit	$1,500	$3,000	2	unit	$1,500	$3,000	$9,000	Waste disposal: Spent Carbon
18	AS/SVE Equipment Rental	12	week	$1,325	$15,900	12	week	$1,325	$15,900	12	week	$1,325	$15,900	$47,700	Assume 3 months of testing
19	AS/SVE Equipment Mob/Demob	1	LS	$5,000	$5,000	1	LS	$5,000	$5,000	1	LS	$5,000	$5,000	$15,000	
20	Electrician	1	day	$1,800	$1,800	1	day	$1,800	$1,800	1	day	$1,800	$1,800	$5,400	System connection
21	Electrical Service	0	month	$0	$0	0	month	$0	$0	3	month	$800	$3,200	$3,200	Assumes electrical service is available from maintained houses in Western and Central areas, temp electrical service installationn Eastern area
22	Lab analytical	36	sample	$130	$4,680	36	sample	$130	$4,680	36	sample	$130	$4,680	$14,040	Assume 2 full TO-15 analyses per O&M event, 2X samples per event, daily events for first week, weekly events thereafter
23	Field oversight (labor and equipment)	18	day	$1,796	$32,328	18	day	$1,796	$32,328	18	day	$1,796	$32,328	$96,984	oversight system setup/breakdown, 1 week of daily system monitoring, then weekly
24	Data analysis	24	hour	$151	$3,624	24	hour	$151	$3,624	24	hour	$151	$3,624	$10,872	
25	Project Management	1	LS	$3,720	$3,720	1	LS	$3,720	$3,720	1	LS	$3,720	$3,720	$11,160	
26	Testing summary	1	LS	$10,024	$10,024	1	LS	$10,024	$10,024	1	LS	$10,024	$10,024	$30,072	
	Subtotal				$137,666				$164,969				$140,866	$443,501	
27	PDI Work Plan	1	LS	$5,000	$5,000	1	LS	$5,000	$5,000	1	LS	$5,000	$5,000	$15,000	
28	PDI Reporting	1	LS	$10,000	$10,000	1	LS	$10,000	$10,000	1	LS	$10,000	$10,000	$30,000	
	Grand Total				**$216,317**				**$253,312**				**$224,016**	**$693,645**	**Grand Total for PDI presented in Item 7 of Cost Summary Table**

BP WEAVER WOODLANDS ALLOTMENT
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TABLE F-4 ANTICIPATED GROUNDWATER MONITORING ESTIMATED COST BUILDUP

Item	Description	Western					Central				Eastern			Total	Notes / Assumptions
		Quantity	Unit	Unit Rate	Cost	Quantity	Unit	Unit Rate	Cost	Quantity	Unit	Unit Rate	Cost		
1	Annual Plume Stability GW Monitoring and Reporting	20	well	$671	$13,419	13	well	$671	$8,722	18	well	$671	$12,077	**$34,218**	Annual sampling, 51 wells around plume perimeters (existing annual monitoring well sampling network) to monitor plume stability, 8260 Analysis **Annual Total Cost presented in Item 4 of Cost Summary multiplied by the assumed number of years of sampling.**
2	Anticipated Annual Performance GW Monitoring and Reporting	20	well	$870	$17,396	20	well	$870	$17,396	20	well	$870	$17,396	**$52,188**	Annual sampling of wells within plume interiors to monitor attenuation, 8260 Analysis and MNA parameters. Assuming 20 wells per plume for cost estimation - actual numbers and locations of wells to be determined. **Annual Total Cost presented in Item 9 of Cost Summary multiplied by the assumed number of years of sampling.**

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TABLE F-5 POTENTIAL ACTIVE REMEDIATION IN WESTERN AREA - ESTIMATED COST BUILDUP

