UNITED STATES

ENVIRONMENTAL PROTECTION AGENCY

REGION 5

Statement of Basis

for

Franklin Power Products/Amphenol Corp. Corrective Action Site

Franklin, Indiana

EPA ID # IND 044 587 848

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ACRONYMS

AOC	Administrative Order on Consent
BGS	Below Ground Surface
BTEX	Benzene, Toluene, Ethylbenzene, and Total Xylenes
CAO	Corrective Action Objective
cVOC	Chlorinated Volatile Organic Compound
CMS	Corrective Measures Study
COC	Chemical of Concern
CMS	Corrective Measures Study
DCL	Default Closure Level
EPA	U.S. Environmental Protection Agency
ERH	Electrical Resistance Heating
EXDCSL	Excavation Worker Soil Direct Contact Screening Level
GVISL	Groundwater Vapor Intrusion Screening Level
HHRA	Human Health Risk Assessment
HI	Hazard Index
IA	Indoor Air
IC	Institutional Control
IDEM	Indiana Department of Environmental Management
IM	Interim Measure
ISCO	In-Situ Chemical Oxidation
ISCR	In-Situ Chemical Reduction
IWM	Industrial Waste Management Consulting Group, LLC
MCL	Maximum Contaminant Level (Drinking Water)
MTGSL	Migration to Groundwater Screening Level
MIP	Membrane Interface Probe
MNA	Monitored Natural Attenuation
NAPL	Non-aqueous Phase Liquid
PCE	Tetrachloroethene
ppb	Parts per billion
ppm	Parts per Million
PlumeStop®	PlumeStop® Liquid Activated Carbon
PRB	Permeable Reactive Barrier
PRG	Preliminary Remediation Goal
P&T	Pump and Treat
RCRA	Resource Conservation and Recovery Act
ROW	Right of Way
RSL	Regional Screening Level
RFI	RCRA Facility Investigation/Report
SB	Statement of Basis

SL	Screening Level
S-MZVI	Sulfidated-MicroZVI™
SS CMS	Second Supplemental Corrective Measures Study
VOC	Volatile Organic Compound
TCE	Trichloroethene
ug/L	
MicroGrams/Liter	
U.S.C.	United States Code
VI	Vapor Intrusion
VESL	Vapor Exposure Screening Level
VOC	Volatile Organic Compound
ZVI	Zero Valent Iron

SECTION I. INTRODUCTION AND PURPOSE OF THE STATEMENT OF BASIS

The primary purpose of this Statement of Basis (SB) document is to invite comments from the public on the approach being proposed by the U.S. Environmental Protection Agency (EPA) to remediate contamination at the former Franklin Power Products/Amphenol Corporation Corrective Action Site ("Amphenol Site," and "Site"), located at 980 Hurricane Road in Franklin, Johnson County, Indiana (see Figures 1 and 2). The Site is approximately one-mile northeast of downtown Franklin. This SB document describes EPA's proposed Final Remedy for the Site ("Final Remedy" and "remedy").

The original work on the Site occurred during the 1990's. EPA selected the original "Interim Final Remedy" in 1997, leaving an opening for some specific additional investigations discussed below. The on-Site interim final remedy for contaminated ground water ("pump-and-treat" and "groundwater recovery system") continues to operate. The system maintains an inward groundwater gradient to keep the contaminated plume within the Site boundaries and treats the captured contaminated groundwater. However, in 2018, community concern about the Site led EPA to evaluate whether the previously selected remedy was protective of human health and the environment based on updated vapor intrusion guidance and changes in volatile chemicals toxicity. This SB document will describe investigative work and interim remedies completed since 2018 and present a proposed Final Remedy for public consideration and comment.

The proposed Final Remedy consists of treating (cleaning) soil and groundwater contaminated with volatile organic compounds (VOCs) on the former Amphenol Site ("on-Site") and in the nearby residential neighborhood ("off-Site") and monitoring the site until cleanup goals have been met for soils and water. Volatile chemicals are a class of chemicals that evaporate easily and form a vapor in the air. VOC vapors can enter buildings and pose potential risk to the health of occupants, an occurrence called "vapor intrusion" (VI). VI happens when VOC vapors from sources beneath buildings (in the soil and groundwater) or through conduits like sewer lines enter buildings. EPA's short-term remedial goal is to mitigate risk to people from VI by reducing the VOC levels in soil and groundwater. The long-term remedial goal is to achieve drinking water standards in the groundwater. The proposed remedy is designed to protect people in the nearby residential community, people currently using the Site, and future construction and industrial workers from potential harmful health effects caused by exposure to contamination.

Amphenol has completed several remedies (known as Interim Measures) between 2018 – 2020 to eliminate and mitigate potential risks from VI (see the Interim Measures section, below). The details of the proposed remedy are provided below. When EPA selects the Final Remedy, Amphenol will prepare a detailed design document for its implementation. EPA will review and approve this design document before it is implemented. The remedy discussion is separated into on-Site and off-Site components.

EPA invites comments from the public on the proposed remedy during the 45-day public comment period that runs from May 18, 2022 to July 1, 2022. See Section VII for instructions on how to provide comments to EPA on the Statement of Basis.

Public comments will be used to inform EPA's final decision regarding the remedy selection. EPA will publish a Final Decision and Response to Comments document conveying EPA's decision about how the Site will be remediated as well as respond to public comments approximately 60 days after the close of the comment period, depending on the volume of comments the Agency receives.

1.1 RCRA Corrective Action Order on Consent

The remedial work being completed on this Site is required under a 1998 Administrative Order on Consent (AOC) with Franklin Power Products, Inc., and Amphenol Corporation. The AOC was issued under the authority of Section 3008(h) of the Solid Waste Disposal Act (commonly referred to as the Resource Conservation and Recovery Act of 1976 ("RCRA")), as amended by the Hazardous and Solid Waste Amendments of 1984, 42 U.S.C. § 6928(h)). The AOC established EPA oversight of the remedial process. Under the AOC, Amphenol Corporation is the "Performing Respondent," assuming primary responsibility for executing the scope of work, while Franklin Power Products, Inc. is the "Owner Respondent." Contaminant releases occurred during operations by a former Site owner, the former Bendix Corporation. This SB documents refers to Amphenol Corporation as the responsible party who completed the recent investigation, performed interim measures, and proposed the Final Remedy to EPA.

An earlier 1990 AOC between EPA and Franklin Power Products, Inc., and Amphenol Corporation required a RCRA Facility Investigation (RFI) and a Corrective Measures Study (CMS) and in addition, resulted in the installation of an on-Site groundwater recovery system, commonly referred to as a pump and treat system, as an Interim Measure. The 1998 AOC that followed was called an "Interim Final Decision" and included a remedy that was selected by EPA in 1997. Instead of a final decision, an Interim Final Decision was selected based on a concern at the time that the Site may have contaminated a public water supply well field (Indiana-American Webb Well Field). However, in 2007, the Indiana Department of Environmental Management (IDEM) determined that the source of contamination to the well field was the Hougland Cannery, which became a Site under the IDEM State Cleanup Program. The 1998 AOC required Amphenol to:

1) operate and improve the existing on-Site groundwater recovery system
2) implement an air sparge/soil vapor extraction system[1]

[1] The groundwater pumped out is made into a spray and the vapor from that is cleaned through a carbon filter.

3) establish a monitoring program to evaluate the results of the corrective measures and to establish institutional controls, and
4) investigate possible contaminant migration from the Facility to the Webb Well Field and execute any related corrective action if the contaminant migration was confirmed.

1.2 RCRA Corrective Action Activity Since 2018 to Present

1.2.1 **Actions Taken 2018 - present**

In 2018, activities at the Site mainly consisted of the operation, maintenance, and monitoring of the groundwater recovery system installed in 1995. In June 2018, community members raised concerns to EPA that the Site had not been properly evaluated and remediated and that residual contamination was the potential cause of incidences of pediatric cancer in Johnson County.

In response to concerns raised from the community and after a review of the historic file, EPA began a re-evaluation of Site conditions on and off-Site in July 2018. EPA required Amphenol to evaluate ambient (outdoor) air around the groundwater recovery system and the system vent pipe. The ambient air investigation determined that VOC levels at the Site perimeter were non-detect or below residential indoor air screening levels (IWM, August 2018). The VOC measurements at the system vent showed levels well below what IDEM would require in an air permit. The evaluation was repeated in 2019 with similar findings.

During an August 3, 2018 EPA public meeting held by IDEM and the Indiana State Department of Health (ISDH), EPA committed to a complete Site re-evaluation. During the re-evaluation, EPA concluded, from the historic file review, that residual contamination along the sanitary sewer lines and in groundwater could pose a vapor intrusion risk to the adjacent residential community. EPA determined that during the Bendix Corporation operations, it is likely that waste solvents containing VOCs from plating room operations had been released to the plating room floor and the sanitary sewer line connected to the residential area. Leaks in the sewer line contaminated the surrounding soil, sewer bed, and groundwater on-Site and in the residential area.

EPA based its 1997 EPA Interim Final Decision in part on a 1996 vapor intrusion risk evaluation that concluded soil and groundwater contamination in the residential area did not pose a threat to people (A.T. Kearney, Inc., 1996). EPA's re-evaluation, using current (updated) vapor intrusion methodology and toxicity science found a potential exposure risk from vapor intrusion into homes and commercial buildings. EPA required that Amphenol perform several investigations to evaluate current conditions, including indoor air evaluation of homes, and to address human health risks and conduct interim cleanup measures, as needed to protect human health.

From September 2018 to August 2020, Amphenol performed indoor air testing in homes and in the on-Site building as well as testing residential plumbing systems for integrity. Amphenol performed intervention or mitigation measures where data indicated vapor entry or when the building structure presented a potential for vapor entry. Concurrently, Amphenol investigated groundwater, soil, soil vapor and sewer vapor conditions. Amphenol completed sewer replacements and soil removals as interim measures from August 2019 through January 2020. The sewer replacements and soil removals were coordinated with the City of Franklin and provided municipal infrastructure improvements.

The interim measures completed to date are described in Section IV. Groundwater is not used for drinking water purposes in this area of Franklin. Environmental media investigations indicate that further remedial actions are warranted for soil and groundwater to eliminate the potential for future vapor intrusion of VOCs into residential structures in the Study Area as depicted in Figure 3 and to attain the long-term goal of restoring the aquifer to meet the drinking water standards.

1.2.2 **Risk Evaluation Data 2017 - present**

VOCs in the soil and groundwater present a concern for potential soil vapor exposure for select residential structures with basements, located on Hamilton Avenue and Forsythe Street, to the south of the Site. After hearing concerns from residents that a potential pediatric cancer cluster may exist in the City of Franklin and Johnson County, IDEM asked the ISDH to conduct a cancer inquiry investigation based on the statistical data and Center for Disease Control and Prevention (CDC) guidance. The analysis was summarized in the Report *Findings of a Cancer Inquiry Investigation, Johnson County, Indiana, 2015-2017* (ISDH 2017). The Report concluded that there was not a pediatric cancer cluster in Johnson County. In addition to the ISDH evaluation, the National Center for Environnmental Health, Division of Environmental Science and Health Practice sent a letter on November 16, 2018 letter ISDH 2017 evaluation.

In 2018, EPA began investigations and required Respondents to address the potential soil vapor exposure pathways within the Study Area. By 2020, all potential soil vapor exposure pathways have been mitigated to prevent exposure to VOCs into residential structures above IDEM Residential Indoor Air Screening Levels. Therefore, EPA has determined the current Site conditions do not pose a human health risk for residents within the Study Area that provided EPA access for indoor air sampling. Additionally, the sanitary sewer system has been replaced or lined on portions of Hamilton Avenue, Forsythe Street, Ross Court, and Glendale Drive to reduce the potential for vapor intrusion into the sanitary sewer system (which could result in potential exposure to VOCs through leaky residential plumbing systems). All tested residential plumbing systems which exhibited vapor leaks were repaired during residential vapor intrusion investigation activities. While exposure pathways have been mitigated for residents within the

Study Area, the risks from VOCs in the soil and groundwater at the Site will be addressed through the Interim Measures (IMs) and the engineering and institutional controls in the remedy proposed in this SB.

In addition to the remedy proposed in the SB, separate professionals are addressing concerns from citizen groups regarding pediatric cancer cases in the town of Franklin. The Agency for Toxic Substances and Disease Registry (ATSDR), a federal public health agency, has been compiling data on outdoor air, indoor air, groundwater, and drinking water reported by EPA and IDEM at several cleanup sites and will follow a standard process to assess whether releases might contribute to non-cancer and cancer health effects in exposed persons. The agency is currently preparing a report for public release. The full report will have separate sections on indoor air and drinking water and will indicate whether there is a potential health hazard and, if so, what mitigation measures can be taken.

1.3 Proposed Remedy Summary

In this Statement of Basis document, EPA proposes the following remedies:

On-Site Proposed Remedies:

1. Permeable reactive groundwater treatment barrier ("groundwater treatment remedy");
2. Permanently shut off groundwater pump and treat system if Corrective Action Objectives ("CAO") are reached in a reasonable time frame; and
3. Inject treatment materials into soil to breakdown VOCs ("soil source treatment remedy").

Off-Site Proposed Remedies:

1. Permeable reactive groundwater treatment barriers ("groundwater treatment remedy");
2. Monitored Natural Attenuation ("MNA"); and
3. Continued operation and monitoring of off-Site engineering controls for vapor intrusion mitigation.

For a full explanation of the proposed remedies, which include both short-term and long-term goals for remediating soil and groundwater, see Section VII: Proposed Final Remedy and Evaluation of Alternatives.

2. SECTION II: FACILITY BACKGROUND

2.1 Site Location

The former Amphenol Facility is located on the northeast side of Franklin, approximately one-mile northeast of downtown Franklin. The Site is bound on the east by Hurricane Road, on the

South by Hamilton Street, on the north by an abandoned rail line, and on the west and northwest by the former Farm Bureau Co-Op facility and the former Arvin Industries facility. Land use around the Facility is light industrial to the west, north, and east, agricultural to the northeast, and residential to the south. The former Facility covered around 15 acres and has been sold off in parcels. The main structure on the facility is a 46,000 square foot building that was formerly used in the manufacture and distribution of electrical components. Currently, the building is rented to light industrial companies. The pump-and-treat system that has been operating as an interim remedial measure is on a 1.5-acre parcel of mown lawn on the southeastern portion of the former facility. The remaining area surrounding the main building is primarily paved.

The Study Area, as depicted in Figure 3, is relatively flat with approximate elevations ranging from 730 and 735 feet above Mean Sea Level. Within the Study Area, the topography slopes to the southeast, toward Hurricane Creek. The Study Area includes portions of streets and adjacent structures that are near and down-gradient of the former facility, including Hurricane Road, Hamilton Avenue, Forsythe Street, Glendale Drive, and Ross Court. For detailed information regarding Site characteristics, see the Second Supplemental Corrective Measures Study (IWM March 2022) and the RCRA Facility Investigation ("RFI") Report (WW Engineering and Science 1994).

2.2 Ownership, Manufacturing, and Release History

Dage Electric, Inc., developed the Site in 1961 and constructed a 46,000-square foot building to manufacture and distribute electrical components. In 1963, the operation was acquired by Bendix Corporation (Bendix) for the Bendix Connector Operations plant to manufacture electrical connectors. When Bendix operated the Site, it covered an area of approximately 15 acres. The Site operated as an electric connector manufacturing facility (Bendix facility) from approximately 1961 through 1983.

In 1983, Bendix merged with Allied Corporation's Amphenol Products Division. Consequently, the manufacturing work at the Bendix facility ceased in September 1983 and the plant closed. In 1986, Amphenol Products Division became Amphenol Corporation, a wholly owned subsidiary of LPL Investment Group, Inc. In June 1989, the Amphenol Corporation sold the Facility to Franklin Power Products, Inc., which manufactured fuel injectors for diesel engines and assembled marine diesel engines at the Site. In January 2007, Franklin Power Products, Inc., sold the Site to Lancer Leasing LLC.

The Site has since been sub-divided into five parcels and an existing building is occupied by companies renting space there. Amphenol leases the southern 1.5 acres for its groundwater remedial system consisting of underground infrastructure and a small shed-sized building. Vacant portions of the Site to the north and west of the Site facility buildings and parking areas have been sold to Bastin Logan Water Services, Inc. (a potable water well drilling company) and a self-storage unit facility, currently under construction.

Historical industrial activities at the Site consisted of manufacturing electrical connectors, electroplating, machining, and storing products and raw materials required for production. From approximately 1963 to 1983, waste acid, cyanide/alkalide, and chromium wastewaters from plating operations were routed into a sanitary sewer manhole, which discharged into the municipal sanitary sewer system south of the Facility, under a discharge permit issued by the City of Franklin. In addition, spills in the plating room migrated to the soil beneath the building through cracks in the foundation. The electroplating room was in the southwest corner of the main Site building. The wastewater discharge consisted of plating solvents made from VOCs, primarily tetrachloroethylene (PCE) and trichloro ethylene (TCE). In 1981, Bendix built a wastewater pretreatment system in a small building at the southwestern end of the parking lot to treat the plating room wastewater with cyanide and chromium. Treated wastewater was discharged to the sanitary manhole south of the Facility. IDEM began closure of RCRA units in February 1984 (the above ground and below ground storage tanks and the drum storage area).

Although the wastewater was treated for metals, the wastewater still was contaminated with VOCs. When the contaminated wastewater flowed within the sanitary sewer line downstream (southward) through the residential area, it leaked from cracks and offset joints in the pipeline, contaminating the soil and groundwater beneath. The impacted areas include the southern portion of the Site and portions of Hamilton Avenue, North Forsythe Street, and Ross Court. The soil and groundwater became secondary sources of VOC vapors that entered the sewers. Amphenol investigated the extent of contamination to delineate the Study Area and worked with EPA to identify homes to test for vapor intrusion.

2.3 Site Characteristics

The following subsections describe the Site's physical characteristics.

2.3.1 Surface Drainage

The Site is relatively flat with a south/southeasterly gradient towards Hurricane Creek. Surface drainage from a large area north of the property enters a 60-inch storm sewer at an infall located on the Arvin property immediately adjacent to the northwest corner of the property. The storm sewer lies along the western property boundary and receives additional flow from a sewer opening on Farm Bureau property located about 450 feet south of the northwest property corner. At the southwest property corner, the storm sewer turns east. Directly south of the main building, the sewer turns south again and extends to Hamilton Avenue. At Hamilton Avenue, the sewer line turns and runs east along the south property line. The storm sewer crosses under Hamilton Avenue in the extreme southeast corner of the property, and discharges 1200 feet southeast of the Site to a small creek connected to Hurricane Creek.

2.3.2 Geology, Soil, and Hydrogeology

The Site is located within the Tipton Till Plain physiographic unit having low-relief topography (flat) and underlain by thick deposits of glacial drift. The geology at the Site has four distinctive units, Units A through D. In the Study Area, Unit A is the uppermost geologic unit, a weathered glacial till, which extends three to eight feet below ground surface ("bgs"). Unit B is the second encountered geologic unit in the Study Area which consists of a sand to silty sand that is saturated in the lower part and extends to eight to twenty-six feet bgs, shallowing in the southern portion of the Study Area. The lower part of Unit B is saturated with groundwater. Unit B overlies a hard, dense till unit about 35 feet thick ("Unit C"), which is the third encountered geologic unit in the Study Area which consists of a slightly moist to dry, hard and dense till which is thirty to thirty-five feet thick. The depth to clay (Unit C) is deepest on-Site at around 25 feet and becomes gradually shallower approaching Hurricane Creek. Unit C, in turn, overlies Unit D, which is the fourth and final investigated geologic unit in the Study Area, Unit D consists of sand that is approximately twelve feet thick.

2.3.3 Localized Groundwater Flow Direction

On-Site, the top of the groundwater ("water table"), is around 7 – 17 feet bgs, depending on the well measured and the year it was measured. The water table becomes shallower as it approaches Hurricane Creek where it is less than 3 feet bgs. The general groundwater flow direction in the Study Area is south by southeast towards Hurricane Creek, as demonstrated during groundwater monitoring activities. (See Figure 4, Potentiometric Surface Map).

Local groundwater flow is captured by the groundwater pump-and-treat system. The groundwater pump-and-treat system was installed in 1995 and upgraded in 1997 to increase its pumping capacity. The system was designed and modified to maintain hydraulic control over the dissolved VOC plume, keeping the groundwater within the Site boundaries and lowering the water table to prevent it from intersecting the stormwater and sanitary sewer pipes. Figure 5 demonstrates how the groundwater capture system works by comparing potentiometric surface contours with and without the recovery system operating.

