PHASE III RESIDENTIAL VAPOR INTRUSION TESTING

FORMER AMPHENOL FACILITY #IND 044587 848
980 HURRICANE ROAD
FRANKLIN, INDIANA
MUNDELL PROJECT NO. M18027
JUNE 24, 2019
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MUNDELL PROJECT NO. M18027

Prepared for:

Mr. Robert Spiegel
Executive Director
Edison Wetlands Association
209 Tyler Road
Edison, New Jersey 08820

June 24, 2019

Prepared by:

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June 24, 2019

Mr. Robert Spiegel
Executive Director
Edison Wetlands Association
206 Tyler Road
Edison, New Jersey 08820

Re: Phase III Residential Vapor Intrusion Testing
Former Amphenol Facility #IND 044587 848
980 Hurricane Road
Franklin, Indiana, 46131
MUNDELL Project No. M1802

Dear Mr. Spiegel:

In response to the Edison Wetlands Association, Inc. Request for Proposal (RFP), Mundell & Associates, Inc. (MUNDELL), a professional environmental engineering company based in Indianapolis, has prepared this report summarizing a third phase of vapor intrusion testing in Franklin, Indiana. The goals of this sampling project were to build upon the first two phases of vapor data collected by MUNDELL in order to address data gaps concerning potential vapor intrusion risks that may be associated with the Former Amphenol Facility in Franklin. In addition, samples were collected from Hurricane Creek in order to assess potential impacts to the creek from the Amphenol site. We appreciate the opportunity to provide services to you on this project. If you should have any questions regarding this report, please feel free to contact us at (317) 630-9060 or via email at jmundell@MundellAssociates.com.

Sincerely,

MUNDELL & ASSOCIATES, INC.

Rachel Walker, Ph.D., L.P.G.
Project Geologist

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President/Senior Environmental Consultant
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EXECUTIVE SUMMARY

Mundell and Associates, Inc. (MUNDELL) has conducted Phase III environmental sampling as part of an expanded investigation into residential vapor intrusion concerns, along with surface soil and water sampling in the Franklin, Indiana area. This phase of the investigation was initiated at the request of the Edison Wetlands Association (EWA), and was performed in response to previous sampling events that uncovered vapor intrusion concerns in and around residential areas in Franklin, Indiana. The U.S. Environmental Protection Agency (U.S. EPA) has identified the former Amphenol Corporation site (Amphenol), located at 980 Hurricane Road, Franklin, as one potentially responsible party. Amphenol was utilized for the manufacture of electrical parts in the 1960s through the 1980s. Wastes generated and stored at the site during this time were reported to include volatile organic compound (VOC) solvents, poor housekeeping and unregulated discharges of which significantly contaminated surrounding soils, groundwater and a sanitary sewer line. Two previous rounds of vapor intrusion testing (June 2018 and October 2018) have been carried out in Franklin by MUNDELL at the request of EWA. This most recent 2019 round of investigative activities follows on from these prior assessments in order to contribute to the available environmental database to support an enhanced understanding of the potential vapor intrusion hazards that may be present as a result of contamination that is related to the Amphenol site and other possible sites within Franklin.

The currently reported sampling and testing activities were carried out from February 25th to March 4th, 2019. The chemicals of concern tested for during this sampling event are classified as chlorinated volatile organic compounds (cVOCs) and include tetrachloroethylene (PCE), trichloroethylene (TCE), 1,1,1-trichloroethane (1,1,1-TCA), cis-1,2-dichloroethylene (cis-1,2-DCE), trans-1,2-dichloroethylene (trans-1,2-DCE), 1,2-dichloroethane (1,2-DCA) and vinyl chloride (VC). Multiple technologies were used to measure vapors, including traditional Summa-type air canisters, passive samplers in the form of Radiello 130 units, and the VaporSafe™ system developed by Groundswell Technologies. VaporSafe™ is a state-of-the-art innovative vapor intrusion monitoring system wherein grab and/or continuous monitoring air samples are collected on-site and injected into a gas chromatograph, analyzed, and the results reported in near real-time. This method provides a quantitative measure of how vapor concentrations may be varying over time as a result of a number of site-specific factors.