Item	Description	Quantity	Unit	Unit Rate	Item Cost	Notes / Assumptions	
Design & Procurement							
1	Design and Design Report	1	LS	$17,992	$17,992		
2	Bid Package	1	LS	$18,696	$18,696		
3	Permitting	1	LS	$9,022	$9,022		
4	Bid Evaluation & Procurement	1	LS	$5,408	$5,408		
5	Project Management	1	LS	$6,504	$6,504		
	Subtotal				$57,622		
System Installation and Commissioning							
6	Well Installation	45	Wells	$5,414	$243,645	Assume 25-2", 35' deep AS/BS wells & 20-4", 20' deep SVE/BV wells	
7	IDW - Soil Cuttings	67.5	drum/rolloff	$75	$5,063	Waste disposal: Soil cuttings from drilling	
8	Equipment	1	LS	$180,534	$180,534		
9	Trenching and Piping	2000	LF	$100	$200,000		
10	Electrical	2	day	$1,800	$3,600	Assume pre-existing power source, electrician day rate only	
11	Electrical Connection	1	LS	$5,000	$5,000		
12	System Enclosure Installation & Connections	1	LS	$18,500	$18,500	Enclosure placement and mounting pad only (connections already covered in electrical day rate)	
13	Fencing	0	LF	$20	$0		
14	Field oversight	25	day	$1,970	$49,250	Day rate includes labor for senior staff and staff level and equipment	
15	Lab analytical	6	sample	$130	$780	Assume 6 full TO-15 analyses during commissioning	
16	Project Management	1	LS	$6,504	$6,048		
	Subtotal				$712,420		
OM&M						Assume 3 years AS/SVE, transition to BS/BV & operate for 3 years before transition to NSZD	
17	Electric Connection	1	Hookup	$5,000	$5,000		
18	Electric (AS/SVE)	36	month	$800	$28,800		
19	Electric (Biosparge Only)	36	month	$400	$14,400		
20	Carbon	6	Unit	$3,000	$18,000	2X carbon changes per year for AS/SVE system operations	
21	IDW	6	unit	$1,500	$9,000	Waste disposal: Spent Carbon (2 changeouts per year)	
22	System O&M	72	month	$1,770	$127,440	monthly visits	
23	System Performance Groundwater Monitoring	24	quarter	$4,130	$99,120	Quarterly sampling of 10 wells in plume	
24	Lab analytical	288	sample	$30	$8,640	BTEXN 8260 - quarterly sampling, 10 wells/event	12 Water analyses per event (includes dup and blank)
25	Lab analytical	216	sample	$130	$28,080	TO-15 Air - monthly sampling during the 3 years of SVE operation	6 Air analyses per event
26	Reporting	6	report	$9,010	$54,060	Assume annual reporting schedule	
27	Project Management	72	month	$1,568	$112,896		
	Subtotal				$505,436		
System Decommissioning							
28	Equipment removal (Subcontractor)	6	day	$5,000	$30,000		
29	Well Abandonment (Subcontractor)	55	well	$1,000	$55,000	Decommissioning of wells installed in Western Area for PDI and remediation	
30	Field oversight	12	day	$1,070	$12,840		
31	Project Management	1	LS	$5,240	$5,240		
32	Reporting	1	LS	$5,400	$5,400		
	Subtotal				$108,480		
Grand Total					$1,383,958	**Grand Total for potential Western Area Remediation presented in Item 8 of Cost Summary Table**	

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TABLE F-6 POTENTIAL ACTIVE REMEDIATION IN CENTRAL AREA - ESTIMATED COST BUILDUP

Item	Description	Quantity	Unit	Unit Rate	Item Cost	Notes / Assumptions	
Design & Procurement							
1	Design and Design Report	1	LS	$17,992	$17,992		
2	Bid Package	1	LS	$18,696	$18,696		
3	Permitting	1	LS	$9,022	$9,022		
4	Bid Evaluation & Procurement	1	LS	$5,408	$5,408		
5	Project Management	1	LS	$6,504	$6,504		
	Subtotal				$57,622		
System Installation and Commissioning							
6	Well Installation	30	Well	$5,448	$163,425	Assume impacts are shallow / perched ~15-20' deep in till. Up to 30 BS/BV wells around pipeline / RI-MW-4-13, GW-4	
7	IDW - Soil Cuttings	45	drum	$75	$3,375	Waste disposal: Soil cuttings from drilling	
8	Equipment	1	LS	$180,534	$180,534		
9	Trenching and Piping	1500	LF	$100	$150,000		
10	Electrical	2	day	$1,800	$3,600	Assume pre-existing power source, electrician day rate only	
11	Electrical Connection	1	LS	$5,000	$5,000		
12	System Enclosure Installation & Connections	1	LS	$18,500	$18,500	Enclosure placement and mounting pad only (connections already covered in electrical day rate)	
13	Fencing	0	LF	$20	$0		
14	Field oversight	25	day	$1,314	$32,850	Day rate includes labor for staff and senior staff level, and equipment	
15	Lab analytical	6	sample	$130	$780	Assume 6 full TO-15 analyses during commissioning	
16	Project Management	1	LS	$6,504	$6,048		
	Subtotal				$564,112		
OM&M						Assume 3 years AS/SVE, transition to BS/BV & operate for 3 years before transition to NSZD	
17	Electric Connection	1	Hookup	$5,000	$5,000		
18	Electric (AS/SVE)	36	month	$800	$28,800		
19	Electric (Biosparge Only)	36	month	$400	$14,400		
20	Carbon	6	Unit	$3,000	$18,000	2X carbon changes per year for AS/SVE system operations	
21	IDW	6	unit	$1,500	$9,000	Waste disposal: Spent Carbon (2 changeouts per year)	
22	System O&M	72	month	$1,770	$127,440	monthly visits	
23	System Performance Groundwater Monitoring	24	quarter	$4,130	$99,120	Quarterly sampling of 10 wells in plume	
24	Lab analytical	288	sample	$30	$8,640	BTEXN 8260 - quarterly sampling, 10 wells/event	12 Water analyses per event (includes dup and blank)
25	Lab analytical	216	sample	$130	$28,080	TO-15 Air - monthly sampling during the 3 years of SVE operation	6 Air analyses per event
26	Reporting	6	report	$9,010	$54,060	Assume annual reporting schedule	
27	Project Management	72	month	$1,568	$112,896		
	Subtotal				$500,436		
System Decommissioning							
28	Equipment removal (Subcontractor)	6	day	$5,000	$30,000		
29	Well Abandonment (Subcontractor)	45	well	$1,000	$45,000	Decommissioning of wells installed in Central Area for PDI and remediation	
30	Field oversight	11	day	$1,070	$11,770		
31	Project Management	1	LS	$5,240	$5,240		
32	Reporting	1	LS	$5,400	$5,400		
	Subtotal				$97,410		
	Total				$1,219,580		
33	**Contingency**	0.2	percent		$243,916	Contingency for Supplemental Remediation due to potential for remedial efforts to be hindered by limited access in Central Area	
Grand Total					**$1,463,496**	**Grand Total for potential Central Area Remediation presented in Item 8 of Cost Summary Table**	