2.3.4 Surface Water and Ecology

Hurricane Creek is located east and south of the Site and flows primarily southward in this area. Based on the investigations conducted from 2018 to 2020, the groundwater plume in Unit B and Unit C as described in Section 2.3.2 does not reach the creek based on groundwater results collected from temporary wells TW-20, TW-21, TW-24, and TW-25 (March 2019) and permanent monitoring well MW-33 (semi-annual since September 2018), see Figure 9.

Additionally, soil analytical results from borings DSB-23 through DSB-33 (February 2019) collected during off-Site interim measure design activities indicate that soil impacts do not extend south beyond soil boring DSB-23 along Forsythe Street. Soil and groundwater contaminant concentrations from all of these sample locations were below IDEM screening levels and/or laboratory detection limits.

2.3.5 Water Supplies and Groundwater Use

The former Facility, commercial buildings around the Site, and the homes in the Study Area as depicted in Figure 3 are serviced by a municipal water supply. EPA is not aware of any private water wells in the Study area.

3. SECTION III: ENVIRONMENTAL INVESTIGATIONS FROM 1985 – PRESENT

3.1 Historical Environmental Investigations (1985 – 2018)

3.1.1 Former Plating Room Floor and Sanitary Sewer Line (1985)

In 1985, Allied/Bendix began a cleanup of the area around the former plating room facilities, including removing the plating room floor and excavating the soil beneath to a depth of nine feet. The 572 tons of impacted material was sent for off-site disposal. Allied/Bendix treated the excavation with calcium hypochlorite, then backfilled the pit with clean soil and poured a new concrete floor. Allied/Bendix also replaced the sanitary sewer lateral beneath the property and replaced 300 feet of damaged sanitary sewer line on its property, locating the new line approximately 35 feet to the east to avoid potentially contaminated soils. In 1985 Allied/Bendix also excavated and disposed of approximately 856 cubic yards of impacted soil from beneath the former plating room floor, disconnected and plugged the subject Site's former sanitary sewer lateral and installed a new sanitary sewer lateral beneath the property. The old sanitary sewer line was left in place and was addressed in 2018.

3.1.2 Storage Tanks (1990)

An underground cyanide tank and above-ground container storage area were "clean closed" under IDEM authority. There are no records of other underground tanks at the site. Borings installed around the Site for other purposes did not encounter any buried tanks or infrastructure such as piping.

3.1.3 **Source Area Remediation (2006 – 2012)**

Numerous corrective actions have been implemented at the plating room source area, including completion of an enhanced bioremediation pilot study (2006 and 2010/2011); installation of a vapor mitigation system at the former manufacturing facility (2010); source remediation using In-Situ Chemical Oxidation (ISCO) beneath the former plating room (2011/2012) and installation of a sub-slab vapor barrier beneath the new concrete floor of the former plating room (2012).

3.2 Environmental Investigations Overview (2018 – Present)

The renewed investigations at Amphenol began in July 2018,[2] in response to community concern about residual VOC contamination from the historical releases by the Bendix Corporation, including emissions from the groundwater recovery system. EPA first required that Amphenol investigate the ambient (outdoor) air around the system and its vent pipe under an EPA approved work plan. The system pumps in or "recovers" contaminated groundwater and removes the VOCs through an air-stripping process. The ambient air investigation using specialized instruments placed around the Site perimeter showed that VOC levels were below residential screening levels or not detectable ("non-detect" as reported by the laboratory). The data was posted on the Amphenol site web page in early August 2018, along with a fact sheet explaining the investigation.

For the renewed investigation into Site conditions, EPA's risk management strategy was to initially focus on vapor intrusion investigations in homes to determine what immediate response actions might be needed to mitigate any exposure risks to residents from VOCs (see Section IV. - Interim Measures). When the residential indoor air investigations were underway, Amphenol began investigating the extent of contaminated environmental media both on- and off-Site, as described below.

3.3 Off-Site Environmental Investigations (2018 – Present)

3.3.1 **Off-Site Contaminant Characterization**

Land-use in the off-Site portion of the Study Area is primarily residential with some light industrial properties. Investigations determined that the Study Area was still impacted with VOC

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[2]Amphenol's contractor, IWM Consulting Group, LLC (IWM), represents Amphenol while performing work under the AOC. While IWM or its subcontractors performed the investigations described in the SB, the work is attributed to Amphenol in this document.

contamination 35 years after the releases ended in 1983. VOCs were found in the groundwater, soil/sewer bedding and vapors were found in the sanitary sewer system, including the lateral pipe connections to homes. Amphenol completed a sanitary sewer and soil remedy in 2019 – 2020, as an interim measure to mitigate vapor intrusion from the sewer pathway. The City of Franklin, Amphenol, and EPA worked together on a sewer replacement and soil removal project as the City had been planning a sewer improvement project in the Study Area before EPA decided to pursue additional Site investigation. The removal of contaminated soil and sewer bedding, sewer pipe and groundwater reduced the potential for further groundwater contamination (see the Interim Measures and Other Cleanups Section IV below).

The off-Site corrective measure evaluation focused on impacts at residential properties and public ROWs within the Study Area impacted by contaminants of concern (COCs) which originated from the Site.

3.3.2 **Off-Site Indoor Air Vapor Intrusion Investigation**

Homes in the Study Area were targeted for indoor air testing if they were:

1) Above the contaminated groundwater plume;
2) Adjacent to tested homes where the soil gas or indoor air exceeded the screening level; and/or
3) Adjacent to a sanitary sewer line with elevated vapor measurements.

Homes on the list were identified as "Priority Residences" (PR). Based on the above requirements for indoor air testing, 42 homes were identified for indoor air testing. Thirty-seven homes were sampled; five homeowners declined access. See the Residential Indoor Air Sampling Summary in Table 1.

Table 1: Residential Indoor Air Sampling Summary

Residential Indoor Air Sampling Summary	TOTAL
Priority residences sampled	37
Sub-slab or exterior soil gas exceedances	7
Sewer gas exceedances	19
Vapor mitigation systems recommended	7
Vapor mitigation systems installed	7
Plumbing vapor leaks tests conducted	11
Plumbing vapor leaks detected/repaired	9
Indoor air exceedances	5
Indoor air exceedance due to sewer gas	2
Indoor air exceedance due to soil gas	1
Indoor air exceedance due to combination of soil and sewer gas	2

Amphenol tested indoor air of homes where access was granted between 2018 and 2020 (37 of 42 homes). Homes were tested both in summer and winter to capture vapor intrusion potential under changing conditions. Amphenol used vapor leak pressure tests at homes where sewer main and lateral pipe (connections to the sewer main) vapors were elevated. Amphenol also repaired plumbing systems in nine homes, where conditions in the piping created a potential conduit for vapors. In seven homes where soil gas and or indoor air exceeded screening levels, Amphenol installed sub-slab depressurization systems that captured and vented vapors trapped beneath the slab to assure the vapors did not enter the home. In many of these homes, the mitigation systems were installed as a conservative measure because changing conditions such as seasons, heating and cooling system use, and groundwater levels could promote vapor intrusion. Generally, the historical release of VOCs to the soil and groundwater created a vapor intrusion exposure concern for certain homes south of the Site.

Homeowners within the Study Area were kept informed and engaged during the indoor air testing process. First, they were contacted by Amphenol's consultant via letter to explain vapor intrusion concerns and to request access (Amphenol Corp was the party completing the testing, so they were party to the access agreement). Once appointments were made, the sampling was a three-day process. The first day, testing equipment was set up, the second day, the 24-hour

sample cannister was installed, and on the third day the sample canister was removed and sent to the laboratory for analysis.
Preliminary laboratory results were generally provided to Amphenol by the laboratory within three days. A third-party validation service provided validated results within approximately 10 days after receipt of the Quality Assurance/Quality Control (QA/QC) data package from the laboratory. Homeowners were provided their results by letter and provided the opportunity to meet in person if desired. If conditions met the criteria for recommending a vapor mitigation system (soil gas or indoor air exceedance of screening levels), Amphenol's consultant would also meet with the property owners in person to discuss the results and recommended next steps or discuss this matter over the telephone if the property owner was not available to meet in person. EPA and ATSDR also spoke with some homeowners about sampling results.

3.3.3 **Off-Site Groundwater Investigations**

Amphenol assessed groundwater conditions to determine the extent of the PCE and TCE plumes. For the investigation, Amphenol used existing and new groundwater monitoring wells, and 43 temporary well points to sample groundwater. The results were used to define the extent of contamination in the shallow (groundwater table interface) and deep (base of Unit B) saturated portions of geologic Unit B.

The groundwater plume extent was determined before and after the sewer and soil interim Measure (IM) was implemented; the groundwater treatment pilot study was initiated during construction of the IM. The plume footprint indicates that the sanitary sewer system conveyed solvent waste from the former Bendix Site and that the waste leaked into the ground from cracks and unsealed joints in the sewer line. The highest concentrations of TCE are near the sewer line and concentrations decrease farther away from the line. Sampling results indicated that the IM and the pilot study reduced the PCE and TCE plume footprints (See Figure 8 and 9). Prior to 2019, eight off-Site monitoring wells were sampled and analyzed. Sixteen monitoring wells were added to the monitoring network since 2018 to obtain information on the off-Site groundwater conditions.

3.3.4 **Off-Site Sewers Investigation**

In 2018, Amphenol collected sewer vapor samples from twenty-three (23) sanitary sewer manholes and four (4) storm sewer manholes using Suma Canisters™ along North Forsythe Street, Hamilton Avenue, Ross Court and Glendale Drive. Except for the protection of workers in the sewers, there are no federal or state standards relating to sewer vapors. As a reference point for the sewer vapor intrusion pathway, the sample results were compared to IDEM residential indoor air screening levels. Fourteen manhole vapor samples were above the screening levels (SLs). The observed concentrations were also compared to the Calculated Sewer Vapor Reference Value

(CSVRVs). Concentration fluctuations were noted throughout the post Off-Site Interim Measures (OIM) confirmatory sampling events. Amphenol measured VOC vapors in the sanitary sewer lines before and after the off-Site soil and sewer IM, see Table 2. The initial investigation was to evaluate conditions in the sewer line and to inform the CSM about potential sewer vapor intrusion.

Following the soil and sewer IM, Amphenol re-sampled the manholes along with the sewer laterals of several homes in April 2020. The vapor levels were unexpectedly elevated in thirteen of the manholes. Amphenol observed that the elevated vapor concentrations were a result of a malfunction of the on-Site groundwater recovery system based on sewer line samples upstream and downstream of the system and proposed a recovery system modification. Following EPA's approval and the recovery system modification, Amphenol re-sampled the sewer lines and confirmed that the vapors had cleared. For details, see the SSCMS and the *Draft Post-OIM Sewer Gas VI Evaluation Report*, June 24, 2020. In addition, Amphenol re-sampled sewer manholes in February 2021 to confirm that the sewer vapor levels remained low. (SSCMS, Table12, IWM, March 2022)

In the SSCMS, Amphenol presents a Site-specific Calculated Sewer Vapor Reference Value (CSVRV) that can be used qualitatively to evaluate sewer vapor measurements. The reference values are based upon attenuation factors developed using Site vapor measurements in the sanitary sewer main, home lateral, and indoor air. Based on vapor analysis using the reference values, additional investigation may be initiated.

Table 2: Range of sewer vapors in the manhole before and after the interim measures.

Chemical of Concern	On-site Range		Off-Site Range		Short-Term CAO Completed through IM	Long-Term CAO
	Pre-IM	Post-IM	Pre-IM	Post-IM	IDEM RCG Residential Indoor Air	Sewer Vapor
1,1-DCA	<0.086 - 7.0	<0.17	0.072 -22.2	<0.086 - <0.22	18	2654.90
1,2-DCA	<0.083 - 2.0	<0.17	<0.083 - 6.7	<0.086 - <0.22	1.1	162.20
cis-1,2-DCE	<0.085 - 115	<0.17	<0.073 - 89.5	<0.085 - <0.22	N/A	N/A
trans-1,2-DCE	<0.083 - 0.41	<0.16	<0.074 - 0.51	<0.085 - <9.6	N/A	N/A
MC	<7.6 - 12.8	<0.16 - <7.1	<7.7- 70.0	<0.16 - 7.7	630	92,920
PCE	3.0 - 260	0.20	0.14 - 2320	<0.22 - 6.7	42	6194.70
1,1,1-TCA	<0.24 - 33.7	<0.22	0.11- 307	<0.22 - <0.24	5200	766.961.70
TCE	0.91 - 111	<0.11	<0.11 - 1290	<0.11- 228	2.1	309.7
VC	<0.053 - <0.055	<0.053	<0.051 - 3.0	<0.031 - <0.057	1.7	250.7

*All units in $\mu g/m^3$. Refer to tables in SSCMS- Table 12. N/A: Screening level not available. NCAO: Numerical Corrective Action Objectives, IDEM- Indiana Department of Environmental Management, RCG- Residential Cleanup Goals.

3.3.5 **Off-Site Soil Investigation**

Based on the results of the off-Site sewer and soil gas investigations completed within the ROW in September/October 2018, Amphenol advanced forty-seven (47) off-Site soil borings and two (2) temporary well borings (TW-15 and TW-16) to the base of Unit B in 2019 to support development of the remedial design described in the *Off-Site Interim Measure Work Plan* (IWM 2019).

During the investigation, one hundred eighty-three (183) soil samples were collected and submitted for laboratory analysis of select VOCs. The borings were continuously sampled and select sample intervals were submitted for laboratory analysis to determine the locations within the soil profile that were impacted by COCs (above, at, or below the sewer pipe). Soil borings were concentrated in areas surrounding documented breaks in the sanitary sewer main observed in a 2015 sewer inspection by the City of Franklin. Amphenol also placed soil borings approximately every 100 feet along the sewer main along portions of North Forsythe Street, Hamilton Avenue, Ross Court, and Glendale Drive. Additional information about the OIM design-level soil boring locations can be found in the *Off-Site Interim Measure Work Plan* (IWM 2019).

3.3.5.1 Post-Construction Soil Analytical Results

Following the interim measure construction, no unsaturated soil samples exhibited an adsorbed COC concentration in excess of the site-specific re-calculated MTGSL. All other soil samples which exhibited a COC concentration in excess of a site-specific re-calculated MTGSL were saturated and the results are biased high due to the presence of impacted groundwater within the soil matrix.

Post-construction sampling reported only 15 (including 3 duplicates) of the 183 soil samples exhibited COC concentrations that exceeded the Site MTGSLs. All saturated zone soil samples were primarily from the base of Unit B. All off-Site soil samples exhibited COC concentrations less than residential cleanup goals ("RCG") for residential direct contact ("RDC") and Excavation Worker Soil Exposure Direct Contact Screening Levels ("EXDCSL"). Laboratory analytical reports and third-party data validation reports were included in the *OIM Report* (IWM 2020).

Table 3: Range of COC levels in Soil (unsaturated and saturated).

Chemical of Concern	Range in bottom of Unit B	Range in Top of Unit C	Unit B	CAOs for Unsaturated or Smear Zone Soils	CAOs for Saturated Soils
	Saturated	Saturated	Unsaturated	Screening Level Re Calculated RCG MTGSL (mg/kg)	RCG Excavation Worker Soil Exposure Direct Contact Screening Level (mg/kg)
1,1-DCA	<0.00036 - <5.7	<0.00036 - <24.4	<0.00022 - <0.026	1.399	1700
1,2-DCA	<0.00039 - <25.0	<0.00034 - <24.4	<0.00029 - <0.026	0.6	730
cis-1,2-DCE	<0.00030 - <21.8	<0.00027 - <24.4	<0.00026 - <0.026	0.855	2400
trans-1,2-DCE	<0.00022 - <21.2	<0.00020 - <24.4	<0.00018 - <0.026	1.258	1900
MC	<0.00040 - <20.6	<0.0021 - <17.3	<0.0020 - 1.0	65.008	3300
PCE	**<0.00031 - 767**	<0.00019 - 2460	0.00017 - 2.0	2.667	70
1,1,1-TCA	<0.00034 - <30.8	<0.00022 - <24.4	<0.00020 - 0.12	181.959	640
TCE	<0.00020 - 47.3	**<0.00018 - 66.6**	0.00022 - 0.25	0.153	95
VC	<0.000085- <5.1	<0.00015 - <24.4	<0.00013 - 0.26	0.022	1300

*All units in mg/kg. Please refer to Table 1 in SSCMS. NCAO- Numerical Corrective Action Objectives, IDEM-Indiana Department of Environmental Management, RCG- Residential Cleanup Goals.

3.3.6 **Off-Site Groundwater Pilot Study Evaluation**

In 2019, Amphenol proposed a pilot study to evaluate whether in-situ injections of a treatment medium could destroy the chlorinated VOCs in the off-Site groundwater. A remedial pilot study is used in a representative area to evaluate whether a full-scale application of the remedy being tested would be successful. EPA approved the *Pilot Study Work Plan* (IWM 2019), which described the objectives and methods for evaluating an off-Site in-situ groundwater remedy. Amphenol completed the pilot study between October 2019 through April 2020 using a specialized subcontractor. The study evaluated the effects of injecting a treatment medium into the aquifer at two locations, Study Areas 1 and 2 (see Figure 10). Overall, the testing showed that the treatment medium was successful at treating chlorinated VOCs.

The pilot study was an in-situ approach, meaning that the testing was done in the ground at the Site itself, rather than in a laboratory. The treatment medium being tested was sulfated zero-valent iron mixed with activated colloidal carbon which had been successfully used to treat similar contamination at other Sites by the provider. The approach was designed to enable two contaminant removal processes: adsorption to soil particles by the carbon and chemical destruction of the VOCs by the sulfated zero-valent iron. Refer to Remedial Technology Fact Sheet – Activated Carbon-Based Technology for In Situ Remediation, EPA April 2018 https://www.epa.gov/sites/production/files/2018-04/documents/100001159.pdf.

The testing areas were in the residential portion of the Study Area. Area 1 surrounded monitoring well MW-35 on Hamilton Avenue near the entrance to Glendale Drive. This area was representative of natural sub-surface conditions. Observed groundwater improvements were representative of the expected results if this technology were to be employed throughout portions of the Study Area. Area 2 was a linear zone along the newly installed sewer main on North Forsythe Street, approximately between monitoring well MW-37 and Ross Court. Six temporary injection wells were installed within the observed saturated portion of Unit B, approximately 50 to 100 feet apart (the maximum thickness of saturation was 2.5 feet). The injection wells were installed in the sewer main trench as the pipe was being replaced during OIM implementation activities. These temporary injection points allowed for the introduction of a remedial mixture along the base of the newly installed sewer main. The low-pressure injections at the base of the trench functioned as a remedial barrier as groundwater fluctuates within and across the sewer backfill area.

For six months following the injections, Amphenol collected groundwater samples from three monitoring wells in the residential area (MW-31, MW-35, and MW-38). The samples were used to evaluate the effectiveness of the groundwater treatment medium by comparing them to the baseline groundwater VOC concentrations. Groundwater samples associated with the pilot study were analyzed for additional parameters beyond short-list VOCs in order to determine if cVOCs were being destroyed via the β-elimination pathway. Groundwater samples from monitoring well MW-35 were collected to evaluate groundwater conditions in Area 1 and groundwater samples from monitoring wells MW-31 and MW-38 were collected to evaluate groundwater conditions in Area 2.

The pilot study was successful in treating and reducing COCs in groundwater. The determination that the pilot study was a success was based on the observed decrease in dissolved VOC concentrations in groundwater and the generation of ethenes and ethanes also demonstrated that chlorinated VOCs were being destroyed via the β-elimination pathway, in lieu of the hydrogenolysis reductive dichlorination pathway which generates cis-1,2-DCE, trans-1,2-DCE, and VC. PCE was not present in monitoring well MW-35 during the baseline sampling event. However, PCE was reduced 53 percent at monitoring well MW-38 which is located 30 and 60 feet from the two closest pilot study injection points. Groundwater results at monitoring well MW-35 reflected the complete elimination of chlorinated VOCs without the generation of any daughter by-products and groundwater results at monitoring well MW-38 exhibited a 74% reduction in VOC concentrations. Dissolved oxygen and ORP field data readings demonstrated that an anaerobic environment was present in the vicinity of monitoring well MW-35 while data obtained from monitoring wells MW-31 and MW-38 only exhibited temporary periods where the subsurface environment may have become anaerobic.

For more details and tables summarizing pilot study groundwater analytical results, see the SSCMS and the *Off-Site Groundwater Treatment Pilot Study Evaluation Report* (IWM 2020).