Thirty (30) houses had grab samples collected using glass syringe samplers, the contents of which were analyzed by the VaporSafe™ system. Grab samples are a “snapshot” in time, but are a useful tool to rapidly screen residences for vapor intrusion concerns and help focus on homes for additional testing. Therefore, it should be noted that the concentrations detected during the grab portion of this sampling event are not necessarily the minimum nor the maximum concentration of vapors in indoor air over a longer period of time, given the inherent variability of vapors in air.

One third of the houses that had grab sampling performed had detectable levels of TCE in indoor air above the reporting limit. Four (4) of these houses had results that suggested the
presence of TCE above Indiana Department of Environmental Management’s (IDEM’s) Residential Indoor Air Screening Levels. Grab samples collected from sewer cleanouts located at five (5) total residences (including homes that had and did not have observed indoor air exceedances at the time of sampling) indicated concentrations of TCE and/or PCE in exceedance of residential indoor air screening levels. The presence of high concentrations of cVOCs in sewer air could pose a potential threat to indoor air in the event that sewer gases enter a house through faulty plumbing.

Continuous monitoring was then performed on five (5) residences using a combination of the VaporSafe™ system, Summa-type air canisters and Radiello passive samplers. Comparison of data from the three distinct technologies provided a “check-and-balance” during the investigation and revealed invaluable considerations about the role of variability on short- and long-term human exposures in Franklin. Three (3) of these houses had indoor air IDEM screening level exceedances of TCE recorded by one or more of the monitoring technologies utilized. Vapor mitigation systems where appropriate were recommended to the homeowners in their individual reports.

The exceedances noted in several residences indicate the necessity for further vapor intrusion monitoring for residences near the Amphenol site and impacted sewer line. Continuous monitoring of select houses conducted with the VaporSafe™ system also demonstrated the variability in concentrations, temperature, and barometric pressure over time in a manner that traditional air canister sampling has not been able to demonstrate.

Additionally, creek bank soil and surface water samples were collected from four (4) locations along Hurricane Creek - two locations upstream of the Amphenol site and two locations downstream of the Amphenol site. Soil from the sampling location situated at the cross point of North Forsythe Street and Hurricane Creek had a detection of TCE just above the IDEM soil migration-to-groundwater screening level. This suggests that occasional discharges of TCE have occurred to Hurricane Creek, and that TCE groundwater impacts beyond those currently identified may exist in the vicinity of Hurricane Creek and beyond. This detection in such a limited data set suggests the need for those overseeing the regulatory aspect of the Amphenol investigation/remediation to expand the scope of sampling for surface water and sediments in Hurricane Creek.

According to historic site documents, the sanitary sewer line located along North Forsythe Street was a primary preferential pathway for VOCs from the former Amphenol site. Due to the high concentrations of PCE and TCE observed in several residential sanitary sewer cleanouts, robust sampling efforts should be initiated to trace vapors not only through sewer gases but also sewer backfill soils and sewer sludge where VOCs may have remained sequestered for an extended time period. Additional soil and groundwater sampling beyond the area immediately surrounding the sewer line is also recommended to fully delineate the horizontal and vertical soil and groundwater contamination extent so that appropriate remedial decisions may be implemented in an effective and timely manner.
Emerging real-time continuous vapor intrusion monitoring techniques such as the VaporSafe™ system are actively being demonstrated in several U.S. EPA regions. Use of these technologies can increase the understanding of temporal and spatial variabilities that standard Summa canister 24-hour averages may not see. Since it is well known that vapor levels vary over time and ambient conditions, dispatching a continuous technology to the most high-risk residences may reveal patterns of intrusion and peak concentrations that may be missed by traditional sampling methods alone. A sampling strategy as was used as part of this sampling event, which screened 30 homes for vapor intrusion concerns in less than one week, can be a significant tool to rapidly identify additional human health risks that may be outside the current U.S. EPA priority study area. The potential risk from PCE and TCE in sewer gas should also be assessed with sewer gas leak tests performed to ensure houses are not at risk of infiltration of PCE or TCE from faulty plumbing.
1. INTRODUCTION