TABLE F-7 POTENTIAL REMEDIATION IN EASTERN AREA - ESTIMATED COST BUILDUP

Item	Description	Quantity	Unit	Unit Rate	Item Cost	Notes / Assumptions	
Design & Procurement							
1	Design and Design Report	1	LS	$17,992	$17,992		
2	Bid Package	1	LS	$18,696	$18,696		
3	Permitting	1	LS	$9,022	$9,022		
4	Bid Evaluation & Procurement	1	LS	$5,408	$5,408		
5	Project Management	1	LS	$6,504	$6,504		
	Subtotal				$57,622		
System Installation and Commissioning							
6	Well Installation	95	Wells	$5,379	$511,045	Assume impacts are ~33-43' deep north of pipeline near RI-MW-6-12 & ~25-35' deep south of pipeline near RI-MW-6-17. Assume 40-2", 45' deep AS/BS wells & 30-4", 30' deep SVE/BV wells north of pipeline & 15-2", 35' deep AS/BS wells & 10-4", 15' deep SVE/BV wells south of pipeline	
7	IDW - Soil Cuttings	142.5	drums	$75	$10,688	Waste disposal: Soil cuttings from drilling	
8	Equipment	2	LS	$180,534	$361,068		
9	Trenching and Piping	4000	LF	$100	$400,000		
10	Electrical	4	days	$1,800	$7,200	Assume pre-existing power source, electrician day rate only	
11	Electrical Connection	2	LS	$5,000	$10,000		
12	System Enclosure Installation & Connections	2	LS	$18,500	$37,000	Enclosure placement and mounting pad only (connections already covered in electrical day rate)	
13	Fencing	0	LF	$20	$0		
14	Field oversight	50	days	$1,314	$65,700	Day rate includes labor for staff and senior staff level, and equipment	
15	Lab analytical	12	sample	$130	$1,560	Assume 6 full TO-15 analyses during commissioning	
16	Project Management	1	LS	$6,504	$6,048		
	Subtotal				$1,410,309		
OM&M						Assume 3 years AS/SVE, transition to BS/BV & operate for 3 years before transition to NSZD	
17	Electric Connection	2	Hookup	$5,000	$10,000		
18	Electric (AS/SVE)	36	month	$1,600	$57,600		
19	Electric (Biosparge Only)	36	month	$800	$28,800		
20	Carbon	12	Unit	$3,000	$36,000	2X carbon changes per year for AS/SVE system operations	
21	IDW	12	unit	$1,500	$18,000	Waste disposal: Spent Carbon (2 changeouts per year)	
22	System O&M	72	month	$3,540	$254,880	monthly visits	
23	System Performance Groundwater Monitoring	24	quarter	$4,130	$99,120	Quarterly sampling of 10 wells in plume	
24	Lab analytical	288	sample	$30	$8,640	BTEXN 8260 - quarterly sampling, 10 wells/event	12 Water analyses per event (includes dup and blank)
25	Lab analytical	432	sample	$130	$56,160	TO-15 Air - monthly sampling during the 3 years of SVE operation	12 Air analyses per event
26	Reporting	6	report	$9,010	$54,060	Assume annual reporting schedule	
27	Project Management	72	month	$1,568	$112,896		
	Subtotal				$726,156		
System Decommissioning							
28	Equipment removal (Subcontractor)	12	day	$5,000	$60,000		
29	Well Abandonment (Subcontractor)	107	well	$1,000	$107,000	Decommissioning of wells installed in Eastern Area for PDI and remediation	
30	Field oversight	23	day	$1,070	$24,610		
31	Project Management	1	LS	$5,240	$5,240		
32	Reporting	1	LS	$5,400	$5,400		
	Subtotal				$202,250		
Grand Total					**$2,396,337**	**Grand Total for potential Eastern Area Remediation presented in Item 8 of Cost Summary Table**	

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TABLE F-8 POTENTIAL PROPERTY ACTIONS