3.4 On-Site Environmental Investigations (2018 – Present)

3.4.1 Source Area Remediation (2019)

Numerous corrective actions have been implemented at the plating room source area, including: in 2019, Amphenol dug out the old sanitary sewer line and surrounding 341 tons of contaminated soils for off-site disposal (while mobilized for the off-Site Sewer and Soil Interim Measure).

3.4.2 On-Site Storm Sewer Repair (2021)

Amphenol repaired the 600-foot portion of a municipal sewer line that crosses the Site to prepare for the Final Remedy. A September 2020 video and visual inspection of the interior of the 60-inch diameter corrugated metal pipe reported separated joints where the original seals had deteriorated. Minor portions of the storm sewer line intersect the water table. However, the on-Site groundwater recovery system depresses the groundwater sufficiently to keep the line above the water table. In preparation for remedial work that will require turning off the system which would raise the water table, Amphenol repaired the line to prevent interception of contaminated groundwater. The stormwater line was thoroughly cleaned before work began. In addition, the storm sewer rehabilitation will be completed in anticipation of the selection of an on-Site remedy to minimize the potential for short-circuiting of injected materials. The stormwater line discharges to Hurricane Creek. See the *Storm Sewer Rehabilitation Summary Report* (IWM 2021 July). A detailed description of on-Site sewer IM is included in Interim measures Section.

3.4.3 **On-Site Indoor Air Vapor Intrusion Investigation**

Indoor air of the on-Site commercial building was tested twice between 2019 and 2020; no exceedances of the VOCs were reported.

3.4.4 **On-Site Soil and Groundwater Investigation**

The primary objective of the on-Site soil and groundwater investigation was to define the horizontal and vertical extent of adsorbed-phase VOCs and potential non-aqueous phase liquid (NAPL) in soil, and to provide information on groundwater conditions. This soil and groundwater information was used to design a remedy. Soils with high concentrations of VOCs adsorbed onto soil particles can contaminate groundwater by *partitioning* (phase or dissolve) into groundwater where they move with the groundwater as a contaminated plume. An objective of the Final Remedy is to treat these high concentration source areas contributing to groundwater contamination.

Soil conditions were characterized using a two-step approach in three phases between May 2020 and January 2021. The information from the on-Site soil and groundwater investigations was used to develop the proposed on-Site source-area and groundwater remedy. See the soil investigation report and the SSCMS for additional details (IWM 2022).

In the first of a two-step approach, mechanical soil borings were drilled to prepare for membrane interface probe (MIP) screening technology. MIP screening is a qualitative approach that identifies VOC locations in real time. The initial stage of source characterization provided data regarding relative VOC contaminant mass distribution in the soils as well as hydrogeologic properties of the subsurface. The second stage of soil characterization utilized standard Geoprobe® soil borings to screen and collect soil samples for laboratory analysis. During the investigation 327 soil samples (excluding QA/QC soil samples) were collected and submitted for laboratory analysis of select VOCs.

The soil investigation reported that the zone at the bottom of Unit B and the top of Unit C is the area of greatest concentrations of VOCs. These are low permeability zones (clay and silty soils) of the saturated portions of Unit B and within the top foot of Unit C, with impacted depths ranging from 18 to 25 feet bgs. This zone is considered a source area and a continuous source of VOC contamination to local groundwater.

Based on the investigation, the source area appears to begin beneath the former plating room on the southwest corner of the building, extends onto nearby property. The selected treatment area is defined by areas where soil concentrations were found to exceed 40 mg/kg for either PCE or TCE. The 40 mg/kg level for PCE and TCE at the source area was selected as an engineering design marker for the proposed injection remedial strategy. During investigation activities soil concentrations in excess of 40 mg/kg were focused on and considered part of the source area. This area required additional efforts to reduce adsorbed COC concentrations using more aggressive chemical technologies (ISCO) and then use of less aggressive chemical technologies (In-Situ Chemical Reduction and Bio-remediation). Once these higher source area concentrations have been reduced via ISCO injections, then In-Situ Chemical Reduction (ISCR) and Bio-remediation activities will follow in the source area.

Generally, the areas to be treated are the former plating room where the release originated and the area along the former sanitary sewer lateral pipe. The lateral pipe conveyed the historical releases to the sanitary sewer main line connected to the residential area. In 2019, the original pipe and the surrounding soil was excavated for disposal. The remedial design investigations demonstrated that remaining, deeper soils are groundwater contamination source areas. The larger on-Site treatment area is defined by areas where soil VOC concentrations exceeded the IDEM Residential Closure Guidance RDC Screening Levels (RCG RDCSLs) at nearby properties.

In general, soil concentrations in excess of Corrective Action Objectives (CAOs) are limited to the lower two (2) to four (4) feet of Unit B and the upper one (1) to two (2) feet of Unit C and are concentrated in the silt and clay-rich soils in those zones. The approximate depths of the on-Site impacted soils range from approximately 18 to 25 feet bgs. The soil investigation also identified the spatial extent of NAPL, an organic liquid that does not mix with water and will continue to be a direct source of long-term release of chemicals of concern to groundwater. Based on laboratory results and field observations, NAPL was observed in very few sample locations. Additionally, the laboratory results and field observations show soil impacts in excess of CAOs are limited to the lower two to four feet of Unit B and the upper one to two feet of Unit C having silt and clay-rich soils. For a detailed description of the investigation, see the SSCMS and the OSI Work Plan (IWM 2018).

Based on the soil and groundwater investigations, the proposed source area treatment zone encompasses approximately 74,000 square feet; the source area is estimated to be 30,500 square feet as shown in Figure 11. Amphenol is proposing to treat the soil source areas to reduce the amount of new groundwater contamination, as well as treating the VOCs already in the groundwater.

3.4.5 On-Site Groundwater Investigations

On-Site source area characterization and semi-annual monitoring groundwater sample results have demonstrated that VOC impacts above screening levels are limited on-Site to the areas beneath, west, and south of the former plating room at the facility. Groundwater impacts are not present beneath the facility building, outside the footprint of the former plating room. Groundwater impacts downgradient (south) of the former plating room are concentrated along the former sanitary sewer lateral from the facility and sanitary sewer main along portions of Hamilton Avenue and North Forsythe Street. Groundwater impacts have been defined laterally and vertically and are confined within Unit B. The majority of cVOC impacts were observed in the bottom of the saturated portion of this geologic unit. High-concentration soil cVOC impacts have been observed in the upper one to two feet of this geologic unit in the immediate vicinity of the Site. Impacts related to cVOCs from the Site have not been observed within Unit D which was evaluated for the 1994 remedial facility investigation.

Reviewing the characterization data, IWM identified a data gap about conditions around the former plating room. In January 2021, fourteen temporary wells and two permanent monitoring wells were installed within and surrounding the former plating room to assess source area groundwater conditions. Groundwater monitoring data from the existing monitoring well network, the temporary wells, and recently installed on-Site and off-Site monitoring wells have defined the on-site plume.

Table 4: Maximum levels of COCs observed in Groundwater under current conditions.

Chemical of Concern Screened Depth	On-site Maximum GW MW-12 R 22-27ft bgs	Off-Site Maximum GW TW-13 11.25-13.25 ft bgs	Construction Worker Groundwater contacted less than 15 ft/ greater than 15 ft	Short-Term CAO Groundwater Vapor Exposure Screening Level µg/L	Long-Term CAO Drinking Water Cleanup Level /MCL µg/L
1,1-DCA	**11.2**	2.7	99/6170	130	28
1,2-DCA	<50.0	<0.27	5.9/1760	50	5
cis-1,2-DCE	**648**	<5.0	2260	N/A	70
trans-1,2-DCE	4.4	<5.0	157/6130	N/A	100
MC	<50.0	<5.0		N/A	5
PCE	**893**	**58.6**	10.2/289	110	5
1,1,1-TCA	<50.0	21.1	1160/2850	13,000	200
TCE	**242**	**117**	0.49/20.2	9.1	5
VC	**20.9**	<0.97	11.9/164	2.1	2

*All units are in µg/L. See Table 8 in SSCMS. * MCL - Maximum concentration level.

*Screening level based on Virginia Department of Environmental Quality Risk Assessment Model (VURAM)

See available information at: https://www.deq.virginia.gov/land-waste/land-remediation/voluntary-remediation/risk-assessment.

4. SECTION IV: INTERIM MEASURES UNDER THE RCRA AOC

IMs are clean-up actions completed by the company/responsible party in advance of EPA's Final Remedy selection. Generally, interim measures are completed to stabilize a Site or to intercede when there are immediate threats to human health and the environment. At Amphenol, there were two basic periods of interim remediation: 1995 – 1997 and 2018 – 2020. In 1997, EPA selected an Interim Final Remedy to continue operating the groundwater recovery system installed in 1995; the system continues to operate.

In the 1990s, the remedial work to control and remediate contaminated groundwater was considered to be *interim* due to the way the 1998 AOC was written. The AOC required the operation and enhancement of the existing pump-and-treat system designed to contain groundwater on-Site by pumping and to remove VOCs from the groundwater using air stripping. In addition, the AOC required an investigation to determine whether the Site had a northward VOC plume that was contaminating the Webb Well Field, a private municipal water supply system. If the investigation concluded such contamination was occurring from the Facility to the Webb Well Field, additional remediation would have been considered. Therefore, the pump-and-treat system was considered to be an *interim remedy* rather than a final remedy. When IDEM determined that a different site was contaminating the well field and included that site in its State Cleanup Program, EPA concluded its investigation requirement. The 1997 Interim Final Decision did not include remediation of the VOC-contaminated media in the residential area based on an EPA-contracted 1996 risk assessment concluding that the off-Site residual contamination did not pose a risk to residents.

4.1 Interim Measures

4.1.1 Groundwater Pump-and-Treat System (1995 – present)

In 1995, Amphenol installed and began operating an on-Site groundwater pump-and-treat remedial system ("groundwater recovery system"). The purpose of the groundwater recovery system is:

1) to recover and treat impacted groundwater:
2) use hydraulic control to keep the on-Site groundwater contamination within property boundaries; and
3) to depress the surface of the water table below the storm sewer invert, thereby minimizing the possibility of VOCs migrating into the storm sewer and ultimately discharging to Hurricane Creek.

The groundwater recovery system interim measure was activated at the Site in February 1995 and has operated continuously since that time. Currently, around 18 million gallons of on-Site contaminated groundwater are treated yearly. As of April 2021, the system had treated

299,930,870 gallons of groundwater since installation. The groundwater recovery system (pump and treat) had multiple monitoring wells near the pump wells which show the trends in contaminants in groundwater, those monitoring wells are listed in the first column in Table 5. From when the wells were first installed to April 2021 a more than 90% reduction was seen in all the monitoring wells indicating very good performance of the recovery system. The cleaned water is discharged to the sanitary sewer line pursuant to a permit and conveyed to the Franklin wastewater treatment plant.

Table 5: Groundwater Recovery System Performance Data

Well ID	Highest Total VOC Concentration (Date) µg/L	April 2021 Total VOC Concentration µg /L	Percent Reduction
IT-2	289 (8/1/86)	24.9	91.38
IT-3	560 (2/1/86)	Non-detect	99.99
MW-12/12R	64,680 (5/1/86)	707.5	98.91
MW-22	6,600 (10/9/96)	566.6	91.42
MW-28	1,015 (2/17/93)	13.9	98.63
MW-30	106 (9/29/00)	Non-detect	99.99

*All units are in µg/L.

To ensure proper performance of the groundwater recovery and treatment system, Amphenol performs routine operation and maintenance inspections. Twice per month, contractors measure the rate of groundwater flow into the system, groundwater elevations of the recovery wells, routine inspections and necessary repairs of influent and effluent lines, and air stripper maintenance.

Once per month, the depth to groundwater is recorded in specific monitoring and recovery wells. The air stripper trays and effluent discharge line are inspected and cleaned as necessary. Also, influent sediment filters are replaced monthly. Quarterly operation and maintenance activities include, complete disassembly and cleaning of the air stripper trays and sump, maintaining the sequestering agent system, and inspecting the air stripper blower lubrication. All recovery well pumps are also removed and cleaned on a quarterly basis. For more detailed information, refer to the Semi-Annual Reports on the groundwater recovery system.

4.1.2 **Vapor Intrusion Investigation and Mitigation Measures (2018 – 2020)**

In 2018, EPA required that Amphenol test the indoor air of homes in the Study Area for vapor intrusion, and to perform any mitigation measures needed to eliminate exposures. The indoor air vapor intrusion investigations followed an approved EPA work plan that was based on the EPA/OSWER *Technical Guide for Assessing and Mitigating the Vapor Intrusion Pathway from Subsurface Vapor Sources to Indoor Air* (2015) (See https://www.epa.gov/sites/default/files/2015-09/documents/oswer-vapor-intrusion-technical-guide-final.pdf). See the discussion on the Conceptual Site Model, above, for information on the selection of homes for indoor air testing and the discussion on Corrective Action Objectives, below, for information about how the Vapor Intrusion Screening Levels ("VISLs") were selected and developed. Consistent with the CSM, Amphenol tested homes and the on-Site building for vapor intrusion considering the groundwater and sewer conduit vapor intrusion pathways. See Table 2 and 3 for a tabulation of testing results.

Most of the residential indoor air vapor intrusion screening level exceedances were the result of faulty plumbing within the residence. Following vapor leak tests and corresponding plumbing repairs, residences which had previously exhibited an exceedance of a VISL or which had COC concentrations approaching their respective VISL no longer exhibited elevated COC concentrations.

Residential Indoor Air (IA) VISL exceedances were not observed as part of typical vapor intrusion (soil gas entering through the foundation or crawlspace) in residences constructed with slab on-grade or crawlspace foundations. The only residences that exhibited the potential for vapor intrusion were constructed with full or partial basements (homes with elevated soil gas or indoor air measurements). In this type of residence, basements extend into the unconfined, sandy, water-bearing unit that exists beneath the Study Area (identified as "Unit B"). Residences slab on-grade or crawlspace foundation configurations contact the *clayey* geological unit in the Study Area, "Unit A."

Amphenol also tested indoor air in the on-Site occupied commercial building during two sampling events during two worst-case scenario winter sampling events in December 2018 and March 2020. The risk screening analysis using commercial indoor air screening levels demonstrated that there were no indoor air issues or potential health risks due to an indoor air inhalation pathway from vapor intrusion.

4.1.3 **Sewer and Soil Interim Measures (2019 - 2020)**

The sewer and soil interim measures were designed to remove source materials (VOC impacted soil and groundwater) surrounding the sanitary sewer main and minimize the infiltration of

VOC-impacted groundwater and vapors into the sanitary sewer system. While the IM was successful, there were constraints during the construction that prevented eliminating all vapors from the sewer system originating from the original releases. These are expected to be eliminated with the Final Remedy.

Amphenol coordinated with the City of Franklin, which had been planning sanitary sewer repairs in the area, to share engineering, planning, and outreach resources, and for partial cost-sharing. Remedial construction began in August 2019 and was mostly completed by December 2019, except for re-paving and restoration work that needed warm weather to complete. The interim measure consisted of the replacement of sewer mains made of vitreous clay pipe along portions of Forsythe Street and Hamilton Avenue and lining portions of existing sewer pipe on Ross Court, Glendale Drive, Forsythe Street, and Hamilton Avenue with cured in place pipe (CIPP) to minimize the infiltration of VOC impacted groundwater and vapors into the sanitary sewer system.

In addition to addressing the sewer mains, several residential pipes that connect homes to the sewer main (laterals) were replaced or repaired. Some private sanitary sewer laterals were not replaced due to their configuration within the homes (i.e., pipe location beneath structures with a basement). Sewer laterals are generally located within the unsaturated zone of Unit B and are susceptible to cVOC vapor intrusion that could contaminate the sewer main. While the interim measures were aimed at removing the impacted laterals, the proposed remedy is aimed at removing the vapor source within the unsaturated zone of Unit B. This approach would eliminate the need for replacing the sewer laterals as the sewer main would not be impacted with cVOC vapors from the treated soil.

The interim measure included the removal of impacted soil and groundwater surrounding portions of the sanitary sewer system along Hamilton Avenue and North Forsythe Street.

Performance monitoring includes observing VOC concentrations in monitoring wells downgradient and adjacent to the remediated areas. See Table 6 for a summary of work completed under this IM.

Table 6: Sewer and Soil Interim Measure Summary

Medium	Unit	Total Amount
Length of sewer pipe replaced	feet	1,286
Length of sewer pipe lined	feet	1,270
Laterals replace or repaired	feet	1,298
Soil excavated	tons	6,400
Contaminated groundwater removed for treatment	gallons	342,330
Additional (on-Site)		
Soil and old pipe excavated	tons	341
Length of old pipe removed	feet	300 estimated

EPA hosted Open House meetings in Franklin with the cooperation and support of the City of Franklin and IDEM in August and December 2019. The August meeting focused on explaining the interim remedy construction logistics and schedule, particularly how residents would be accommodated during any inconveniences created by the construction (e.g., traffic patterns). By the December meeting, the construction was mostly completed, and the focus of the meeting was to explain the completed and remaining (warm weather) portions of the remedy. The meetings included staffed poster sessions to answer questions and to explain other aspects of the Amphenol Site corrective action, while IDEM answered questions about the Sites under its jurisdiction.

5. SECTION V: RISK EVALUATION AND CORRECTIVE ACTION OBJECTIVES

5.1 Site Risks

The historical release of VOCs to soil and groundwater by the Bendix Corporation created a vapor intrusion exposure concern. EPA required that Amphenol sample environmental media and analyze potential risk to human health by comparing the analytical results to the conservative risk-based screening thresholds. EPA's first priority for the Site was the evaluation and mitigation of any immediate risks to people from vapor intrusion and the elimination of any potential exposure pathways identified. Amphenol addressed the immediate potential exposure risk from vapor intrusion in homes during 2018 through 2020. During this period, the indoor air of homes was tested for potential exposure risk from VOC vapors entering homes from beneath (soil vapors) and from sewer vapor intrusion. Seven homes had vapor mitigation systems installed and plumbing repairs were made in nine homes. The interim measures of residential vapor mitigation system installations and plumbing system repairs, and also the soil and sewer IM, has eliminated or mitigated exposure to residents via the sewer vapor intrusion and groundwater migration pathways. Although current exposure conditions are controlled, groundwater VOC concentrations remain above the groundwater VISLs in some off-Site areas. The proposed Final Remedy is designed to meet the groundwater vapor exposure standards.

Cleanup measures to address potential future exposure risk that ensure that groundwater leaving the former Amphenol Site is below VISLs is a short-term objective. The long-term objective is to clean groundwater to at or below the Maximum Contaminant Limits (MCLs) for drinking-water. Table 7 provides a summary of the evaluation and the potential exposure pathways for each medium. See Table 4 for the highest on-Site soil VOC concentrations and the SSCMS Table 1 for a comprehensive report of on-Site VOC soil concentrations.

Table 7: Risk Evaluation Summary, Cleanup Objectives, Interim Measures and Proposed Remedies

Medium	Target Areas	Potential Future Risk to Human Health or Environment	Corrective Actions	Interim Measures	Clean up goals	Points of compliance
Soil	*Saturated On-site soil*	Excavation Worker Contact	Active Remedy In-Situ Injections	None	IDEM Excavation Worker Direct Contact Screening Level	Source Area Boundary
	Unsaturated or smear Zone On-site Soil	Contaminant migration to groundwater to protect VI pathway	Active Remedy In-Situ Injections	Plating Area Remedy implemented between 1997-2012.	Re-calculated RCG MTGSL	Source Area Boundary
	Off-site	Contaminant migration to groundwater to protect VI pathway	None	Yes, Completed in 2019.	Re-calculated RCG MTGSL	VI Study area boundary
Unit B GW	*On-site*	GW: Unacceptable risk VI: Unacceptable risk	Source Area Remediation (In-situ Injections and MNA), PRB with ICSR and ICs	Yes. On-going GW Pump and treatment system	Industrial VISLs for Indoor Air Residential VISLs for GW Industrial VISLs for GW	On-site Indoor Air Property Boundary On-site Plume
	Off-site	GW: Unacceptable risk VI: Unacceptable risk	PRB with ISCR, MNA Remediation	Sewer line excavation and home mitigation systems	Residential VISLs for Indoor Air Residential VISLs for GW MCLs	Off-site Indoor Air VI Study area boundary
Unit D Aquifer GW	On-site	No Criteria Exceedance	N/A	N/A	N/A	N/A
Soil/Sewer Vapor	*On-site*	VI: Unacceptable risk	Sewer Ventilation continued until final remedy is complete.	Plating room soil excavation and sanitary sewer line replacement (1985).Removal of old sanitary sewer line, soil excavation and disposal (2020)	Reference Values for COCs Sewer Vapor or Industrial VISL	On-site Sewer manholes and soil gas in ROW
	Off-site	VI: Unacceptable risk	Continue follow-up with new owners; Screening analysis and corrective action if necessary	SSDS to address soil vapor and , Plumbing Repairs to address sewer vapor intrusion	Reference Values for COCs in Sewer Vapor or soil residential VISL	Sewer manholes in the study area and soil gas in ROW.