1.1 AMPHENOL SITE BACKGROUND

The approximately 15-acre former Amphenol Corporation site (Amphenol or “the Site”) is located at 980 Hurricane Road, Franklin, Indiana (see Figure 1), and was utilized for the manufacturing of electrical parts in the 1960’s through the 1980’s. Wastes generated and stored at the site during this time were reported to include metal hydroxide sludge, volatile organic compound (VOC) solvents and thinners, and cyanide solutions. According to Bendix Connector Corporation, the predecessor of Amphenol, these wastes leaked through the facility’s floor and were discharged through a cracked sanitary sewer line. Unregulated discharges of hazardous chemicals significantly contaminated surrounding site soil, groundwater and surface water. A network of on-site monitoring wells was installed in the 1980s, and a groundwater recovery system reportedly began operating on the property in 1995. VOC contaminants of concern at the Site include trichloroethylene (TCE), tetrachloroethylene (PCE), cis-1,2-dichloroethylene (cis-1,2-DCE), trans-1,2-dichloroethylene (trans-1,2-DCE), 1,1,1-trichloroethane (1,1,1-TCA) and vinyl chloride (VC).

Significant data gaps were uncovered during an earlier review of the Amphenol site history, that are relevant to the current stage of the investigation. These historic data gaps include, but are not limited to, the following areas of interest:

1.1.1 Off-Site Downgradient Groundwater and Sewer Impacts

- In 1992 and 1993, a series of groundwater grab samples were collected within the neighborhood immediately south of Amphenol and along North Forsythe Street to Hurricane Creek. The grabs located along North Forsythe Street indicated the presence of a groundwater plume extending down North Forsythe Street to at least Ross Court. Limited delineation was performed on either side of North Forsythe Street, with only three soil borings/groundwater grab samples collected to the east and three to the west. While those to the east were non-detect, the groundwater grab samples collected to the west of North Forsythe had detections of TCE between 3 and 25 µg/L. No additional delineation appears to have been performed at that time further west of these grab locations.

- A 35-foot section of sanitary sewer was replaced on the former Amphenol site itself in the mid-1980’s, but the sanitary sewer line down North Forsythe Street was not replaced. No confirmation sampling appears to have been conducted at that time to confirm whether there were off-site impacts present along the sewer line.

- As such, the extent and migration of the groundwater plume and sewer contamination were not fully characterized, particularly in the off-site and residential areas, prior to the Amphenol site cleanup considered to be complete by the U.S. EPA in 1998.
1.1.2 Off-Site Residential Vapor Intrusion

- A November 14, 1995 correspondence document from Paul Little (EPA Enforcement and Compliance Assurance Branch) to Samuel S. Waldo (Amphenol Corporation) notes: “Due to leakage from sanitary sewer at middle of [Forsythe] street VOC contamination occurs at the street and likely also on adjacent properties... Human Health risk may be difficult to quantify, but chemical odors have been detected in basements near the street.”

- In 1996, following this letter, a draft *Indoor Air Risk Evaluation for the Residences along Forsythe Street* was performed using modeling techniques to assess potential risk from groundwater contamination to the indoor air of residences. The conclusions of this qualitative assessment were not validated with field data.

- **As such, the potential for vapor intrusion and risk to residences near the Amphenol site were not adequately addressed historically.** No further assessments regarding vapor intrusion were performed until the 2018 air sampling programs completed by MUNDELL and others.

1.1.3 On-Site Remediation System Effectiveness

- The on-site pump and treat system started operating in 1995. After over 23 years, the system is still operating and concentrations of site contaminants of concern remain significantly above cleanup goals in a number of wells.