Address or Parcel #	Street Name	Remedial Area	Ownership	Potential Drinking Water Testing	Potential Water Line Connection	Potential Drinking Water Well Decommissioning (if water line)	Potential Environmental Covenant	Comments
174 / 176 / 178	Center Rd.	Eastern Area	Third-Party	Yes	Yes	Yes	Yes	
200 / 202 / 204	Center Rd.	Eastern Area	Third-Party	Yes	Yes	Yes	Yes	
Parcel 2304275	Center Rd.	Eastern Area	Third-Party	No	No	No	Yes	No Residence, No Drinking Water Well
542 (and adjacent parcel 2302478)	Center Rd.	Western Area	BP	Yes	Yes	Yes	Yes	
5180	Dailey Rd.	Eastern Area	BP	Yes	Yes	Yes	Yes	
5201 / 5203 / 5205	Dailey Rd.	Eastern Area	Third-Party	Yes	Yes	Yes	Yes	
5206	Dailey Rd.	Eastern Area	Third-Party	Yes	Yes	Yes	Yes	
5215 / 5219	Dailey Rd.	Eastern Area	Third-Party	Yes	Yes	Yes	Yes	
5222	Dailey Rd.	Eastern Area	Third-Party	Yes	Yes	Yes	Yes	
5229 / 5233	Dailey Rd.	Eastern Area	Third-Party	Yes	Yes	Yes	Yes	
5239 / 5247	Dailey Rd.	Eastern Area	Third-Party	Yes	Yes	Yes	Yes	
5249 / 5253	Dailey Rd.	Eastern Area	Third-Party	Yes	Yes	Yes	Yes	
5261	Dailey Rd.	Eastern Area	Third-Party	Yes	Yes	Yes	Yes	
Parcel 2301504	Dailey Rd. (vacant parcel)	Eastern Area	Third-Party	No	No	No	Yes	No Residence, No Drinking Water Well, Not Buildable
569	Fairwood Rd.	Western Area	Third-Party	Yes	Yes	Yes	Yes	
578	Fairwood Rd.	Western Area	Third-Party	Yes	Yes	Yes	Yes	
585	Fairwood Rd.	Western Area	Third-Party	Yes	Yes	Yes	Yes	
586	Fairwood Rd.	Western Area	Third-Party	Yes	Yes	Yes	Yes	
594	Fairwood Rd.	Western Area	BP	No	Yes	No	Yes	No Drinking Water Well
604	Fairwood Rd.	Western Area	BP	No	Yes	No	Yes	No Drinking Water Well
605 (and adjacent parcel 2300994)	Fairwood Rd.	Western Area	BP	Yes	Yes	Yes	Yes	
614	Fairwood Rd.	Western Area	Third-Party	Yes	Yes	Yes	Yes	
615	Fairwood Rd.	Western Area	BP	Yes	Yes	Yes	Yes	
607	Highland Park	Western Area	BP	Yes	Yes	Yes	Yes	
615	Highland Park	Western Area	Third-Party	Yes	Yes	Yes	Yes	
5245	Kaylin Dr.	Central Area	Third-Party	Yes	Yes	Yes	Yes	
5255	Kaylin Dr.	Central Area	BP	Yes	Yes	Yes	Yes	
5260	Kaylin Dr.	Central Area	Third-Party	Yes	Yes	Yes	Yes	
5265	Kaylin Dr.	Central Area	BP	Yes	Yes	Yes	Yes	
5270	Kaylin Dr.	Central Area	Third-Party	Yes	Yes	Yes	Yes	
5282	Kaylin Dr.	Central Area	Third-Party	Yes	Yes	Yes	Yes	
300	Maywood Dr.	Eastern Area	Third-Party	Yes	Yes	Yes	Yes	
303 (Parcel 2300034)	Maywood Dr. (Undeveloped Parcel)	Eastern Area	BP	No	No	No	Yes	No Residence, No Drinking Water Well

TABLE F-8 POTENTIAL PROPERTY ACTIONS

Address or Parcel #	Street Name	Remedial Area	Ownership	Potential Drinking Water Testing	Potential Water Line Connection	Potential Drinking Water Well Decommissioning (if water line)	Potential Environmental Covenant	Comments
339	Maywood Dr.	Central Area	BP	Yes	Yes	Yes	Yes	
349	Maywood Dr.	Central Area	Third-Party	Yes	Yes	Yes	Yes	
359	Maywood Dr.	Central Area	Third-Party	Yes	Yes	Yes	Yes	
Parcel 2305125	Maywood Dr.	Central Area	BP	No	No	No	Yes	No Residence, No Drinking Water Well
Parcel 2305653 (Wisdom Woods Property)	S. Main Street	Eastern Area	Third-Party	No	No	No	Yes	No Residence, No Drinking Water Well
536	Center Rd.	Adjacent to Western Area	BP	Yes	Yes	Yes	No	
550	Center Rd.	Adjacent to Western Area	Third-Party	Yes	Yes	Yes	No	
566	Center Rd.	Adjacent to Western Area	Third-Party	Yes	Yes	Yes	No	
572	Center Rd.	Adjacent to Western Area	Third-Party	Yes	Yes	Yes	No	
590	Center Rd.	Adjacent to Western Area	Third-Party	Yes	Yes	Yes	No	
602	Center Rd.	Adjacent to Western Area	Third-Party	Yes	Yes	Yes	No	
612	Center Rd.	Adjacent to Western Area	Third-Party	Yes	Yes	Yes	No	
5280	Dailey Rd.	Adjacent to Eastern Area	Third-Party	Yes	Yes	Yes	No	
5281	Dailey Rd.	Adjacent to Eastern Area	Third-Party	Yes	Yes	Yes	No	
5282	Dailey Rd.	Adjacent to Central Area	Third-Party	Yes	Yes	Yes	No	
5290	Dailey Rd.	Adjacent to Eastern Area	Third-Party	Yes	Yes	Yes	No	
555	Fairwood Rd.	Adjacent to Western Area	Third-Party	Yes	Yes	Yes	No	
570	Fairwood Rd.	Adjacent to Western Area	Third-Party	Yes	Yes	Yes	No	
624	Fairwood Rd.	Adjacent to Western Area	Third-Party	Yes	Yes	Yes	No	
625	Fairwood Rd.	Adjacent to Western Area	Third-Party	Yes	Yes	Yes	No	
599	Highland Park	Adjacent to Western Area	Third-Party	Yes	Yes	Yes	No	
627	Highland Park	Adjacent to Western Area	Third-Party	Yes	Yes	Yes	No	
5235	Kaylin Dr.	Adjacent to Central Area	Third-Party	Yes	Yes	Yes	No	
5252	Kaylin Dr.	Adjacent to Central Area	Third-Party	Yes	Yes	Yes	No	
309	Maywood Dr.	Adjacent to Eastern Area	BP	Yes	Yes	Yes	No	
318	Maywood Dr.	Adjacent to Eastern Area	Third-Party	Yes	Yes	Yes	No	
331	Maywood Dr.	Adjacent to Central Area	BP	Yes	Yes	Yes	No	