* Unacceptable risk refers to exceedance of soil to groundwater migration criteria and provides the basis for addressing the source of contamination and future exposure risk. Under current conditions, the exposure risk is controlled through ICs and ECs.

*IM- Interim Measure, GW - Ground Water, VI- Vapor Intrusion, IC- Institutional Control, EC - Engineering Control, SSDS- sub-slab Depressurization system

The proposed Final Remedy and associated remedial goals are designed to protect human health and the environment by mitigating potential risk to current and future receptors. Table 7 summarizes the risks associated with soil, ground water and vapors found at the site.

EPA's corrective action goal for groundwater is to prevent adverse effects to human health and the environment, both now and in the future. EPA believes that short-term exposure prevention and long-term cleanup goals are both essential elements to achieve this overall goal. EPA expects final remedies to return groundwater to its maximum beneficial use within a timeframe that is reasonable, given the particular circumstances of the Site. This is a general EPA goal regardless of whether the aquifer is currently being used for a water supply or has the potential to be used as a water supply. The long-term goal is to remediate the groundwater to the National Primary Drinking Water Standard Maximum Contaminant Levels (MCLs).

In addition to attaining the reduced concentrations of COCs in environmental media, the selected corrective measure should allow for the deactivation of the current on-Site pump-and treat system.

5.2 Conceptual Site Model (Figure 6) and Amphenol Study Area (Figure 3)

EPA's investigations for the Site were governed by a conceptual site model ("CSM") which integrated Site physical characteristics, sources of contaminants, their fate and transport (where and how far it may have traveled and how deeply), affected environmental media, and potentially exposed people (receptors). EPA used the CSM to identify data gaps and what environmental media to sample and re-sample. The initial CSM was developed from the historical investigations (1990s) and the years of operational reports from the on-Site groundwater recovery system. The CSM was updated in 2018. The updated CSM indicated potential exposure pathways existed from both groundwater vapors and sewer vapors entering homes.

Between 2018 and 2021, Amphenol investigated the conditions in groundwater, soil vapor, soil, sewer vapor, residential and commercial indoor air, and ambient air. The extent of contamination defined the boundaries of the Study Area, the area thought most likely to be impacted by the release of contaminants from the Amphenol site. The Study Area included portions of streets and nearby structures near to and down-gradient of the Site, including Hurricane Road, Hamilton Avenue, Forsythe Street, Glendale Drive, and Ross Court. (See Figure 3). All investigations proceeded under EPA approved work plans. For investigation details, see the referenced work plans and reports.

IDEM has calculated Default Closure Levels (DCLs) for the State of Indiana to protect human health and the environment from contaminants present in industrial and residential settings. The residual contaminant levels below these DCLs do not pose an unacceptable risk to people or the environment if exposure to the contaminated media occurs through the following pathways:

- Incidental ingestion;
- Incidental dermal contact; and
- Inhalation of dust/volatiles.

The acceptable target risk level for the IDEM DCLs has been set at $1x10^{-5}$ excess cancer risk (meaning one in one hundred thousand persons may experience an additional lifetime cancer risk) and at a hazard quotient value of 1 for non-cancer health risks. These target levels are derived from a combination of default exposure parameters, chemical/physical properties of contaminants, toxicological data and other relevant criteria to evaluate the impact of chemicals on human health. IDEM's DCL risk level is at the midpoint of EPA's acceptable risk range.

EPA evaluated IDEM's VISLs and determined that they were comparable to the SLs developed by EPA and appropriate to use for screening and as the media cleanup standards for this Facility.

Based on the results of Site characterization work, depths to impacted soils, and an evaluation of potential receptors and exposure pathways, the following environmental media screening levels and CAOs for the protection of human health apply to the Site:

5.2.1 **Environmental Media Screening Levels***

1. RDCSL: Residential Direct Contact Screening Level
2. EWDCSL: Excavation worker soil direct contact screening level
3. IDCSL: Industrial/commercial direct contact screening level
4. MTGSL: Migration to groundwater screening level
5. RIASL: Residential Indoor Air Screening Level
6. IIASL: Industrial Indoor Air Screening Level
7. SGeSL: Soil Gas Screening Level
8. SGssSL: Subslab Soil gas /Sewer gas Screening Level

*These levels are based on IDEM Remedial Closure Guidance (IDEM RCG), (https://www.in.gov/idem/cleanups/resources/technical-guidance-for-cleanups/idem-screening-and-closure-level-tables/) and EPA's drinking water standards also known as maximum contaminant levels (MCLs) (https://www.epa.gov/ground-water-and-drinking-water/national-primary-drinking-water-regulations).

While the above screening levels are based on conservative site geology or exposure conditions, IDEM RCG allows the development of media-specific clean-up levels or cleanup objectives based on the field data documenting site-specific geology and the fate and transport of contaminants of concern. Following this approach, Amphenol developed the following site-specific criteria to support the cleanup objectives:

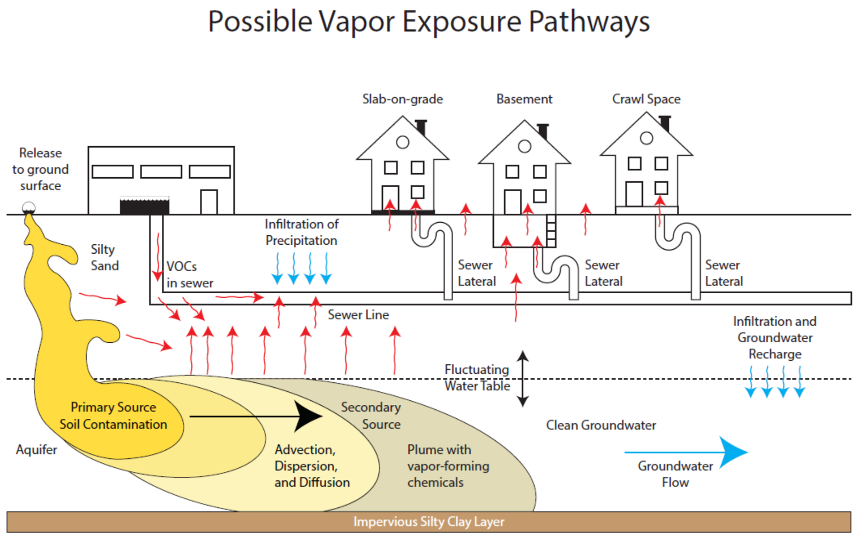
a) Calculated Sewer Vapor Reference Value (CSVRVs): Vapor in Sewer Manholes CAOs, for details, see section 2.2 of the SSCMS (2022) and the *Draft Post-OIM Sewer Gas VI Evaluation Report*, June 24, 2020.
b) Re-calculated RCG MTGSL: Site-specific Migration from soil to groundwater CAOs, for details, see section 2.2 of the SSCMS (2022).

The initial CSM and the targeted list of COCs were based upon review of historical investigations, current investigations and operational reports for the groundwater recovery system. A list of COCs included the following compounds: TCE, PCE, VC, trans-1,2-DCE, 1,1-DCA, cis-1,2-DCE, 1,2-DCA, MC, and 1,1,1-TCA. PCE was found primarily on-Site and TCE was found primarily off-Site. TCE is the more mobile of the two cVOCs, particularly in groundwater. 1,2-DCA was found in the indoor air of a few homes but as it was not also found in soil gas or sewer vapors, meaning that its presence was not attributed to vapor intrusion. 1,2-DCA vapors emitted from consumer products such as home decorations made of molded plastics. PCE and TCE became the risk-drivers as they are the most volatile and mobile of the COCs found on this site.

As data were collected about conditions in groundwater, soil, sewer vapor, and indoor air, EPA and Amphenol adjusted the CSM and expanded the list of homes targeted for indoor air testing. When a tested home indicated potential vapor intrusion, the adjacent homes were added to the testing list. The list expanded to 42 homes. Between July 2018 and October 2020, under EPA oversight, Amphenol tested the indoor air of 37 homes where access was granted (homeowners of five homes denied access). EPA and ATSDR evaluated and discussed the indoor air testing results with Amphenol to identify any homes needing mitigation measures or further testing such as plumbing system integrity.

Where investigations identified contaminated media, subsequent sampling was often completed to refine the CSM. After each sampling event or investigation phase, EPA worked with Amphenol to evaluate the CSM and determine the adequacy of the data to support decision-making (for example, which additional homes should be added to the indoor air testing list). The updated CSM identified two potentially complete contaminant transport pathways into homes: *via* groundwater vapors and sewer vapors. The figure (Figure 1) below shows the preliminary CSM used to guide the investigation of vapors at the site and in the Study Area.

Figure 1: Vapor Exposure Pathways



5.3 Environmental Indicators

EPA developed two "environmental indicators" ("EIs") to track conditions at cleanup sites that affect human health and groundwater impacts. The Human Exposure EI identifies whether there are any unacceptable human exposures to contamination at the Facility, and the Groundwater EI identifies whether any contaminated groundwater from the Facility is not stabilized and migrating off-site. EPA uses the EI evaluations to assess whether immediate or early intervention is needed at a site (such as an interim measure to prevent people drinking contaminated groundwater) and to help identify data gaps and focus data collection. The EI evaluations are a "snapshot" of conditions and use available environmental data, such as measurements of contaminants in groundwater, within a decision matrix.

In 2019, based on the re-evaluation of Site conditions, EPA reversed its previous Human Exposure and Groundwater EI determinations that showed conditions at the Site were under control. The original determinations made in 2000 were based on data and risk criteria available at the time. However, as explained in Section I, in 2018 EPA began reviewing historical data and collecting new data that indicated potentially complete VOC exposure pathways to people still existed. EPA immediately required that Amphenol begin residential vapor intrusion investigations and intervention steps where needed. While the renewed investigation confirmed that the groundwater plume was not expanding, groundwater VOC concentrations were above the VISL beneath homes and therefore considered to not be "under control."

From 2018 through 2020, Amphenol tested the indoor air of homes where access was granted and when potential vapors were found, completed interim measures in homes to mitigate potential vapor intrusion via the groundwater and sewer migration pathways. In 2019, Amphenol completed the soil and sewer interim measure in the residential area (and additional sewer and soil work on-Site) to remove sources related to the sewer vapor intrusion pathway. Currently, there are no known unacceptable exposure to people from vapor intrusion. The existing groundwater plume in the residential area does not pose risk through a drinking water pathway or through surface water interaction. Residents are connected to municipal water. The Human Health Environmental Indicator (CA725) determination will be further updated when the Final Remedy performance monitoring is conducted. In addition, when the Final Remedy performance monitoring is conducted, EPA will re-evaluate and update the Groundwater Environmental Indicator (CA750) determination if warranted.

5.3.1 **Risk Evaluation for Construction and Remediation Workers**

Table 3 and Table 4 identify the exceedance of screening levels for construction workers. Exposure to contaminated subsurface soil and groundwater is potentially a complete pathway for construction or remediation workers through inhalation of contaminants. However, construction workers are not expected to come in contact with soil or groundwater through ingestion or dermal contact pathways. Groundwater impacts are not present beneath the facility building or outside the footprint of the former plating room. Groundwater impacts downgradient (south) of the former plating room are concentrated along the former sanitary sewer lateral from the facility and sanitary sewer main along portions of Hamilton Avenue and North Forsythe Street. On-Site, the top of the groundwater ("water table"), is around 7 – 17 feet bgs, depending on the well measured and year. The water table becomes shallower as it approaches Hurricane Creek where it is less than 3 feet bgs. Currently, no excavation is planned to address the contamination as the approximate depths of the on-Site impacted soils range from approximately 18 to 25 feet bgs. The risk to construction or excavation workers associated with the inhalation pathway of soil or groundwater is negligible because health and safety programs are in place requiring personal protective equipment for any environmental investigation or remediation work. Further, the planned remediation activities are associated with in-situ treatment (injections of a material into the ground to treat soil and groundwater) without having to excavate soil or pump out groundwater for above-ground clean up.

5.4 Corrective Action Objectives and Reference Values

EPA worked with Amphenol to develop CAOs, also called remedial action objectives, to ensure that contamination will not impact current or future on-Site or off-Site receptors and the environment. CAOs and reference values were developed for groundwater, soil and sewer vapor. Residential vapor mitigation system deactivation will be based on IDEM RCG Calculated Sub-Slab Soil Vapor Screening Levels. Short-Term Groundwater Vapor Exposure Screening Levels will be utilized to evaluate effectiveness of the proposed remedial technology.

5.4.1 **Final Remedy Short-Term Goals**

1) Reduce groundwater VOC concentrations beyond the facility boundaries to below VISLs.
2) Prevent migration of VOCs from the on-Site secondary source area to the downgradient aquifer beyond the facility boundary.
3) Implement active remedial measures for off-Site groundwater contamination until VISLs are attained as confirmed by performance monitoring reporting.
4) Prevent VOC leaching from soil source areas into groundwater resulting in VOC concentrations above the VISLs.

5.4.2 **Final Remedy Long-Term Goals**

1) Reduce VOC mass from primary and secondary soil source areas to the extent that:
   a. they no longer pose an unacceptable risk from direct contact by workers; and
   b. leach VOCs to groundwater resulting in VOC concentrations above the MCLs.
2) Continue implementing the final corrective measures and demonstrate efficient plume contraction and stabilization; and
3) Continue implementing the final corrective measures such that the CAOs are achieved on-Site and MCLs are met and maintained at the property line point of compliance with and without active remedial measures. The decommissioning of sub-slab depressurization systems on homes, due to sources below levels of concern, is the ultimate goal.

CAOs and reference values are designed to protect human health and the environment, and are based upon residential, commercial/industrial, and environmental exposure criteria, EPA guidance, site data analysis, and applicable state and federal regulations. Reference values were developed for sewer system vapor levels using site-specific data and attenuation factors to estimate the potential for sewer vapor intrusion. In the SSCMS, CAOs were used to develop remedial alternatives.

5.4.3 **Soil CAOs**

Considerations for soil CAOs included their potential to contaminate groundwater and/or produce VOC vapors at levels that could cause vapor intrusion, and for direct contact during construction. IDEM values for soil-to-groundwater contamination potential were made site-specific (using site soil characteristics) and developed as “re-calculated” Migration to Groundwater Soil Levels (MTGSLs). The MTGSLs apply to both “smear zone” and vadose zone unsaturated soils. The smear zone is the area of soil above the water table where contamination can accumulate when contaminated groundwater rises and falls, for example, during rain events. See Table 4.

5.4.4 **Groundwater Numeric CAOs**

EPA and Amphenol developed both short- and long-term CAOs for groundwater. The short-term CAOs are based upon the VOC concentrations in groundwater that have the potential to cause vapor intrusion and use the IDEM RCG VISLs. The long-term groundwater CAOs are the EPA Maximum Contaminant Levels (MCLs) for drinking water. While groundwater is not used for drinking water in the Study Area, restoring aquifers to their maximum beneficial use is an EPA general goal. See Table 5.

5.5 Cleanup Timeframes for Corrective Action Objectives

EPA anticipates that off-Site groundwater can attain the VISL CAOs within five years of remedy implementation. In one area of the groundwater treatment pilot test, the VOC measurements were non-detect within one month. Additionally, at other remedial sites with similar contamination and treatment, VOC concentrations became non-detect almost immediately. Amphenol will propose performance monitoring approaches in its design documents to identify what conditions would trigger repeating treatments, as needed. On-Site, soil source-area treatments may need to be repeated if performance monitoring demonstrates that the remedial CAOs are not being attained. Groundwater CAOs have been defined as Calculated Res RGVISLs for short-term (0-5 years) and MCLs for long-term (over 10 years).

In its remedial design documents, Amphenol will propose a timeframe that identifies performance monitoring and steps to take if the MCLs are not attained within ten years of remedy implementation (Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Ground Water, EPA/600/R-98/128, September 1998).

6. SECTION VI: PROPOSED ALTERNATIVES FOR FINAL REMEDY

Site investigation activities have demonstrated that remedial actions are warranted to remediate soil and groundwater impacts and eliminate the potential for vapor intrusion of VOCs into residential structures in the Study Area. Corrective measures alternatives developed for the Site make use of individual technologies or various combinations of technologies to determine which of the candidate technologies are suitable for the Site. The purpose of the SSCMS was to identify, develop, screen, and evaluate potential corrective measure alternatives and to recommend a preferred remedial approach. The SSCMS evaluated corrective measure technologies for both on-Site and off-Site areas within the Study Area.

The alternatives developed in the SSCMS reduced the large number of candidate technologies to a manageable number of alternatives for detailed evaluation. USEPA guidance recommends that three general criteria be used in the development of alternatives: 1) effectiveness, 2) implementability, and 3) cost.

The on-Site corrective measure evaluation focused on impacts from historical releases within the area immediately beneath, adjacent, and down-gradient (south) of the former plating room at the facility, including the area along the former sanitary sewer line. These releases created an on-Site groundwater plume which is being addressed by the groundwater recovery system.

The off-Site corrective measure evaluation focused on impacts within the nearby residential area where historical VOC releases to the sanitary sewer line contaminated soil and groundwater and created indoor air vapor intrusion risk. The SSCMS relied on the detailed information provided in the environmental media investigations performed since 2018. Some investigations assessed conditions following the soil and sewer IRM completed in 2019 and the groundwater treatment pilot study.

Remedial alternatives for the on-Site and off-Site areas are evaluated and discussed below. Generally, remedial alternatives can be categorized as *engineering controls* and *institutional controls.*

6.1 Remedial Alternatives Using Engineering Controls

The remedial alternatives chosen for the Final Remedy will address residual VOC contamination to attain the Site-specific Corrective Action Objectives, which include contaminated soils, contaminated groundwater, the on-Site groundwater recovery system. Contaminated soils pose potential direct contact risk to future construction and remediation workers, provide a source for dissolved VOCs in groundwater, and generate VOC vapors that could pose a vapor intrusion risk. The on-Site groundwater recovery system treats contaminated groundwater and discharges a high volume of treated water to the Franklin Wastewater Treatment plant. The City of Franklin prefers that the discharge cease to free up capacity for the plant. Off-Site contaminated groundwater is a degraded natural resource and poses potential vapor intrusion risk. The Final Remedy will restore the natural resource by treating the VOCs in the groundwater with short-term and long-term remedial actions.

6.1.1 **Background on Engineering and Institutional Controls**

6.1.1.1 Engineering Controls (EC)

In remediation, engineering controls ("EC") use construction or other physical means to reduce contaminant levels and eliminate or reduce exposure to a chemical hazard. Examples include remedial soil containment, slurry walls, extraction wells, and treatment methods. A common EC used to address soil vapor contamination and vapor intrusion is a sub-slab depressurization system (SSDS).

6.1.1.2 Institutional Controls (IC)

The EPA uses institutional controls ("IC") to reduce the risk of exposure to contamination through administrative and legal methods. These non-physical controls may be implemented during and following completion of the remedial process. Remedies restrict land- or resource-use at a Site through legal instruments. ICs are distinct from engineered (construction) remedies. ICs preclude or minimize exposures to contamination or protect the integrity of a remedy by limiting land- or resource-use through administrative means such as rules, regulations, building permit requirements, well-drilling prohibitions and other types of ordinances. For an IC to become part of a remedy, there must be binding documentation such as land-use restrictions in the environmental covenant, local zoning restrictions, or similar restrictions. An IC was recorded on the Site through a property deed on January 6, 1999, restricting future use to industrial/commercial operations. The IC also prohibited the installation of drinking water wells.

6.1.2 **Engineered Corrective Measures**

Amphenol developed engineering controls as corrective measures to reduce on- and off-Site soil and groundwater impacts that in turn will reduce the potential for vapor-phase COCs to enter homes through the sub-slab or sewer migration pathways. Below are descriptions of engineering controls evaluated by EPA as potential corrective measures at the Site.

6.1.2.1 In-Situ Treatment

A treatment is referred to as "in-situ" when it happens in place, without having to excavate soil or pump out groundwater for above-ground cleanup. In-situ treatment uses various materials to treat many types of contaminants like fuels, solvents, and pesticides. Generally, in-situ treatment relies on injections of a material into the ground to treat soil and groundwater. The selection of the type of injected material depends on what type of chemical contamination is being treated and the characteristics of the soil. Treatment sometimes relies on bacteria, or microbes, to assist the breakdown of the chemical, and is known as a biotic treatment. Other types of treatment that do not rely on bacteria are called abiotic.