- The current Site consultant claimed the pump and treat system was maintaining hydraulic control of the dissolved VOC plume and that the cone of influence of the on-site system extends beyond the southern Site boundary. However, at that time, there were only two off-site wells in existence, both of which are located immediately south of the Site across Hamilton Avenue. Only one of those wells showed some evidence of hydraulic control related to the on-site system.

- **Pump and treat technology at the Site has not been shown to be effective as a remedial alternative alone, given the significantly elevated VOC concentrations in groundwater that have migrated into residential areas to the south.** More state-of-the-art remediation technologies, such as in-situ bioremediation or chemical oxidation, have been developed and shown to be very effective in significantly reducing the concentrations of chlorinated compounds like TCE or PCE to acceptable levels in a reasonable time period.

1.1.4 Amphenol Site Management

- The Amphenol site is currently monitored under the U.S. EPA Resource Conservation and Recovery Act (RCRA) Corrective Action program. Given the deficiencies referenced
above, additional investigatory work must be completed to close all current data gaps and ensure that human health and environmental exposures are under control.

- Recent data collection summaries presented by the U.S. EPA at the June 5, 2019 public meeting in Franklin provided estimates of the extent of groundwater, soil and sewer gas impacts centered along North Forsythe Street and Hamilton south of the former Amphenol site. However, this is based on a rather limited data set without the benefit of delineation by a comprehensive network of groundwater monitoring wells.

- Proposed remediation of impacted soils along the sewer via excavation and removal and replacement of the sewer is planned to begin in the early fall of 2019 and be completed by the end of 2019. However, public concerns regarding the implementation of a Health and Safety Plan to minimize health impacts to on-site workers and residents during this excavation work have not been fully addressed. In addition, no formal plan has been made available at this time for public input and comment prior to the start of the planned activities.

1.2 OTHER SITES OF INTEREST

1.2.1 Webb Wellfield

The Webb Wellfield is located approximately 3,500 feet northeast of the Amphenol site, near the intersection of County Roads 440E and 100N (see Figure 1). Three wells in the Webb Wellfield were shut down between 2007 to 2013 due to TCE, cis-1,2-DCE and trans-1,2-DCE detections found above Maximum Contaminant Levels (MCLs) in or near the wells. According to the Indiana Department of Environmental Management (IDEM), the Webb Wellfield supplied water to over 18,000 service connections prior to shutdown of the wells, and was part of Indiana American Water Company’s (INAWC) distribution system. Hurricane Creek, a surface water body within the Youngs Creek Watershed, flows south through the wellfield, and past the Amphenol site and Glendale-Ross neighborhood on the eastern side.

INAWC has previously expressed concerns that contamination from the Amphenol site could migrate to the wellfield; however, Amphenol Corporation has previously asserted that its site is not the source. A Supplemental Site Assessment report was prepared by IWM Consulting in 2007 at the request of the U.S. EPA with the goal of evaluating whether VOCs from the Amphenol site had potentially migrated onto the wellfield. This report concluded that other industrial facilities in the area, not Amphenol, potentially contaminated the wellfield based on historical flow data and the collection of new samples from existing wells at the time. However, questions as to the origin of the contamination in Webb Wellfield and the influence that drinking well pumping and shut off may have had on the migration of groundwater plume(s) in the area remain.
1.2.2 Webb and Needham Elementary Schools

Two schools located within 0.5 miles southeast of the Amphenol Site and 0.7 miles southwest from the former Webb Wellfield (see Figure 1) are considered ‘sensitive receptors’ by the U.S. EPA since their young occupants are more susceptible to the adverse effects of exposure to toxic chemicals, including chlorinated organic solvents. Needham Elementary services approximately 412 students from kindergarten to Grade 4 (ages 5 to 10 years old) and Webb Elementary services about 340 students from pre-school to Grade 4 (ages 3 to 10 years old).