Number of properties within Remedial Areas = 26 Third-Party-Owned + 12 BP-Owned = 38
Number of homes within Remedial Areas = 23 Third-Party-Owned + 10 BP-Owned = 33
Number of drinking water wells within Remedial Areas = 23 Third-Party-Owned + 8 BP-Owned = 31

FEASIBILITY STUDY
REMEDIAL ALTERNATIVES COST COMPARISON
RESPONSE TO COMMENTS
BP WEAVER WOODLANDS
NEW FRANKLIN, OHIO

Below, are Ohio EPA's December 20, 2022 comments to BP's draft December 6, 2022 Weaver Woodlands Feasibility Study (FS) Alternatives Cost Comparison, and BP's associated responses in italics below each comment. The draft cost comparison has been revised to address Ohio EPA's comments and is attached for review. Upon approval by Ohio EPA, the Alternatives Cost Comparison will be presented in the FS as Appendix F (Tables F-1 through F-8).

Cost Summary Worksheet:

Alternative 4 (column), Environmental Covenants (row):

- What about the vapor intrusion (VI) pathway? Are environmental covenants (ECs) not necessary for exposure units with a potential VI pathway?

  BP Response: ECs are anticipated at all 38 properties within the Remedial Areas to address the VI and drinking water pathways. The Cost Summary table (Table F-1) has been revised, and for Alternative 4, these costs are now presented in the row for Environmental Covenants (Cost Summary Item 5), in the same manner as for Alternatives 3 and 5.

General question:

- Are the future costs for BP owned houses included?

  BP Response: Yes, the future costs for BP-owned homes are included in the Alternatives cost comparison.

Non-Remediation Cost Buildup Worksheet:

Annual drinking water testing and reporting:

- Assume this is based on Figure 1-3 in the FS? Do the wells include both those within and outside the plume, including the buffer area?
- See question below on Settlement Agreements

  BP Response: Annual drinking water testing (Cost Summary Item 1) is anticipated at all 31 homes (third-party and BP-owned) with drinking water wells within the Remedial Areas (two BP-owned properties lack a drinking water well) and 22 homes (third-party and BP-owned) located immediately adjacent to the Remedial Areas, for a total of 53 wells. These locations are identified on Figure 1-3 (2021 Drinking Water Sampling Location Map) from the 2021 Annual Drinking Water Testing Summary for the Weaver Woodlands Allotment. Note that drinking water testing is not planned at the 5 additional properties within the Remedial Areas that are undeveloped (no homes or drinking water wells). Refer to Table 1-10 of the FS for a listing of the 38 properties retained in the three Remedial Areas. Table F-8, to be included in Appendix F, has been prepared listing the 38 properties in the Remedial Areas and the additional 22 properties immediately adjacent to the Remedial Areas and the potential property actions for each.

<u>Drinking water well replacement</u>:

- Assume no ECs or Settlement Agreements necessary as already covered elsewhere? Hence 'zero' costs?
- Difference between EC and Settlement Agreements? Ohio EPA will require ECs typically, to ensure protection of future receptors.
    - [Question also applicable to Environmental Covenants—see below]

BP Response: ECs are anticipated at all 38 properties within the Remedial Areas to address the VI and drinking water pathways. The costs for ECs are presented as Item 5 in the Cost Summary. No additional costs for ECs are anticipated specifically for properties where drinking water wells are replaced. Costs for potential Settlement Agreements between BP and individual property owners are not included in cost table, as they are not driven by regulatory requirements.

<u>Interim Responses</u>:

- Criteria for interim actions basis? Drinking water impacts/ground water or soil gas above VISLs to current receptors?
- LNAPL: 2 wells in worksheet, versus 3 wells identified in FS?
- Have homes for total vapor abatement been identified? Basis? Flexibility?
- Have homes for annual indoor air sampling been identified? Basis? Flexibility?

BP Response: For the purpose of cost estimation, interim actions include continuation of existing interim actions, anticipated interim actions, and contingency interim actions, if needed as data or site conditions warrant, as detailed in this response. It is assumed that interim response actions (Cost Summary Item 5) will be performed to address the VI pathway. These actions include continued operation of the temporary vapor abatement system and annual indoor air sampling at 5249 Dailey Road, and installation and operation ofa temporary vapor abatement system and annual indoor air sampling at one additional property. As discussed in the FS, there are 4 properties where either subslab soil vapor results exceeded VISL (2 vacant, BP-owned properties, 594 Fairwood Road and 605 Fairwood Road) or groundwater concentrations exceed VISL and permission has not yet been granted to perform subslab vapor sampling (359 Maywood Drive and 5249 Dailey Road). Subslab vapor sampling at these 4 locations is planned as part of the Pre-Design Investigation (PDI) and costs for that subslab sampling are included in the PDI, as discussed later in this document. For cost estimation purposes, it is assumed that installation and operation of a vapor abatement system and annual indoor air sampling will be performed as an interim response at one of these properties and these costs are included in Cost Summary Item 5; however, this would only be performed if subslab sampling results indicate a VI risk at a home that is or could be occupied.