A. ISCO

In-situ chemical oxidation (ISCO) uses chemicals called "oxidants" to help change harmful contaminants into less toxic ones. ISCO is usually used to treat soil and groundwater contamination in the source area where contaminants were originally released. The source area generally contains contaminants attached to soil particles that have not yet dissolved into groundwater. This approach uses wells or pipes to pump the treatment mixture into the ground under gentle/adequate pressure. Once the oxidant is pumped down the wells, it spreads into the surrounding soil and groundwater where it mixes and reacts with contaminants. ISCO can produce rapid and complete contaminant destruction in a short period of time. See A Citizen's Guide to In Situ Chemical Oxidation Web-link.

Amphenol evaluated ISCO for source-area treatment at the Site. Based on the evaluation, activated persulfate, hydrogen peroxide, and/or permanganate are expected to be successful treatments for the source-area soils with concentrations of VOCs present and any daughter products that contribute to groundwater contamination. This corrective measure may be used to achieve short- or long-term CAOs in both soil and groundwater. ISCO is a versatile treatment technology that is often used in source zones that have moderate to high contaminant concentrations in groundwater.

One outcome of the January 2021 site investigation was a confirmation that the ISCO treatments completed in 2010 beneath the former plating room were successful overall, with a few pockets of contaminated soil remaining to be treated. It should be noted that ISCO treatments would not remediate soil directly but would promote accelerated desorption of COCs from soil particles to groundwater where the COCs would be destroyed by groundwater treatment injections. This corrective measure can be implemented immediately to significantly reduce adsorbed and dissolved impacts and achieve short-term groundwater CAOs. However, subsequent injections might be required to further address residual impacts based on the results of the long-term performance monitoring. The recent source area investigations indicate only minimal amounts of potential NAPL are present on-Site and are centrally located. Some areas of private property will be included in the remedy for soil and groundwater treatment. Sample locations, results, and the location of the private property being treated cannot be publicly disclosed per the Privacy Act of 1974.[3]

ISCO treatments are a moderate expense and can be implemented readily. It is noted that the effectiveness of this remedial approach may be limited for COCs that have diffused into the low permeability silty sand lenses and silty clay (top of Unit C), since delivery of the injectant into these zones may be difficult, and it is imperative that the ISCO chemicals come in contact with the impacted soil to quickly desorb for COC destruction. Down-gradient permeable reactive barriers (PRBs) (see Section 6.1.2.1.B. below) would also be required for this technology to

[3] The Privacy Act of 1974 (5 U.S.C. § 552a) sets forth requirements for federal agencies when they collect, maintain or disseminate Privacy Act information. See EPA Privacy Policy (September 14, 2018) here. Privacy Act information includes "information about an individual that is retrieved by name or other personal identifier assigned to the individual which has special requirements under the Privacy Act." *Id*. Privacy Act information also protects personally identifiable information (PII), which is "any information about an individual maintained by an agency that can be used to distinguish, trace, or identify an individual's identity, including personal information which is linked or linkable to an individual. *Id*.

prevent off-Site migration of groundwater contaminated with the dissolved COCs from the ISCO treatments. Since the ISCO remedial approach has historically been successful at reducing contaminant mass beneath the former plating room and has the potential to meet short- and long-term CAOs on-Site, this corrective measure was retained as a potential on-Site preferred technology.

B. ISCR

In-situ chemical reduction uses chemically reducing additives (in the PRB) to help change harmful contaminants into less toxic ones. PRBs are a type of ISCR treatment remedy that rely on injecting reactive materials underground and creating a type of *barrier* where a dissolved contaminant plume passes through in the direction where it naturally flows, following the hydraulic gradient of the groundwater and the contamination reacts wth the barrier, rendering it less toxic. This in-situ method for remediating dissolved-phase contaminants in groundwater combines a passive chemical adsorption, chemical reduction, or biological treatment zone with natural subsurface groundwater flow. This is the treatment approach tested in the groundwater pilot study in 2019 – 2020.

PRBs are usually installed within or hydraulically perpendicular to the location of the known dissolved phase contaminant plume. PRBs are often installed hydraulically upgradient of sensitive receptors in order to remediate the groundwater prior to reaching the sensitive receptor. In the proposed remedy, a PRB would be established along Hamilton Avenue to prevent a plume moving into the residential area before the groundwater treatment system is turned off and the on-Site source-area (soil) treatment begins.

The VOCs may be adsorbed and/or destroyed within the PRB as they react with the treatment materials and the measure may be used to achieve short- or long-term CAOs in groundwater. The PRBs serve as a curtain to remove the contaminants in the dissolved medium (in groundwater) after the soil treatment. This corrective measure can be implemented immediately to significantly reduce dissolved impacts and achieve short-term groundwater CAOs and then be combined with Monitored Natural Attenuation to achieve long-term groundwater CAOs. This technology may be optimal in areas where soil impacts are minimal off-Site or on the perimeter of the on-Site impacted area where significant soil treatment is not required. PRB technology has been shown to have immediate results and is of moderate expense. The recent Pilot Study conducted at the Site confirms that this remedial approach can be readily implemented, with the most limiting factor being site access to privately or municipally owned off-Site properties. As PRBs are a remedial option to achieve both short- and long-term groundwater CAOs, this corrective measure was retained as a preferred technology.

Another type of corrective measure that uses in-situ chemical reduction (ISCR) technology involves the use of various chemicals such as zero valent Iron (ZVI) to promote the chemical reduction of chlorinated solvents and the daughter products. ISCR technology might require multiple injection events based on long-term performance monitoring results to maintain short-term groundwater CAOs.

ISCR technology can be combined with other in-situ technology to assist in reducing initial source area contaminant mass. Since the ISCR remedial approach has been shown to be successful at reducing contaminant mass at other sites and has the potential to meet short- and long-term groundwater CAOs both on-Site and off-Site, this corrective measure was retained as a potential on-Site and off-Site preferred technology. However, the effectiveness of this technology may be limited for COCs adsorbed to the low permeability silty clay (top of Unit C). Since it is imperative that the ISCR compounds come in contact with the impacted groundwater to destroy the COCs, it will be necessary for COCs to diffuse out of Unit C into the groundwater in Unit B for treatment.

C. In-situ Bioremediation and Bioaugmentation

These technologies are used to promote anaerobic biological dechlorination of chlorinated solvents in soil and groundwater, through direct and co-metabolic degradation processes. *Bioremediation* technology involves using naturally occurring subsurface microbes to breakdown/dechlorinate VOCs. Some approaches add a specific genus of dechlorinating bacteria into the subsurface. *Bioaugmentation* may be required if indigenous microorganisms are not able to degrade the COCs or to create optimal conditions for this activity. Bioaugmentation amendments include electron donors, pH buffer/adjustments, and, in some cases, nutrients to expand the microbial population. Electron donors used in bioremediation applications are formulations that include or consist of alcohols, sugars, fatty acids, and/or vegetable oils.

If biological remediation technologies are used on-Site, then down-gradient PRBs would be required to prevent off-Site migration of dissolved COCs. This measure is a moderate expense and might require additional injection events to supplement the barrier, based on long-term performance monitoring to attain and maintain groundwater CAOs. This technology may also be combined with other in-situ technologies to assist in reducing initial source area (soil) contaminant mass to attain lowered VOC concentrations over a longer time period. Since the bioremediation and bioaugmentation approach has been shown to be successful at reducing contaminant mass at other sites and has the potential to meet short- and long-term groundwater CAOs on-Site, this remedial alternative was retained as a potential on-Site preferred technology.

Treatment to achieve soil and groundwater CAOs on-Site will incorporate one or more of the in-situ technologies discussed above. However, since off-Site soil impacts are limited, CAOs may be achieved off-Site using less aggressive methods, such as PRBs which incorporate carbon-based and ISCR products. In-situ treatment options have been retained for further evaluation.

D. In-Situ Thermal Treatment

Another engineering control being considered for on-Site remediation is Electrical Resistance Heating ("ERH"), a type of in-situ thermal treatment. This type of treatment method uses heat to vaporize and mobilize targeted chemicals in impacted soil and groundwater. The mobilized chemicals are drawn by suction toward collection wells through the soil and groundwater. From the wells, the COCs are piped to the surface for treatment; some chemicals are destroyed underground during the heating process. Thermal treatment is described as "in situ" because the heat is applied underground directly to the contaminated area. It can be particularly useful for chemicals called "non-aqueous phase liquids" or "NAPLs," which do not dissolve readily in groundwater and can be a source of groundwater contamination for a long time if not treated. Note that only a few samples had any NAPL on-Site.

The proposed ERH engineering control would recover vapors using mechanical vacuum blowers and then pass them through a treatment system using activated carbon or catalytic oxidizers. The subsurface would be heated to the boiling point of water and remove COCs using steam-stripping for adsorbed, dissolved, and NAPL phase VOCs. This technology is often paired with groundwater recovery and treatment to limit the influx and movement of cooler water into the heated treatment area.

ERH could achieve both short- and long-term CAOs in the on-Site treatment area where there are no access issues. However, this remedial approach would be impractical off-Site where soil impacts are limited, and sufficient property access for equipment placement is not achievable. Furthermore, the presence of various subsurface utilities would impede implementation.

ERH is a relatively short-term remedial approach that requires construction of mechanical equipment for vapor and groundwater recovery, which must be maintained. Underground infrastructure and buildings could limit the scope of the vapor recovery system. There is a degree of safety concern associated with the magnitude of electricity needed for this engineering control. While ERH could achieve on-Site CAOs in a relatively short time period (one to two years including design and installation), an average of nine to twelve months is required to complete the engineering design, permitting, and installation activities before the remedy is operable. The approach is expensive and not considered to be green technology due to the amount of energy required and waste generated. Since the ERH measure is an option for meeting short and long-term CAOs on-Site, the corrective measure was retained as a potential on-Site preferred technology. See *A Citizens Guide to In Situ Thermal Treatment* here.

6.1.2.2 Monitored Natural Attenuation (MNA)

Natural Attenuation relies on natural processes to decrease or *attenuate* concentrations of contaminants in soil and groundwater. Conditions are monitored through sampling to ensure natural attenuation is occuring within the anticipated timeframes. Monitoring typically involves collecting soil/groundwater samples to analyze them for the presence of contaminants and other indications of chemical breakdown. The entire process is called monitored natural attenuation ("MNA"). Natural attenuation occurs at most contaminated sites. However, the right conditions must exist underground to clean sites properly and quickly enough. MNA is frequently used as a polishing step following an active remedy.

Groundwater conditions would be monitored on a long-term basis to observe trends in COC concentrations. Sample data would be used to evaluate whether groundwater impacts are being reduced through natural processes in an acceptable timeframe. MNA may be used to evaluate long-term CAOs. However, it is unlikely that MNA would attain short-term CAOs. Since MNA is an option for the evaluation of long-term CAOs, the corrective measure was retained as a preferred technology to be coupled with an active remedy that addresses short-term groundwater CAOs. The MNA measure is one of the slowest methods to achieve long-term CAOs and is fairly easy to implement. See *A Citizen's Guide to Monitored Natural Attenuation Web-link.*

6.1.2.3 Groundwater Pump and Treat

Pump and treat is a common method for cleaning up groundwater contaminated with dissolved chemicals, including industrial solvents, metals, and fuel oil. Groundwater is pumped from wells to an above-ground treatment system that removes the contaminants. Pump and treat systems also are used to *contain* the contaminant plume. Pumping helps keep contaminants from reaching particular areas including drinking water wells, wetlands, streams, and other natural resources. Pump and treat may last a few years to several decades. The actual cleanup time will depend on several factors, which vary from site to site. For example, it may take longer where contaminant concentrations are high, or the contamination source has not been completely removed. See available information at: *A Citizens Guide to Pump and Treat Web-link*. Based on the continued presence of impacts at the Site after operating the groundwater pump and treat system for approximately 25 years, it is likely that this remedial alternative would not reach either the short or long-term groundwater CAOs in a reasonable time frame. For this Site, it is likely additional technologies will be required to effectively lower groundwater concentrations to meet CAOs. Therefore, groundwater pump and treat is not retained as a preferred technology for the Final Remedy.

6.2 On-Site Alternatives

EPA found the following five remedial alternatives were suitable for the on-Site area and evaluated in detail in the SSCMS:

1) Alternative I – No Further Action with Institutional Controls (included as a baseline for comparison to action alternatives);
2) Alternative II – In-situ Treatment using ISCO, ISCR, and/or Bioremediation;
3) Alternative III – ERH with PRBs;
4) Alternative IV – PRBs using ISCR; and
5) Alternative V – MNA - Natural processes to achieve site-specific corrective action objectives including biodegradation, sorption, dispersion and dilution, chemical reactions, and/or volatilization. Requires periodic monitoring to verify progress.

6.2.1 On-Site Preferred Alternative:

After evaluating these corrective measure alternatives, EPA recommends a combination of Alternatives II, IV and V as the Final Remedy for the Site. EPA determined the combination of alternatives are feasible, implementable and an environmentally sustainable approach to eliminating the risks to human health and the environment while meeting short and long-term groundwater CAOs for the on-Site area. Specifically, the preferred remedy would combine Alternative II, IV and V. Alternative II: ISCO, ISCR, and/or Bioremediation; Alternative IV: a PRB using ISCR; and Alternative V: MNA to address long term goals through biodegradation, sorption, dispersion and dilution, chemical reactions, and/or volatilization with periodic monitoring. Some additional detail on the combination of these alternatives is described below.

6.2.2 On-Site Alternatives II and IV

These remedies would be implemented in the following specific sequence. The treatment area is primarily located on the Site, but also includes some private property.

1) PRB(s) (Alternative IV) consisting of carbon-based substrate and ISCR would be established to prevent the on-Site plume from migrating beyond the property boundaries, which could potentially affect homes located down-gradient of the Site. The PRB(s) will be installed in the vicinity of Hamilton Avenue, south of the on-Site treatment area.
2) Terminate operation of groundwater recovery system. In addition to treating the on-Site groundwater, the groundwater recovery system pumping action keeps the plume from migrating off-Site. Following the establishment of the PRBs, the recovery system would be turned off in preparation for source-area soil injections of treatment medium. The system needs to be non-operational to prevent it from suctioning the treatment

media away from the treatment zones.

3) In Alternative II, treatment media would be pressure-injected using a bottom-up approach into the source area soils, initially with ISCO. The type of treatment used in Alternative II (ISCO, ISCR, and/or bioremediation) will be refined in the remedial design document.

6.2.3 **Downgradient Permeable Reactive Barriers (Alternative IV)**

Downgradient PRBs near the southern property boundary around Hamilton Avenue would be established to further prevent potential off-Site migration of a contaminated groundwater plume before the groundwater recovery system is turned off. The PRB would consist of in-situ injection of carbon-based substrate and ISCR (ZVI) into the contaminated plume area in Unit B. This approach was tested in the groundwater treatment pilot study discussed above. The PRB would substitute for the hydraulic control function of the P&T system that would be turned off to prevent mobilizing the injected treatment medium. Following the initial injection event, monitoring will determine if groundwater conditions have met short-term groundwater CAOs and potential exposure pathways have been eliminated or if additional in-situ technology injection events are necessary to eliminate potential exposure pathways and meet short-term groundwater CAOs.

6.2.4 **Source Area Treatment (Alternative II)**

The proposed on-Site treatment area covers up to 74,000 square feet and includes the on-Site source area (approximately 30,500 square feet). The reactive chemical oxidants (ISCO) to be injected into the groundwater are anticipated to produce rapid and complete contaminant destruction. Typical chemical oxidants include activated persulfate, hydrogen peroxide, and permanganate. After the initial ISCO injections, soil and/or groundwater performance samples in the treatment area will be collected to determine if additional ISCO injections would be needed in the high-concentration soil areas to eliminate potential exposure pathways and meet the short-term groundwater CAOs. VOCs in soil, particularly the upper layer in the clay Unit C, may continue to desorb and dissolve into groundwater following the initial remediation actions. Long-term monitoring is necessary to determine if additional injection ISCO, ISCR, and/or bioremediation products would be needed to achieve or maintain short-term groundwater CAOs. The treatment area for this remedy is shown in Figure 11.

The details of the treatment and performance monitoring will be described in the remedial design documents. The conceptual approach is described in the SSCMS. Temporary injection points will be installed using direct push drilling equipment with 1.5-inch diameter drill rods and retractable two-to-four-foot screens. The in-situ treatment mixture would be pressure-injected into the ground using a bottom-up injection technique. The pressure-injection ground-pumps would be inside an injection trailer. The vertical treatment area (15 to 25 feet bgs) would target the area around the interface of Unit B and Unit C, at around 25 feet bgs. Geologic conditions will not permit the adequate distribution of in-situ treatment materials throughout the clay till in the top of Unit C via direct injection. Consequently, it is anticipated that the in-situ treatment materials would reach the targeted areas by diffusing directly into the top of Unit C where it will destroy and desorb COCs. If conditions do not meet short-term groundwater CAOs, additional injection events will target areas with high concentration soils (greater than 40 mg/kg) in the on-Site source area and any necessary subsequent injections will be used to continue to lower soil and groundwater concentrations to meet short-term groundwater CAOs.

Once the treatment program is completed, groundwater monitoring would determine whether supplemental treatments of ISCR and/or bioremediation products should be used to further remediate the treatment areas and whether a larger treatment footprint beyond the high concentration initial target area should be used. ISCR would incorporate products such as zero valent iron (ZVI) to complete the reductive chemical reactions and degrade the COCs present at the Site. Bioremediation amendments for biostimulation could include electron donors, pH buffer/adjustments, or potentially nutrients. Electron donors (nutrients) used in bioremediation applications are formulations that include or consist of alcohols, sugars, fatty acids, and/or vegetable oils.

6.2.5 **Monitored Natural Attenuation (Alternative V)**

On-Site Alternative V provides groundwater monitoring throughout the Site to confirm that biotic and abiotic processes are continuing to degrade COCs until long-term CAOs are achieved in groundwater as it leaves the Site, following the completion of active remediation activities.

Following active remediation (in-situ injections) groundwater concentrations would be monitored to ensure short-term CAOs are achieved, and MNA would be used to verify long-term CAOs are reached and maintained. Performance/compliance monitoring would be performed on a regular basis (quarterly, semi-annually, or annually) to verify short-term groundwater CAOs are maintained and to document plume attenuation or stability in order to verify that long-term CAOs are achieved.

The details of the MNA remedy will be provided in the remedial design document.

6.3 Off-Site Alternatives

EPA found the following four remedial alternatives were suitable for the off-Site area and evaluated in detail in the SSCMS:

1) Alternative I – No Further Action (included as a baseline for comparison to action alternatives);

2) Alternative II – PRBs using ISCR;
3) Alternative III – Groundwater Pump and Treat; and
4) Alternative IV – MNA - Natural processes to achieve site-specific corrective action objectives including biodegradation, sorption, dispersion and dilution, chemical reactions, and/or volatilization. Requires periodic monitoring to verify progress.

6.3.1 **Off-Site Preferred Alternative**

After evaluating these corrective measures, EPA recommends a combination of Alternatives II and IV as the Final Remedy for the Site.

6.3.2 **Alternative II and IV**

Impacted groundwater in the off-Site area would be remediated using PRBs with ISCR technology. Installation of PRBs would consist of injected carbon-based substrates and ISCR (e.g., sulfated MZVI) in select off-Site locations along Hamilton Avenue, Forsythe Street, and Ross Court. The off-Site PRBs would be located in the down gradient flow direction of the on-Site source areas and would create permeable treatment zones for impacted groundwater as it passes through the barriers. The objective of this remedial approach is to treat the off-Site dissolved VOC plume and to create an in-situ reactive barrier that would eliminate any further off-Site plume migration.

The details of the remedy and performance monitoring will be described in the remedial design documents. The conceptual approach is described in the SSCMS.

The sequence of events will be as follows:

1) Install the off-Site PRBs (south side of Hamilton Avenue), then install additional PRBs in key locations further south along Forsythe Street towards Ross Court. It is anticipated that ZVI and a carbon-based substrate product would be injected via temporary injection points to create eight primary off-Site treatment zones (with a combined estimated total length of 2,665 linear feet). Locations of PRBs are displayed on Figure 11. The estimated time to complete these work activities is 50-60 days.
2) Obtain *progress* groundwater samples and field data to confirm the PRBs along Hamilton Avenue have effectively been distributed into the subsurface. This will be completed during the injection activities and immediately following the injection activities. Once confirmed that the PRB is in place and functioning, the on-Site groundwater treatment system will be deactivated.
3) Once the groundwater treatment system has been deactivated, downgradient on-Site PRB (north side of Hamilton Avenue) will be installed and then the initial on-Site ISCO treatment program can be initiated. Progress soil and/or groundwater samples will be obtained in order to document the effectiveness of the ISCO program and then once

satisfactory results have been obtained, the ISCR/Bioremediation injection activities will be implemented throughout the initial ISCO treatment area and the larger remediation area footprint.