For cost estimation purposes, it is assumed that LNAPL characterization may be performed on the 3 monitoring wells where LNAPL was historically encountered, pending measurable LNAPL recurrence. This has been revised from the previous draft that only estimated costs for 2 wells.

For cost estimation purposes, it is assumed that installation and operation of temporary vapor abatement system will be performed at one additional property that would be determined based on subslab sampling results This would only be performed if subslab sampling results indicate a VI risk at a home that is or could be occupied. A temporary vapor abatement system has already been installed at 5239 Dailey Road and the estimated costs assume that this will continue to operate.

For cost estimation purposes, it is assumed that annual indoor air sampling will be performed at one additional property that would be determined based on subslab sampling results. This would only be performed if subslab sampling results indicate a VI risk at a home that is or could be occupied. Indoor air sampling is already performed at 5239 Dailey Road and the estimated costs assume that this sampling will continue on an annual basis.

Environmental Covenants:

- Difference between ECs and Settlement Agreements?
    - Do Settlement Agreements need to be included?
- Scope of ECs (media/activities that will be addressed)
    - Compliance with the Uniform Environmental Covenants Act (UECA)
    - Confirm ECs to be included in Alternative 5 as a protective measure (?)
- Basis of EC numbers?

BP Response: ECs will address the VI and drinking water pathways and will comply with UECA. Costs for potential Settlement Agreements between BP and individual property owners are not included in cost table, as they are not driven by regulatory requirements. ECs are included in Alternatives 3 through 5 and are anticipated at all 38 properties within the Remedial Areas, as listed in Table 1-10 of the FS.

Monitoring well decommissioning:

- Basis of numbers (114)? Eventual decommissioning? Interim decommissioning of any wells outside the plume?

BP Response: The costs for monitoring well decommissioning developed on the Non-Remediation Cost Buildup worksheet (Table F-2) and presented as Cost Summary Item 10 are for the eventual decommissioning of all 114 existing monitoring wells, as listed in Table 1-6 of the FS. Note that two monitoring wells listed in Table 1-5 of the FS are already decommissioned (M3-3 and DP-3). Costs for decommissioning any wells installed during the PDI or remediation are included with remediation system decommissioning costs developed on the individual cost buildup worksheets for potential active remediation in each of the Remedial Areas (Tables F-5 through F-7).

PDI Worksheet

Soil gas profiling:

- Uniform # of soil gas probes across Western, Central and Eastern Areas?
- Annual sampling or twice yearly?

BP Response: It is anticipated that vertical soil probes will be installed to investigate soil vapor during the PDI. As a preliminary assumption prior to plan development, it is assumed that 6 soil probes will be installed in each Remedial Area. It is also assumed that each soil probe will be sampled twice to evaluate seasonal variations.

Sub-slab sampling:

- Basis of #s?

BP Response: Provided that access is granted, during the PDI, subslab vapor sampling will be conducted at homes where groundwater chemical of concern (COC) concentrations exceed VISL that were not characterized during the Remedial Investigation because access had not been granted by the property owners [359 Maywood (Central Area) and 5249 Dailey (Eastern Area)] or have subslab COC concentrations that exceeded VISL [BP-owned homes at 594 Fairwood and 605 Fairwood (Western Area)], for a total of 4 homes. Subslab samples will be collected from 3 subslab vapor probe locations in each home. Subslab vapor probes have already been installed at 594 Fairwood and 605 Fairwood.

Natural gas source evaluation:

- Clarify (Eastern Area only)

BP Response: To investigate potential impacts from the natural gas pipelines in proximity to the petroleum pipeline in the Eastern Area, it is anticipated that select monitoring wells will be sampled for analysis of paraffins, isoparaffins, aromatics, naphthalenes, and olefins (PIANO analysis) during the PDI. As a preliminary assumption prior to plan development, it is assumed that this sampling will be performed at 6 monitoring wells in the Eastern Area.

Evaluate NSZD/MNA:

- Uniform # of wells across Western, Central and Eastern Areas?

BP Response: As an aid in evaluating natural source zone depletion (NSZD) and monitored natural attenuation (MNA), it is anticipated that well headspace field monitoring of CH_4, CO_2, and O_2 will be performed on select monitoring wells, and select monitoring wells will be sampled for MNA parameters, during the PDI. As a preliminary assumption prior to plan development, it is assumed that these activities will each be performed on 12 monitoring wells in each Remedial Area during one event.

Supplemental COC analysis in proposed treatment areas:

- Uniform across Western, Central and Eastern Areas?

BP Response: To provide additional data for remedial design, it is anticipated that supplemental soil investigation will be performed in proposed treatment areas during the PDI. As a preliminary assumption prior to plan development, 5 boreholes are assumed in each Remedial Area. The locations will be determined during plan development.

Ground water monitoring worksheet

Different wells identified for plume stability monitoring versus annual performance monitoring?

BP Response: Plume stability monitoring (Cost Summary Item 4) refers to sampling of the 51 monitoring wells around the plume perimeters (20 in Western Area, 13 in Central Area, and 18 in Eastern Area) that are currently in the annual groundwater monitoring well sampling network. Performance monitoring (Cost Summary Item 9) refers to sampling that would be performed in the interiors of the groundwater plumes to evaluate attenuation. The actual numbers and locations of monitoring wells to be included in performance monitoring have yet to be determined. For cost estimation purposes, it is assumed that 20 monitoring wells will be sampled within each plume, for a total of 60 monitoring wells.