4) Progress groundwater samples (on-Site and off-Site) will be obtained on a regular basis post in-situ treatment activities in order to monitor the progress of the implemented remediation activities and to determine if supplemental remediation activities are warranted in select areas.

For a description of Alternative IV, see Section 6.2.5 – Monitored Natural Attenuation.

7. SECTION VII: PROPOSED REMEDY THRESHOLD AND BALANCING CRITERIA

The proposed final remedy and associated CAOs are designed to protect human health and the environment by mitigating risk to current and potential receptors. Amphenol evaluated alternative remedial options for the Facility, which are described in detail in the SSCMS (IWM 2021). EPA uses general threshold and balancing criteria to determine the applicability of each remedial alternative in relation to the specific circumstances of the impacts defined at the site. It is not required that each of the balancing criteria be applied in the evaluation. However, each remedial alternative besides the No-Action Alternative (used as a baseline for comparison purposes) must meet the three Threshold Criteria.

Threshold Criteria:

1) Protect human health and the environment based on reasonably anticipated land use(s), both now and in the future
2) Achieve media cleanup objectives appropriate to the assumptions regarding current and reasonably anticipated land use(s), and current and potential beneficial uses of water resources
3) Control the sources of releases to achieve elimination or reduction of any further releases of hazardous wastes or hazardous constituents that may threaten human health and the environment

Balancing Criteria:

1) Long-term reliability and effectiveness (long-term effectiveness should consider reasonably anticipated future land uses)
2) Reduction of toxicity, mobility, and volume of waste
3) Short-term effectiveness
4) Implementability (technical feasibility and availability of services and materials)
5) Cost

6) Community acceptance of remedy
7) State/support agency acceptance

The remedial alternatives developed for a site make use of individual technologies or various combinations of technologies to determine which of the candidate technologies are suitable for the Site. The facility then proposes a remedy in the CMS document and EPA selects a Final Remedy to propose to the public in the SB document.

The SSCMS evaluated and screened various potential technologies to identify the most practicable, time-efficient, least intrusive, and cost-effective alternatives that would meet the Site-specific CAOs. These remedies were screened out as being impractical, not timely, and unlikely to attain CAOs:

1) On-Site excavation and disposal remedy (incomplete removal due to underground infrastructure and above-ground buildings)
2) Off-Site pump-and-treat remedy (based on the continued presence of impacts at the Site after operating the on-Site recovery system for approximately 25 years, it is likely that this remedial alternative would not reach either the short or long-term groundwater CAOs in a reasonable time frame. Furthermore, the City of Franklin is concerned about the volume of discharge to the POTW)
3) No Further Action remedy

The results of the screening indicate that no single technology would be effective in addressing all media and COCs to meet and maintain CAOs. Therefore, multiple technologies were considered to be optimal to attaining CAOs. Please reference SSCMS Table 13 for a detailed alternatives evaluation. Table 8 below summarizes EPA’s proposed remedy threshold and balancing criteria and Table 9 in Section 7.2 summarizes the costs.

7.1 Proposed Remedy Threshold and Balancing Criteria

Table 8: Proposed Remedy Threshold and Balancing Criteria Summary

Threshold Criteria	**Evaluation**
1. Protect human health and the environment	EPA's proposed remedy for the Site protects human health and the environment by eliminating, reducing, or controlling potential exposure risk to contaminated groundwater and vapor intrusion.
2. Achieve media cleanup objectives	EPA's proposed remedy aims to meet the media cleanup objectives based on assumptions regarding current and reasonably anticipated land and water resource use(s). The remedy proposed in this SB is based on the achieving the cleanup objectives with short term and long term clean up time frame.
3. Remediating the sources of releases	In the sequentially placed ISCO/ISCR/bioremediation proposed remedy, EPA seeks to eliminate or reduce further releases of hazardous wastes and hazardous constituents that may pose a threat to human health and the environment. In addition, several interim measures at the plating room source area have already been completed, and the proposed remedy will further treat remaining source contamination.
Balancing Criteria	**Evaluation**
1. Long-term effectiveness	The long-term effectiveness of the proposed remedy is expected. The Corrective Action Objectives for the Site were established to ensure short term, intermediate, and long term protection to human health and the environment. The proposed remedy is expected to achieve those objectives. Pilot testing and completed interim measures have demonstrated the effectiveness of the proposed remedies.
2. Reduction of toxicity, mobility, or volume of the Hazardous Constituents	The remediation of the source area will result in a reduction of contamination and the implementation of the ISCO/ISCR/bioremediation injection system will reduce the contamination and eliminate the vapor intrusion risks in the neighborhood. PRB with ISCR at the property boundary and MNA will ensure the continued migration prevention as well as reduction of the contaminants throughout the property.
3. Short-term effectiveness	The Corrective Action Objectives for the Site were established to ensure short term, intermediate, and long-term protection to human health and the environment. The proposed ISCO/ISCR/bioremediation remedy is expected to achieve short term objectives of significantly reducing the contamination at the source area.
4. Implementability	EPA's proposed remedy is readily implementable. Once the final remedy is selected, Amphenol will be able to immediately plan for the implementation of the work.
5. Cost	EPA's proposed remedy is cost effective. The total capital costs for Alternatives 2 and 3 are $6,585,864 and $9,525,038 respectively. The annual post implementation costs are $6,910,864 for Alternative 2 and $9,770,038 for Alternative 3. See Table 9 below.
6. Community Acceptance	EPA will evaluate community acceptance of the proposed remedy during the public comment period, and it will be described in the Final Decision and Response to Comments.
7. State/Support agency acceptance	It is anticipated that the State and local stakeholders will find this remedy acceptable.

7.2 Estimated Costs of Proposed Remedy

Table 9: Cost of Remedial Measures Summary

Corrective Measure Alternatives		
	Alternative 2	**Alternative 3**
Direct Capital Costs		
Well Abandonment (On-Site Extended Source Area)	$0	$10,500
PRB/ISCR Injections (**Off-site**)	$1,049,398	$1,049,398
In-Situ Injections (**On-Site** Treatment Area and/or PRBs)	$4,897,666	$599,116
ERH (On-Site Extended Source Area)	$0	$7,068,174
Installation Oversight/Management	$638,800	$797,850
Total Capital Costs	$6,585,864	$9,525,038
Annual Post Implementation Monitoring Costs		
Groundwater Monitoring	$150,000	$90,000
Reporting	$50,000	$30,000
Site Closure Costs		
System Decommissioning	$40,000	$40,000
Monitoring Well Abandonment	$60,000	$60,000
Reporting	$25,000	$25,000
Total	$6,910,864	$9,770,038

*Alternative 2 - In-Situ Injections & PRBs/ISCR On-Site & PRBs/ISCR Off-Site

*Alternative 3 - ERH & PRBs/ISCR On-Site & PRBs/ISCR Off-Site

8. SECTION VIII: EPA'S PROPOSED REMEDY

The alternative corrective measures that were evaluated were based upon available and proven technologies that have been successful at other remedial sites. Iterative performance monitoring for supplemental treatment needs to be conducted to ensure success at meeting the CAOs.

8.1 On-Site Impacted Soil (Source Area)

It is important to treat the contaminated VOCs in unit B/C in the source area to limit the future migration of VOCs to downgradient portions bottom of Unit C and Unit D. Following an evaluation of potential remedies, a sequential injection of ISCO/ISCR/bioremediation is proposed to remediate the VOCs to achieve the CAOs. Sequential injections with the oxidizing or reducing agents for source zone remediation is expected to dechlorinate chlorinated VOCs to non-toxic end products with no long-term accumulation of daughter products such as vinyl chloride and to create a clean waterfront which would migrate downgradient and reduce plume concentrations. An ISCR pilot test was completed in 2020 after the off-Site interim measures demonstrated the effectiveness of this technology.

8.2 On-Site Groundwater

The proposed remediation of the source area will reduce the VOC groundwater impacts on the bottom of the Unit B and top of the Unit C aquifers and prevent the migration of VOCs at concentrations exceeding the VISLs. Monitored natural attenuation (MNA) following source area treatment is proposed to achieve long term CAOs. Institutional controls (deed restrictions) are also proposed to restrict land use and groundwater use.

8.3 Off-Site Groundwater

The proposed remediation of PRB with ISCR will reduce the VOC impacts on the bottom of the Unit B and top of the Unit C aquifers. MNA following source area treatment is proposed to achieve long term CAOs. To prevent downgradient plume migration to the south of the source area treatment system, a PRB with ISCR injections in the southern boundary is proposed. Vapor monitoring and operation and maintenance of the existing vapor intrusion mitigations systems until groundwater no longer serves as a source of contamination to soil vapors is also proposed.

8.4 Monitored Natural Attenuation

Following injection activities and creation of PRBs, MNA would be used to verify that short- and long-term CAOs are attained and maintained. Following establishment of the PRBs, groundwater concentrations would be monitored to ensure short-term CAOs are achieved and MNA would be employed to verify long-term CAOs are reached and maintained.

Groundwater monitoring will be performed throughout the off-Site area to confirm that biotic and abiotic processes are continuing to degrade COCs until long-term groundwater CAOs are achieved following completion of the active remedial work. Additional details of the MNA remedy will be provided in the remedial design document.

8.5 Remedial Monitoring

Following implementation of the Final Remedy, a period of groundwater monitoring will begin to confirm the effectiveness of the selected technologies and determine if additional active remediation is warranted. Amphenol will submit a monitoring plan to EPA as part of the final design document.

8.6 Financial Assurance

As part of the Final Remedy, the responsible parties under the RCRA Section 3008(h)AOC, here Amphenol Corporation and Franklin Power Products, Inc., must demonstrate the financial ability to complete corrective action, including constructing the proposed remedy and monitoring Site conditions following remedy construction (as needed) by securing an appropriate financial instrument, consistent with the requirements of 40 C.F.R §§ 264.142 and 264.144. The responsible parties will develop a detailed cost-estimate as part of, or in advance of, the corrective measures implementation work plan. The responsible parties may use any of the following financial mechanisms to make the demonstration: financial trust, surety bonds, letters of credit, insurance, and/or qualification as a self-insurer (corporate guaranty) by means of a financial test. After successfully completing the construction phase of the remedy, the responsible parties may request that EPA reduce the amount of the financial assurance to the amount necessary to cover the remaining costs of the remedy, including any yearly operation and maintenance costs. The responsible parties may make similar requests of EPA as the operation and maintenance phase of the remedy proceeds and ceases.

8.7 Long-Term Stewardship

EPA will require the responsible parties to establish a long-term stewardship plan, including monitoring and reporting, for the duration of time contamination remains on-Site above unrestricted-use levels. Long-term stewardship will be addressed in separate documents, the Post-Closure Care Plan, and an Environmental Restrictive Covenant. The Post-Closure Care Plan will include a detailed description of planned monitoring activities following remedy construction, including monitoring frequency and threshold conditions used to determine whether additional corrective actions are needed. EPA also requires that performance monitoring approaches be proposed in the remedial design documents. The final monitoring plans can be proposed in the post-closure plan.

The responsible parties must ensure all controls and long-term remedies are maintained and operate as intended. The responsible parties will submit an annual certification that all controls are in place and remain effective. In addition, long-term remedies will be reviewed and inspected on a five-year basis to ensure the remedy is functioning as intended, the exposure assumptions, toxicity data, cleanup levels, and CAOs are still valid, and any information that comes to light that could call into question the protectiveness of the remedy is considered.

If any five-year review indicates that changes to the selected remedy are appropriate, EPA will determine whether the proposed changes are non-significant, significant, or whether fundamental changes to the remedy are needed. EPA may approve non-significant changes without public comment. EPA will inform the public about any significant or fundamental changes to the remedy.

8.8 Land Use Institutional Control

To limit exposure to remaining contaminants, EPA will require that the responsible parties establish an enforceable institutional control to restrict the land use of the property to industrial or commercial use now and in the future. Some ICs have already been recorded for the Site. EPA requires that an Environmental Restrictive Covenant (ERC) also be established. ERCs are generally worked on collaboratively with EPA and the state. The draft ERC submittal can follow remedy construction.

9. SECTION VIIII. PUBLIC PARTICIPATION AND INFORMATION REPOSITORY

EPA requests feedback from the community on this proposal to remediate soil and groundwater using the chemical treatments described above at the Amphenol Site. The public comment period will last forty-five (45) calendar days, from May 18 to July 1, 2022. On May 20, 2022, EPA placed an announcement in the Franklin Daily Journal to notify the public of the availability of this Statement of Basis document and its supporting Administrative Record.

EPA project contacts will host an in-person meeting on the Statement of Basis Thursday, June 9, 2022, from 6-7 p.m. at Franklin City Hall, at 70 E. Monroe St. in Franklin. A formal public hearing will follow at 7 p.m. COVID-19 protocols will be followed during the event, which are subject to change without notice. In addition to this meeting, EPA posted a pre-recorded presentation on the site's webpage, located at: https://www.epa.gov/in/amphenolfranklin-power-products-franklin-ind. EPA invites you to view the presentation and submit your comments in one of the following ways:

- By website, directly at: https://bit.ly/3kOUikw
- By confidential voicemail at (312) 919-4621
- By email to safakas.kirstin@epa.gov
- By mail to: Kirstin Safakas at
  U.S. EPA Region 5
  External Communications Office
  77 W. Jackson Blvd, EC-19J
  Chicago, IL 60604-3590

We encourage community members to submit any comments regarding the proposed remedy in writing by July 1, 2022. Following the 45-day public comment period, EPA will prepare a Final Decision and Response to Comments document that will identify the selected remedy for the Facility. The Response to Comments document will address all significant comments sent to the EPA. EPA will make the Final Decision and Response to Comments document available to the public. If public comments or other relevant information cause EPA to propose significant changes to the currently proposed remedy, EPA will seek additional public comments on any proposed revised remedy.

The Facility Record contains all information considered when making this proposal and will include the Response to Comments document. The Facility Record may be reviewed at the website provided above or at these locations (please call for hours):

Johnson County Public Library Franklin Branch 401 State St Franklin, IN (317) 738-2833	EPA Region 5 Office EPA Records Center 77 W. Jackson Blvd., 7th Floor Chicago, IL (312) 886-4253

If you have any additional questions, contact:

Chris Black (LU-16J)
77 W. Jackson Blvd
Chicago, IL 60604
(312) 886-1451
black.christopher@epa.gov

9.1 Next Steps

Following issuance of the Final Decision and Response to Comments document, Amphenol will prepare for EPA review and approval a Corrective Measures Implementation Work Plan. The Plan will identify any additional data collection needed to implement the corrective measures, along with the specifications for completing the selected corrective measures. The Work Plan will provide a detailed construction schedule. Based on the proposed corrective measures, it is anticipated that the majority of the remedial measures can be completed within two years of the Final Decision.

ATTACHMENTS

Figure 1. Locality Map Franklin, Indiana

Figure 2. Site Location

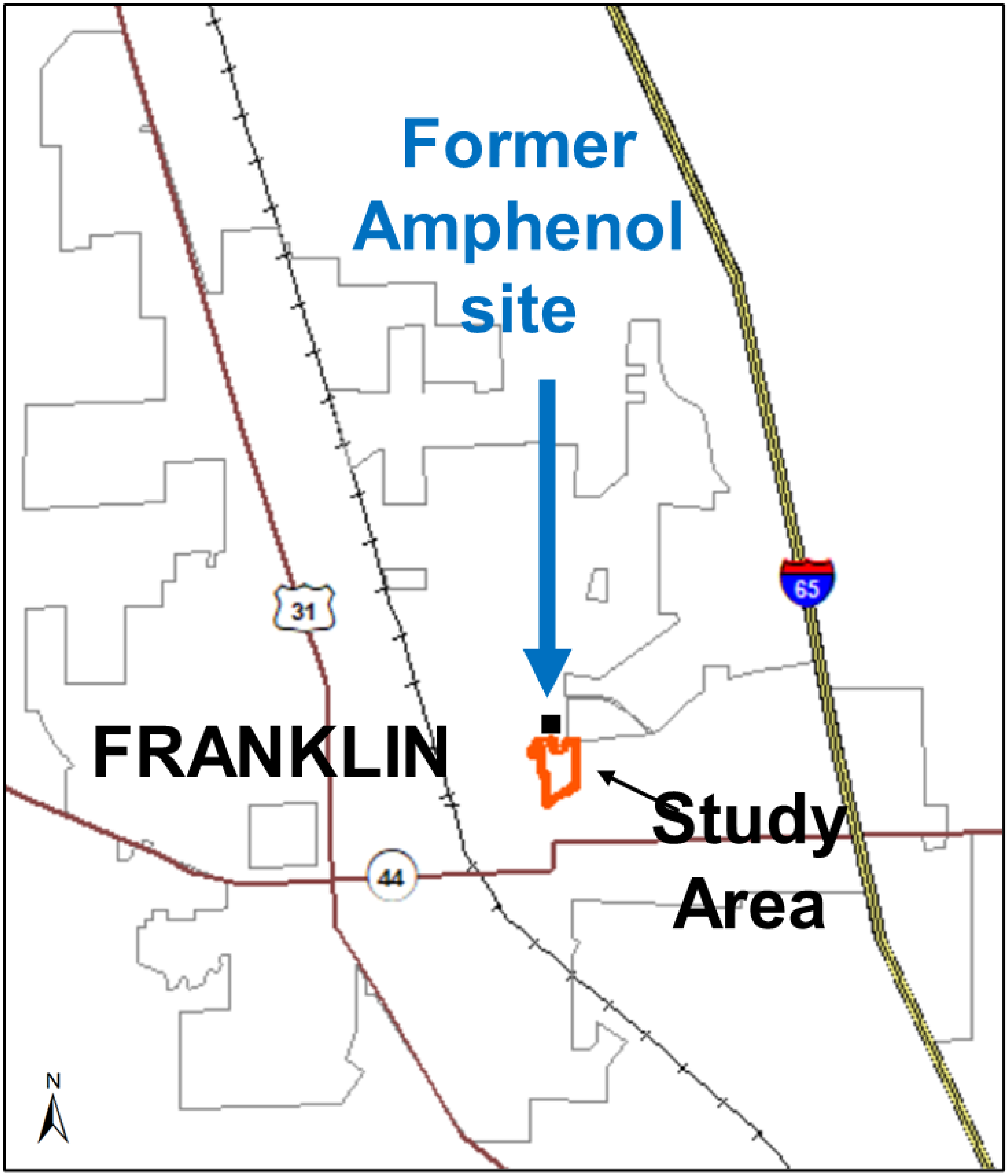


Figure 3. Amphenol Study Area

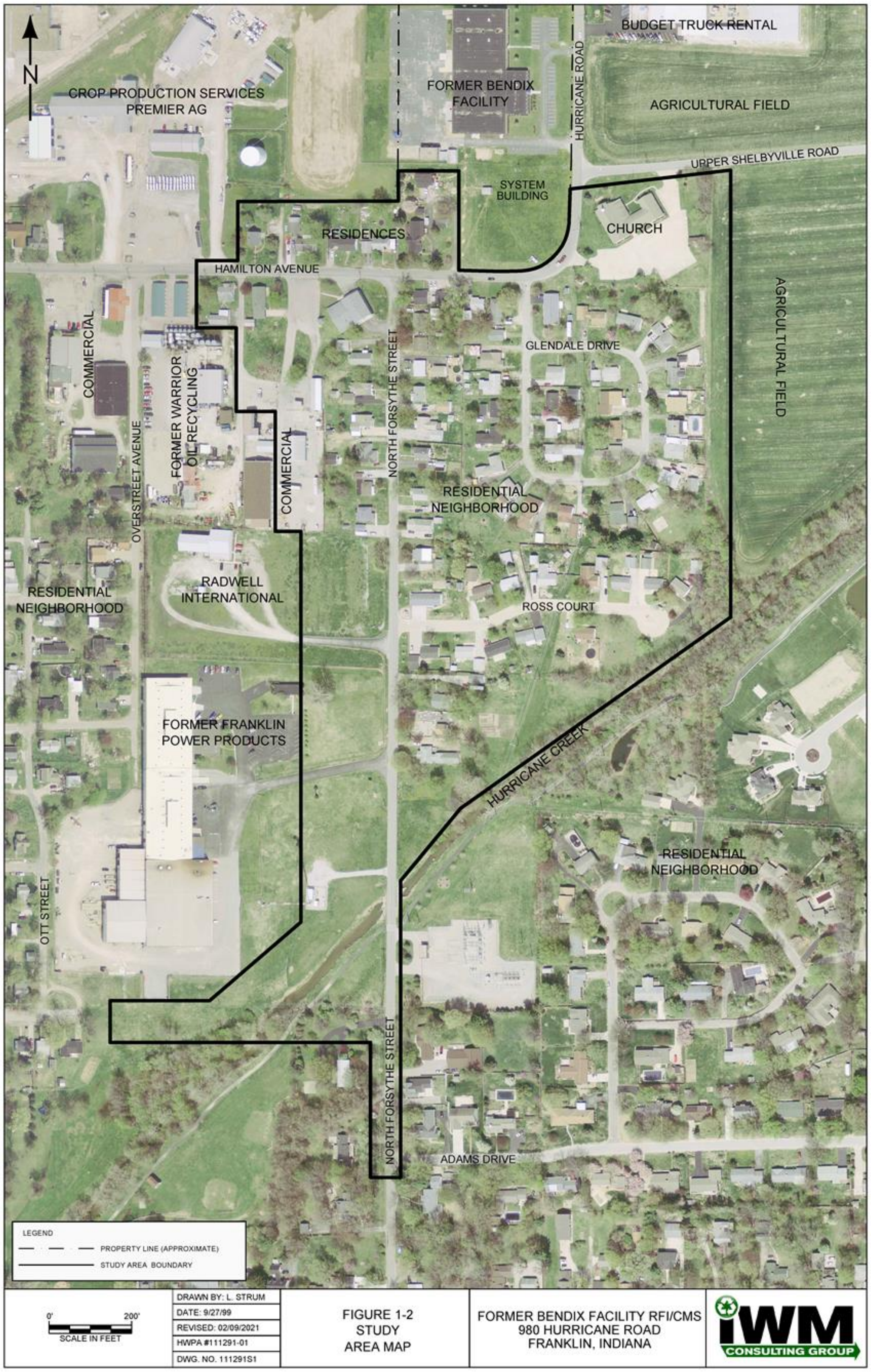


FIGURE 4: POTENTIOMETRIC SURFACE MAP

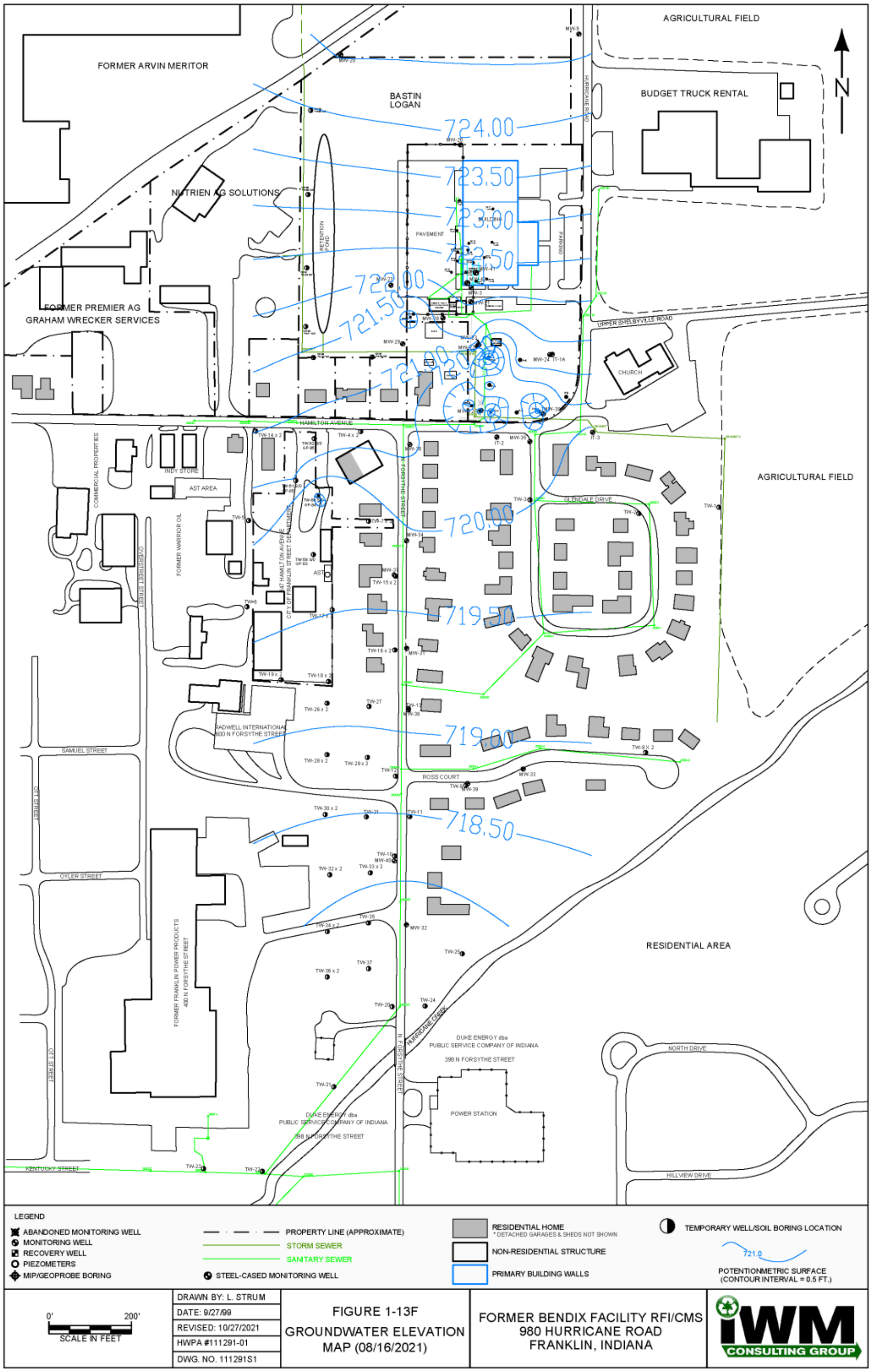


Figure 5. Influence of Groundwater Remedial System on Potentiometric Surface On-Site