Western, Central and Eastern (3) Worksheets

- Well installation: basis of numbers? [45 in Western Area; 30 in Central; 45 in Eastern Area]
- Any overlap between OM&M and Annual GW Monitoring costs? For example, lab analyticals
- Allowance for 'contingency' in Central Area but not Eastern or Western. Assume difference related to access issues in Central Area?

BP Response: Remediation costs presented for Alternative 5 represent potential costs based on preliminary estimation of the treatment areas and radius of influence in each Remedial Area. For the Western Area, the preliminary estimate assumes installation of 25 air sparge/biosparge (AS/BS) wells and 20 soil vapor extraction/biovent (SVE/BV) wells. For the Central Area, the preliminary estimate assumes installation of 30 BS/BV wells. For the Eastern Area, the preliminary estimate assumes installation of 55 AS/BS wells and 40 SVE/BV wells. The actual treatment areas and remediation system designs will be determined based on the results of the PDI.

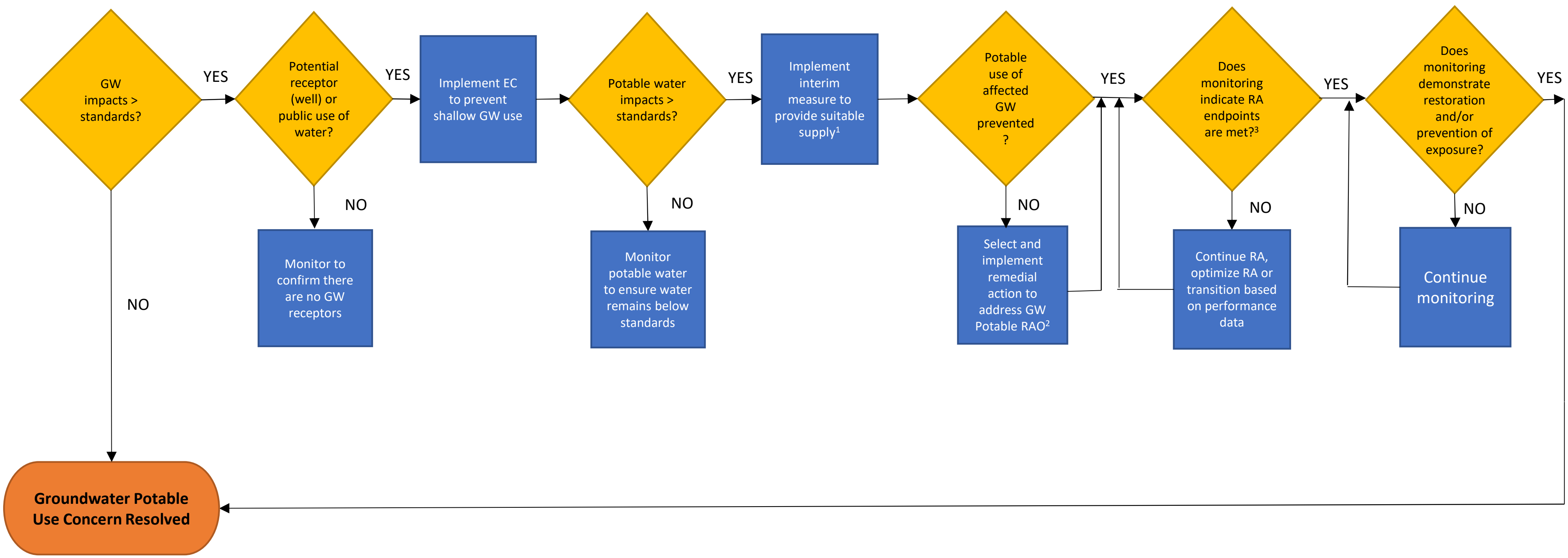
There is no overlap in costs between OM&M and annual groundwater monitoring because these activities involve sampling of different wells. Costs for groundwater performance monitoring to be performed quarterly during active remediation are presented as Item 23 (System Performance Groundwater Monitoring) on the individual cost buildup worksheets for potential active remediation for each of the three Remedial Areas. These samples would be collected from wells within the interiors of the groundwater plumes and would be analyzed for the site chemicals of concern (COCs), benzene, ethylbenzene, toluene, total xylenes, and naphthalene (BTEXN). Annual plume stability monitoring (Item 4 on the Cost Summary) would be performed on wells located around the perimeters of the groundwater plumes and samples would be analyzed for the same site COCs (BTEXN).

As discussed in the FS, BP has been denied access to a portion of the Central Remedial Area, which may impede remedial efforts. For this reason, on the individual cost buildup worksheet for potential active remediation for the Central Remedial Area only, a contingency (Item 33) is included for supplemental remediation should the effectiveness of initial remedial efforts be hindered by limited access.

APPENDIX G

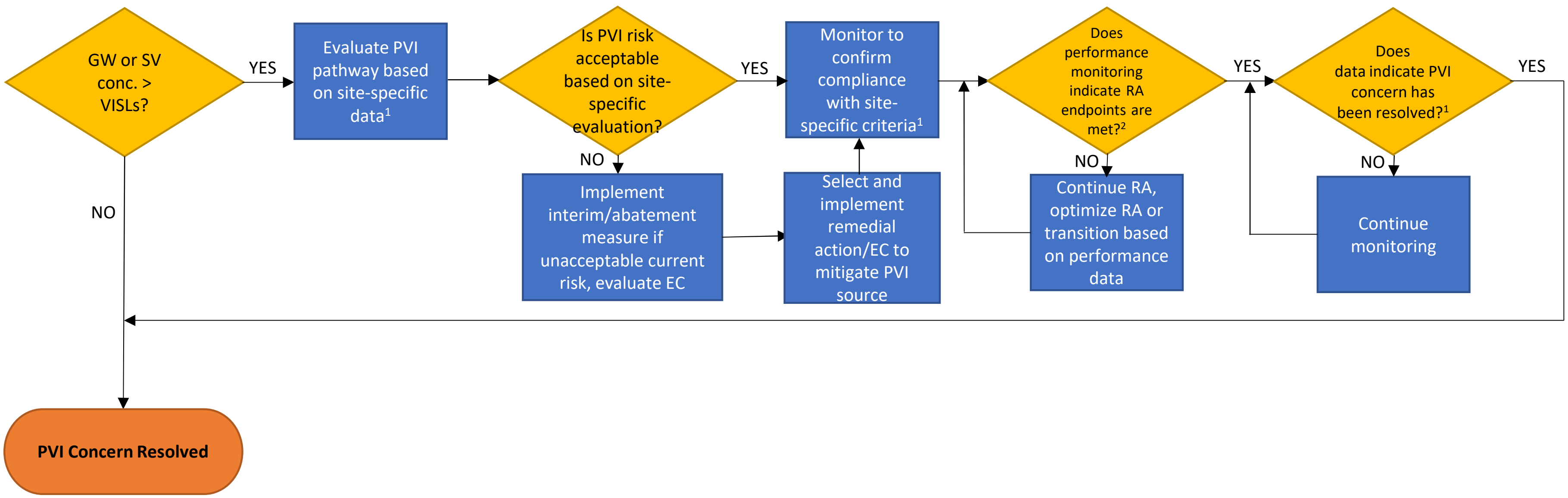
Remedy Implementation Flowcharts

Figure G-1: Potable Water Use Exposure Prevention



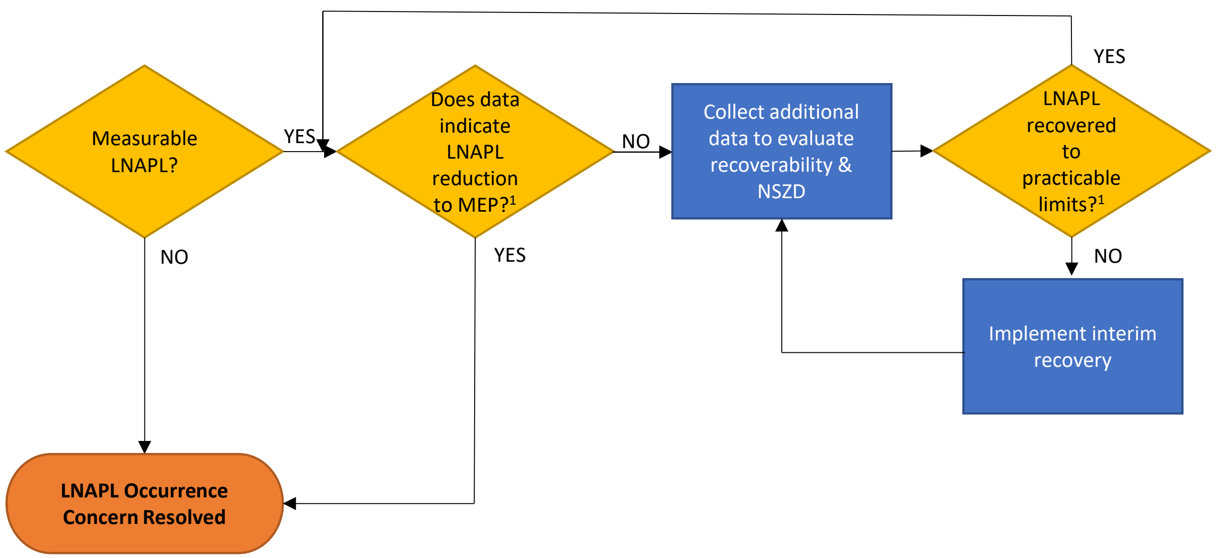
Notes:
1 Suitable drinking water supplies include public water line connection, deep double cased well or other construction with sampling results to confirm acceptable quality for residential use and consumption
2 Remedial alternative screening, testing and selection to be parcel specific as outlined in FS
3 Performance metrics and remediation technology endpoints to be established during remedy design

Figure G-2: EU Petroleum Vapor Intrusion Concerns



Notes:
1 Process for PVI evaluation & metrics for demonstrating compliance with site-specific criteria /RAO as outlined in FS
2 Performance metrics and remediation technology endpoints to be established during remedy design

Figure G-3: EU LNAPL Occurrence Concerns



Notes:
1 Multiple lines of evidence may be used to demonstrate MEP, or LNAPL presence below recoverability limit, e.g., transmissivity, declining recovery per ITRC LNAPL3

Figure G-4: EU Closure