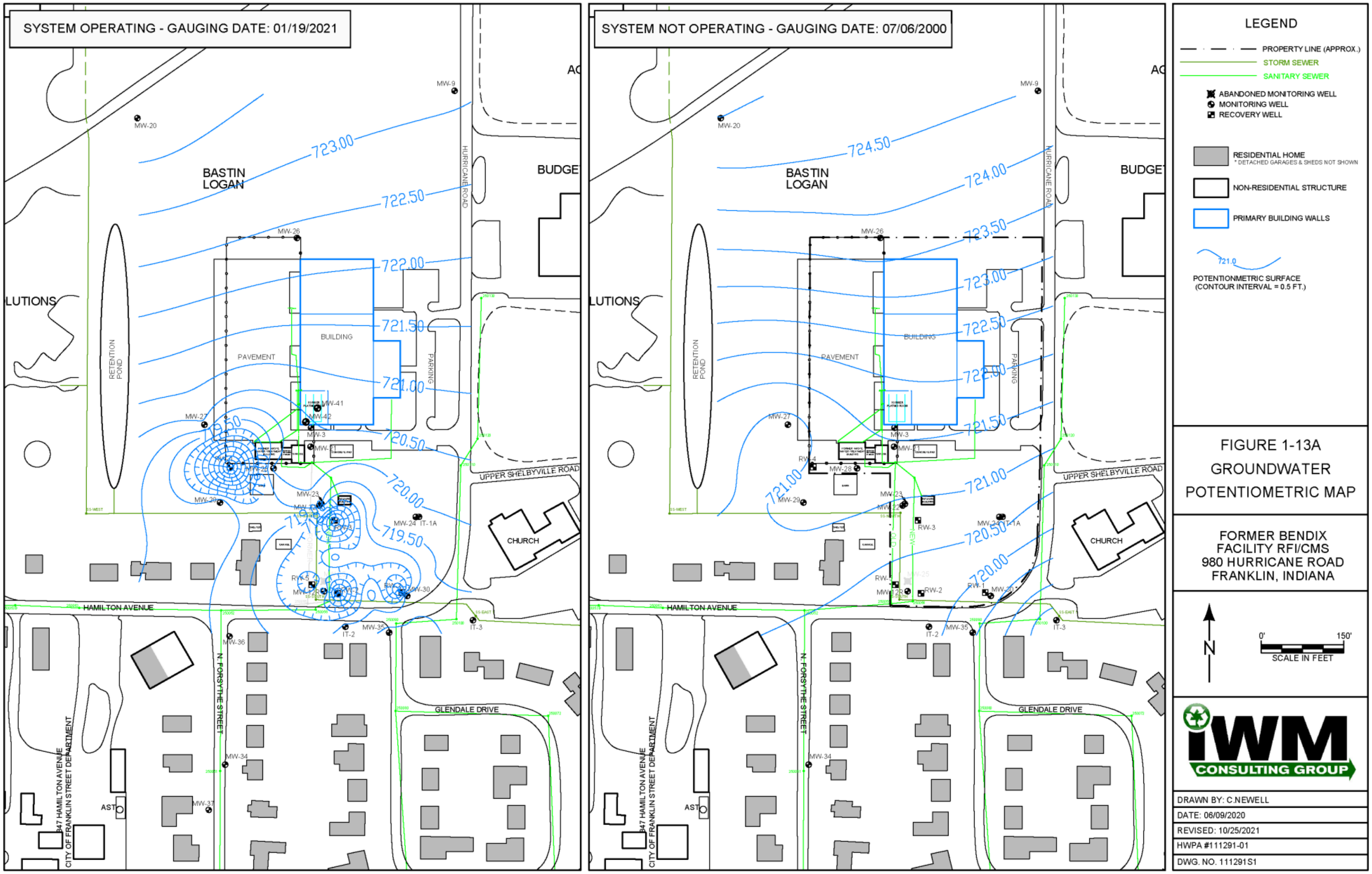


Figure 6. Conceptual Site Model

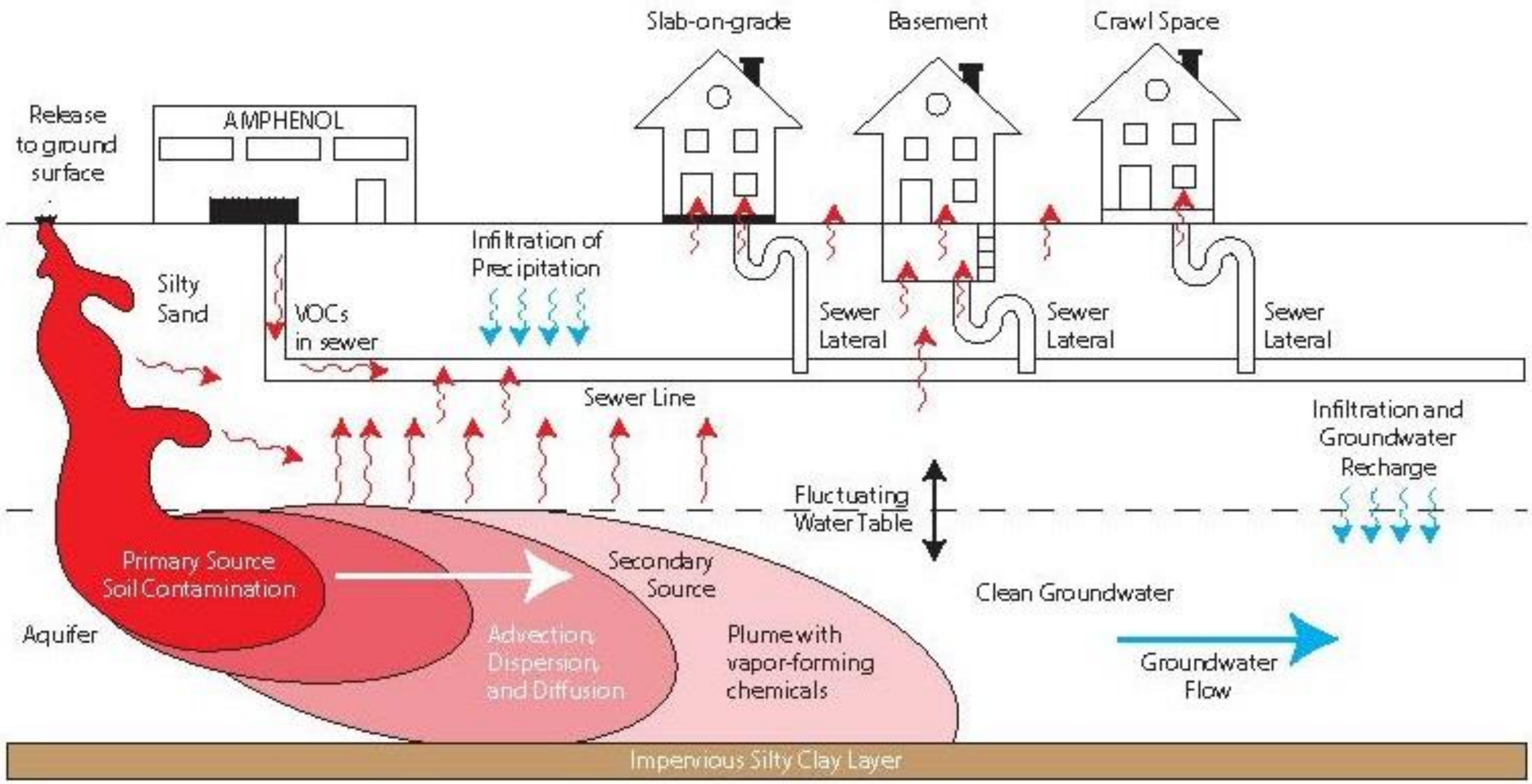


Figure 7. Vapor Exposure Pathways

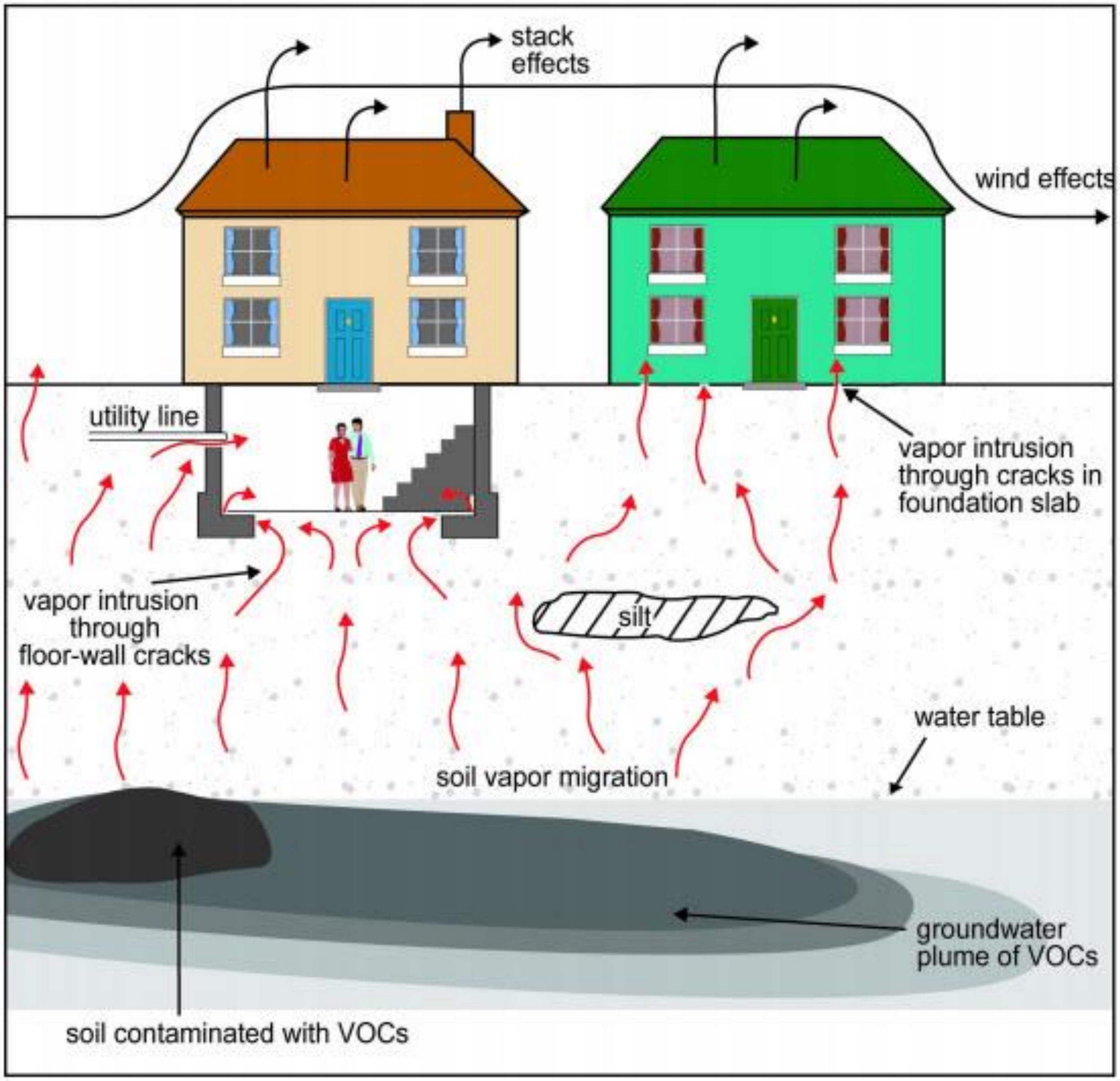


Figure 8. PCE Plume in Groundwater Unit B, shallow and deep

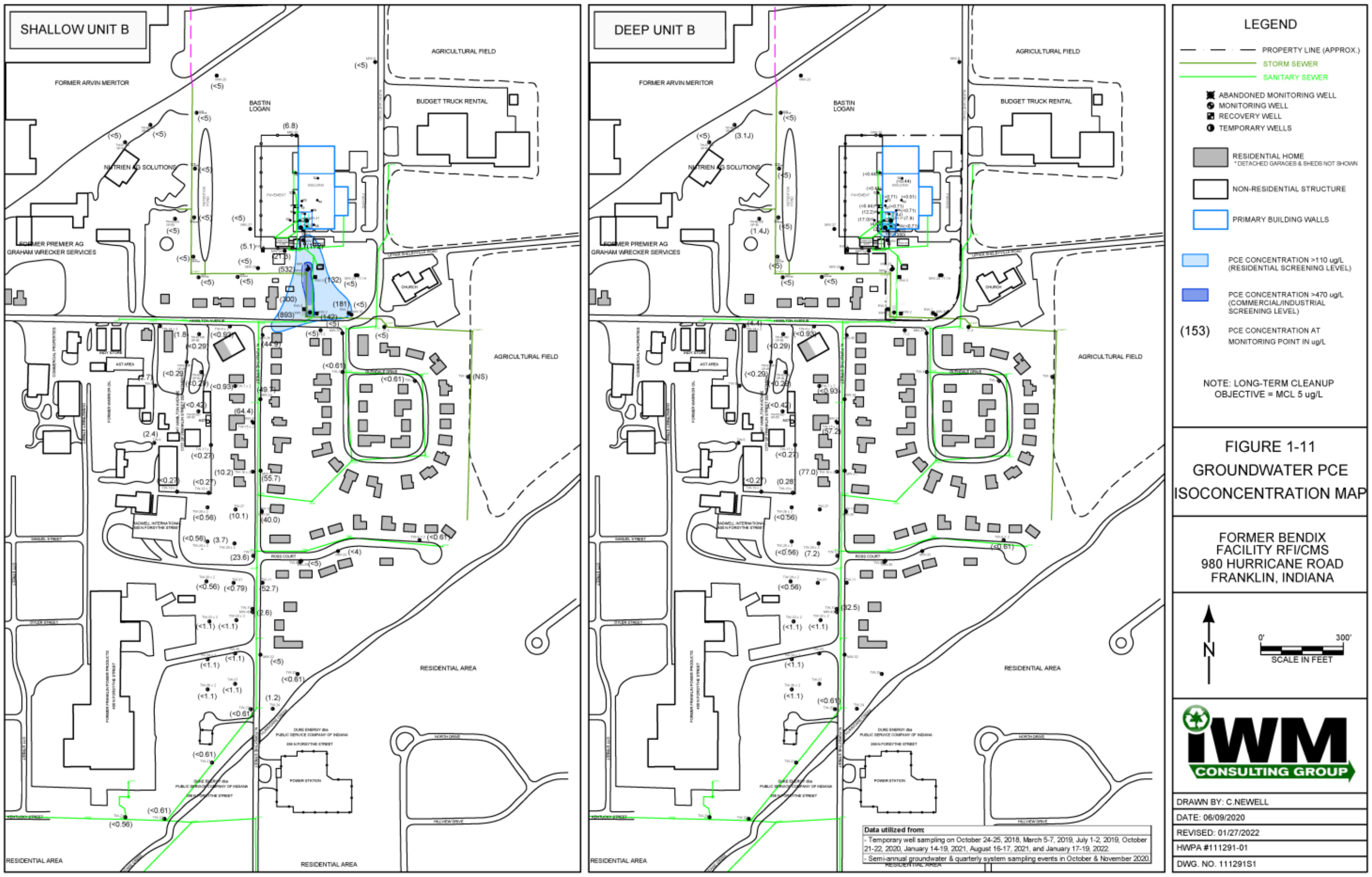


Figure 9. TCE Plume in Groundwater Unit B, shallow and deep

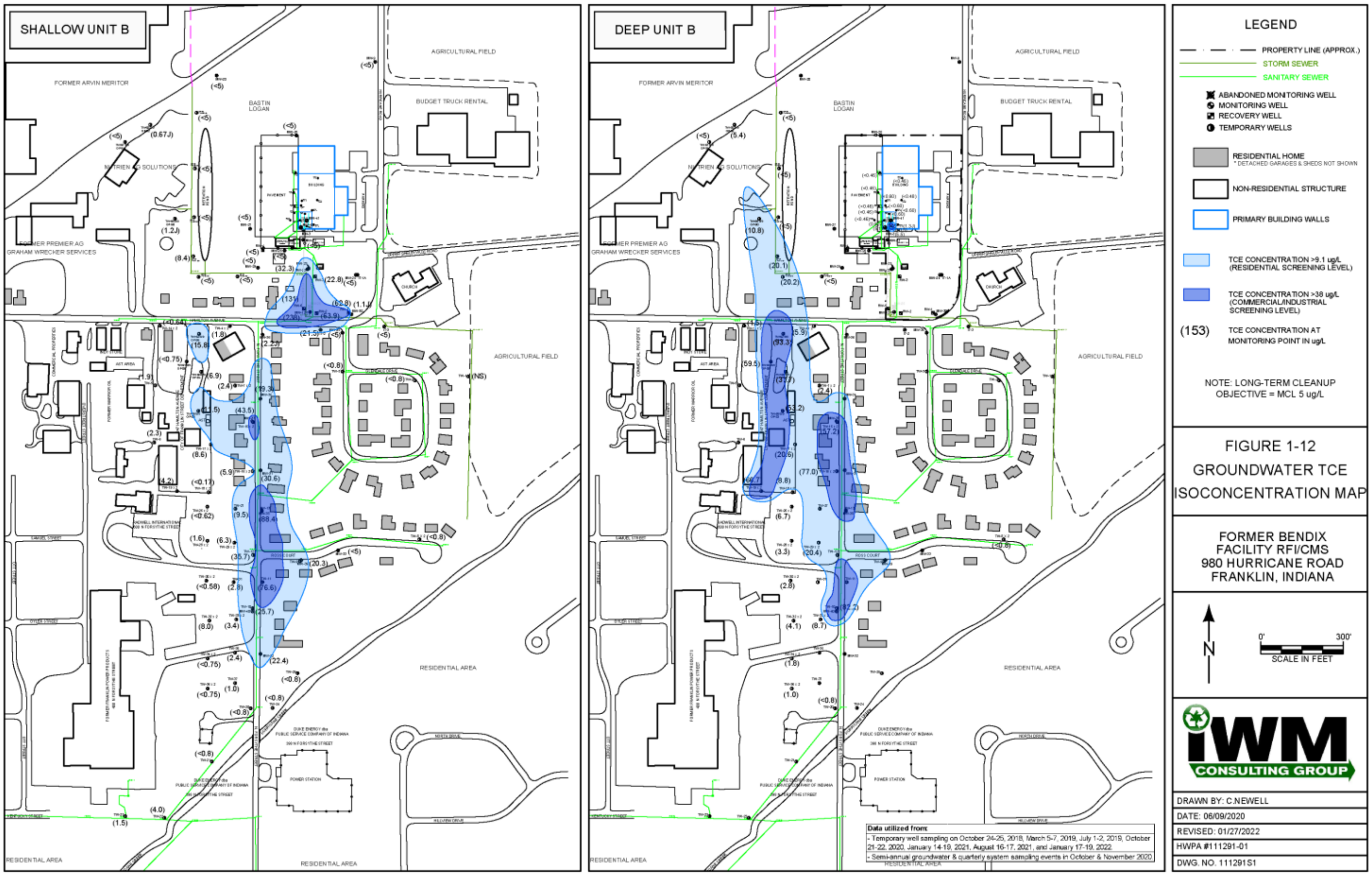


Figure 10. Study Area Pilot Injections

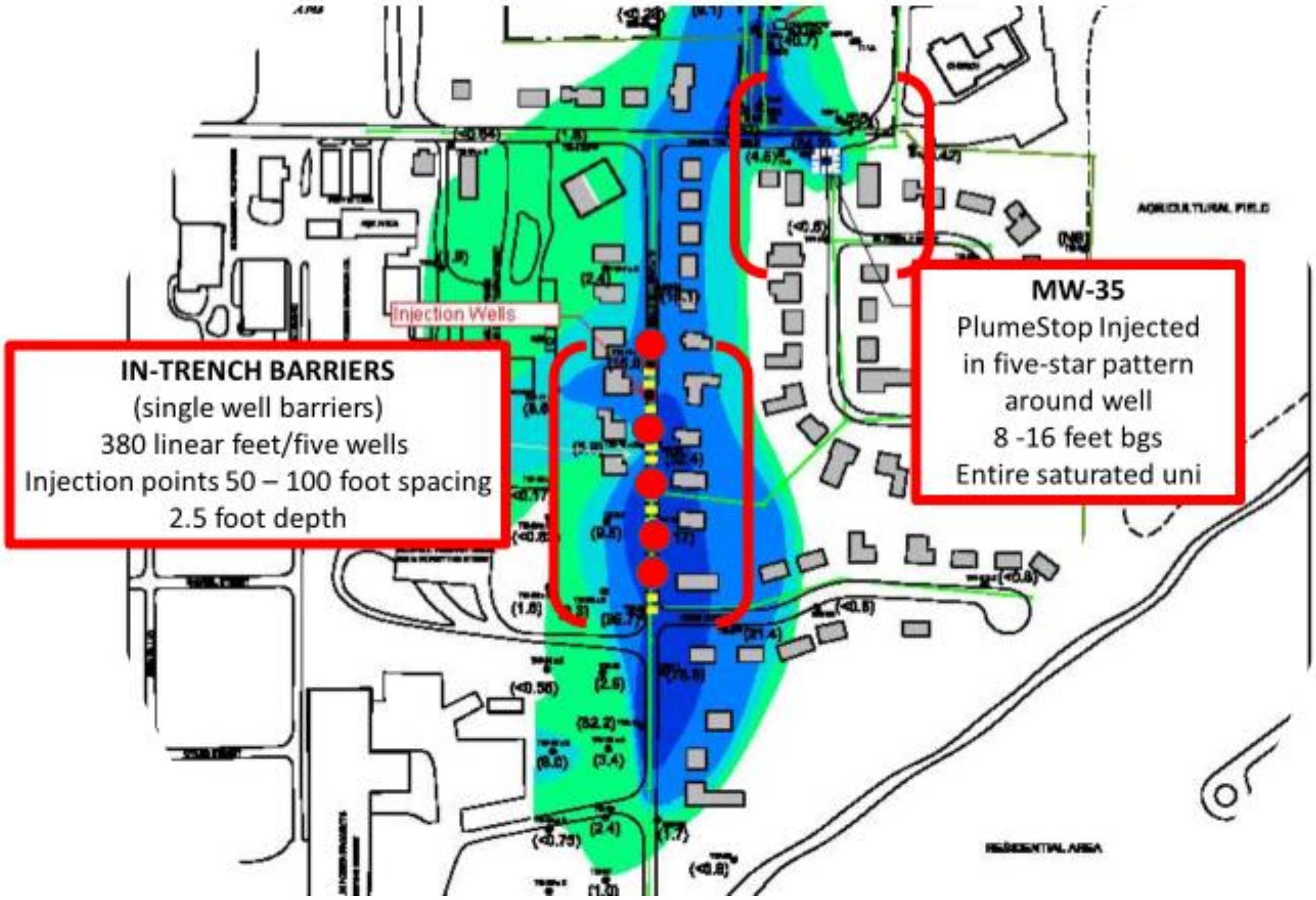


Figure 11. Treatment Plan for ISCO, ISCR and PRBs

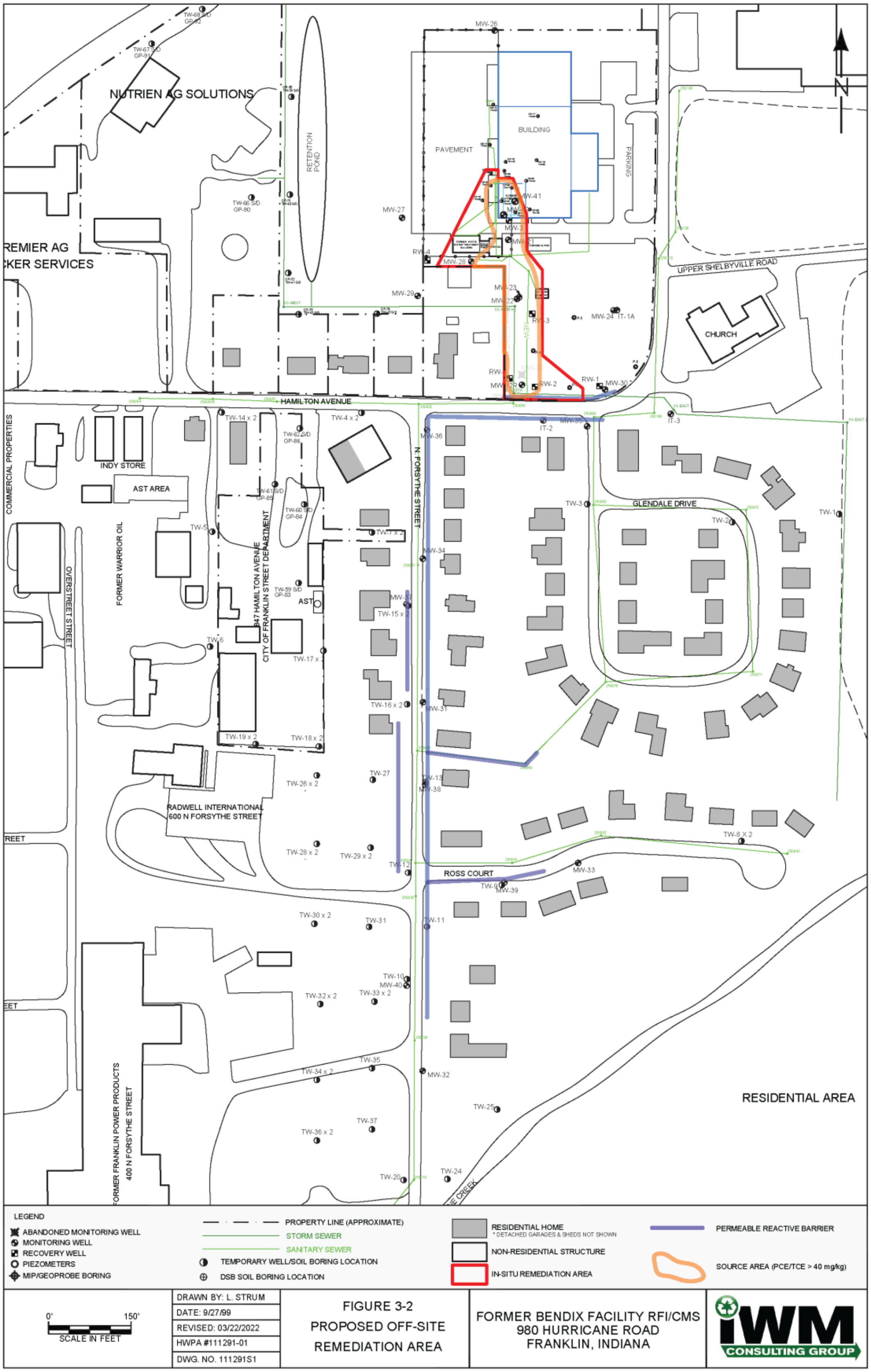
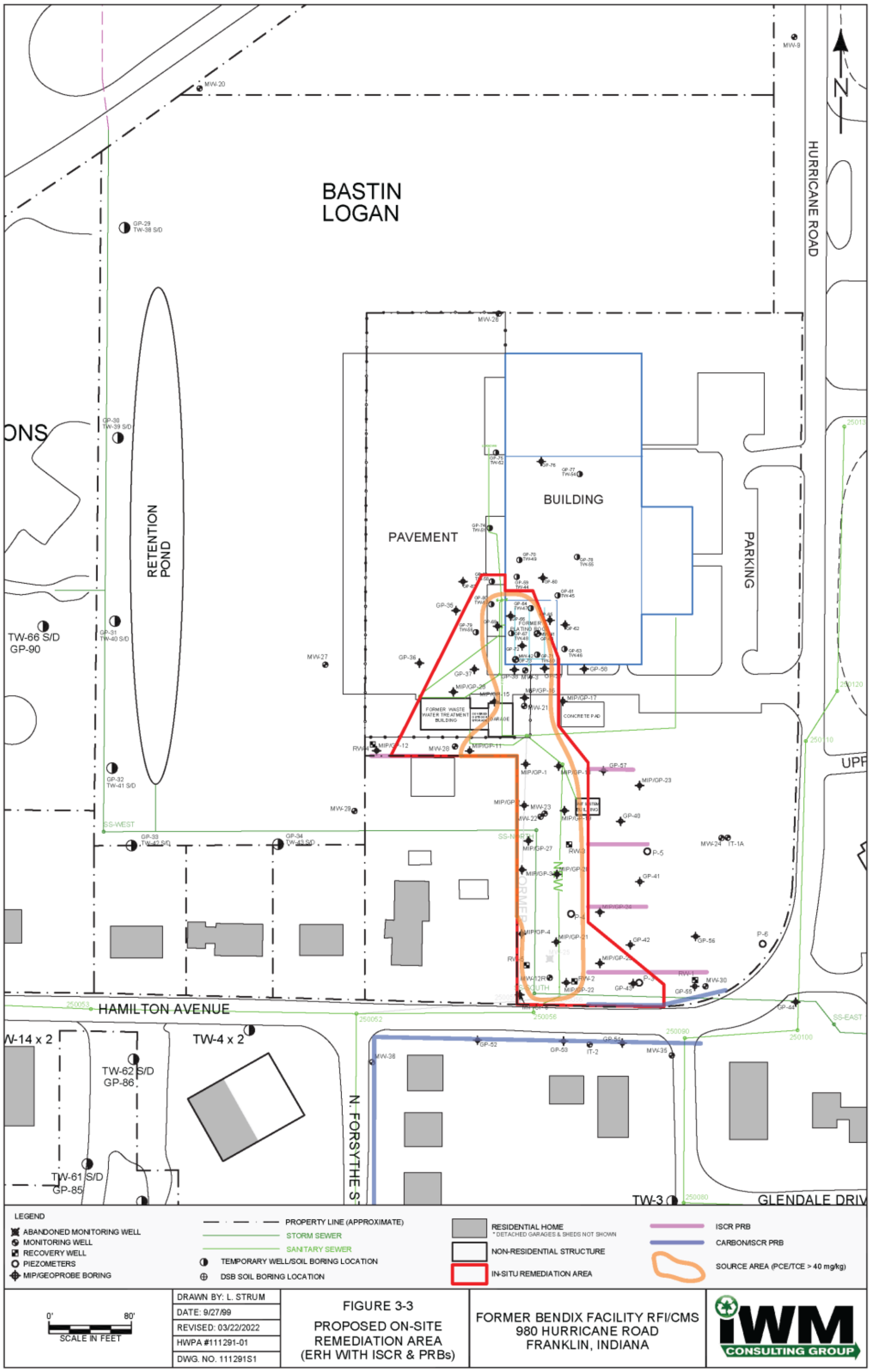


Figure 12. Treatment Plan for ISCO, ISCR and PRBs



Administrative Record Index

FRANKLIN, JOHNSON COUNTY, ILLINOIS

EPA ID NO: IND 044 587 848

1. RCRA 3008(h) Administrative Order on Consent, 1990
2. RFI Report (WW Engineering and Science 1994).
3. A.T. Kearney, Inc. 1996. Draft Indoor Air Risk Assessment for the Residences Along Forsythe Street. October 1996.
4. RCRA Administrative Order on Consent, 1998
5. EPA 2019. Stakeholder Information Plan. July 2019.
6. EPA 2018. Remedial Technology Fact Sheet – Activated Carbon- Based Technology for In Situ Remediation.   EPA 542-F-18-001, April 2018
7. IWM March, 2022. *Second Supplemental Corrective Measures Study Franklin Power Products, Inc./Amphenol Corporation.*
8. IWM 2021 July. *Storm Sewer Rehabilitation Summary Report*. July 2021.
9. IWM 2020. OIM Construction Completion Report. January 2020.
10. IWM 2020. Off-Site Groundwater Treatment Pilot Study Evaluation Report.
11. IWM 2020 June 24. Draft Post-OIM Sewer Gas VI Evaluation Report
12. IWM 2018. Draft Ambient Air Investigation Results Summary Report. August 2018.
13. ISDH 2017. Findings of a Cancer Inquiry Investigation, Johnson County, Indiana, 2015-2017**.** December 2017

Work Plans:

14. Design-Level Data Soil Investigation Work Plan (IWM Consulting, February 2019)
15. On-Site Soil Investigation Work Plan (IWM Consulting, February 2020) and Addendum
16. Off-Site Groundwater Investigation Work Plan (IWM Consulting, October 2018)
17. Additional Off-Site Groundwater Investigation Work Plan (IWM Consulting, February 2019)
18. Vapor Intrusion Investigation – Exterior Soil Gas Sampling Work Plan (IWM Consulting, September 2018)
19. Sewer Gas Vapor Intrusion Investigation Work Plan (IWM Consulting, September 2018)
20. On-Site Sewer Vapor Intrusion Investigation Work Plan (IWM Consulting, January 2020)
21. Ambient Air Investigation Work Plan (IWM Consulting, July 2018)
22. Residential Vapor Intrusion Investigation Work Plan for Priority Residences. (IWM Consulting. September 2018)
23. Off-Site Interim Measure Work Plan and Response to Comments (IWM Consulting, June 2019)
24. Off-Site Interim Measure Work Plan Addendum (IWM Consulting, August 2019)
25. Conditionally Approved OIM Work Plan – Response to Comments (IWM Consulting, September 2019)
26. Off-site Groundwater Treatment Pilot Study (IWM Consulting, October 2019)
27. Off-Site Interim Measure Construction Completion Report (IWM Consulting. January 2020)
28. On-Site Sewer Gas Vapor Intrusion Investigation Summary Report (IWM Consulting, April 2020)

29. Off-Site Groundwater Treatment Pilot Study Evaluation Report (IWM Consulting, September 2020)
30. On-Site Source Soil Investigation Work Plan (IWM Consulting, December 2020)
31. Supplemental Soil and Groundwater Investigation Work Plan (IWM Consulting, July 2021)

Guidance:

32. Assessment and Delineation of DNAPL Source Zones at Hazardous Waste Sites (U.S. Environmental Protection Agency, 2009, Washington, DC, EPA 600-R-09-119). Kueper, B. H. and K. Davies.
33. U.S. Environmental Protection Agency (USEPA). May 1994. "Final RCRA Corrective Action Plan". Office of Solid Waste and Emergency Response, EPA 520-R-94-004, U.S. Environmental Protection Agency, Washington D.C.
34. U.S. Environmental Protection Agency (USEPA). March 2000. "EPA Threshold and Balancing Criteria", Attachment One of Fact Sheet #3, Final Remedy Selection for Results-Based RCRA Corrective Action. U.S. Environmental Protection Agency, Washington D.C.
35. U.S. Environmental Protection Agency (USEPA). December 2004. "DNAPL Remediation: Selected Projects Approaching Regulatory Closure – Status Update". Office of Solid Waste and Emergency Response, EPA 542-R-04-016, U.S. Environmental Protection Agency, Washington D.C.
36. U.S. Environmental Protection Agency (USEPA). March 2016. "RCRA Corrective Measure Study Bulletin". U.S. Environmental Protection Agency, Washington D.C
37. Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Ground Water, EPA/600/R-98/128, September 1998)