In response to the initial June 2018 sampling report released by MUNDELL and EWA, EnviroForensics performed ambient air and soil gas sampling at both Needham and Webb Elementary Schools in July 2018 on behalf of Franklin Community Schools. The ambient air sample results indicated non-detectable concentrations of PCE and TCE. The soil gas samples had detections of PCE and TCE that were below the relevant IDEM screening levels; however, the presence of these chemicals in the soil gas suggests that they are also present in the groundwater.

On March 9, 2019, EnviroForensics conducted another round of testing at the Webb and Needham Elementary Schools. Concentrations of TCE in exceedance of IDEM screening levels were found in a number of sub-slab soil gas samples from both schools, indicating a need to conduct indoor air testing and ensure student safety. Indoor air testing was performed on March 23 and 24, 2019. The indoor air results were non-detect for PCE, TCE, and other chemicals of concern. However, given the presence of TCE and PCE vapors beneath the slab, the Franklin School System has chosen to move forward with the installation of sub-slab depressurization systems.

1.2.3 Additional Sites Under State Oversight

IDEM has also listed the following as sites of interest undergoing active investigation/enforcement actions in Franklin. A brief description of current and/or former operations and chemicals of concern at these facilities is included below:

- **Former Warrior Oil Service** (809 Overstreet Street) – Former used oil recovery business. As part of a 2010 Environmental Site Assessment (ESA) report for this property, the possibility for groundwater contamination from the former Amphenol site to migrate off-site and potentially impact the Warrior Oil property was discussed. IDEM currently indicates on its “Franklin, IN” webpage that no groundwater contamination above IDEM Remediation Closure Guide Residential Tap Water Screening Levels was detected in the on-site drinking water well in 2018. This data did not appear to be posted on the agency’s Virtual File Cabinet, however.

- **Hurricane Development (former Houghland Property)** (1130 Eastview Drive) – Former tomato canning operation. Chemicals of concern in soil and groundwater at this site include the cVOCs PCE, TCE, and cis-1,2-DCE.
- **RCO Reed Manufacturing Corporation (former Houghland Property) (1056 Eastview Drive)** – Former tomato canning operation and current manufacturer of bolts, screws, and other machining work. Chemicals of concern in soil and groundwater at this site include the cVOCs PCE, TCE, and cis-1,2-DCE. In 2018, the site was referred to IDEM’s Remediation Services Branch and cited for violations regarding the generation and storage of used oil.

- **Former Arvin Industries (1001 Hurricane Street)** – Former automobile exhaust systems manufacturer. According to a May 2019 Initial Site Investigation report, historical records indicate the following were used and disposed at the site: TCE, polychlorinated biphenyls (PCBs), waste paint, waste batteries and corrosive solids.

1.3 **FRANKLIN, INDIANA**

1.3.1 **Population**

Franklin is a prosperous community located in Johnson County, approximately 21 miles south of Indianapolis. In 1990, U.S. Census data indicates that there were 12,907 people living in Franklin, 3,007 of which were under the age of 18 years. Franklin underwent rapid growth in the decade from 1990 to 2000, with the population increasing by more than 50% to 19,463 people by the year 2000, of which 5,050 were under the age of 18. According to the last available census year of 2010, there were 23,712 people in the city of Franklin, of which 6,237 were under the age of 18 (U.S. Census Bureau, 2010). The Glendale Drive group of residences has been present since the early 1950’s. However, historic aerial images of Franklin indicate that housing developments to the south and southeast of the former Amphenol Corporation site expanded substantially between 1972 and 1998. As a result of this demographic change and expanding development, there are today many more residences that could be exposed to potential impacts from historic industrial sites such as Amphenol.

1.3.2 **Geology/Hydrogeology**

The Site Study Area is located at the confluence of several unconsolidated aquifer units in Johnson County. The Amphenol Site itself sits within the New Castle Till Aquifer System. This system consists of unconsolidated deposits that range from 40 feet to 250 feet in thickness. Potential aquifer materials include outwash sands and/or gravels that typically range from 10 to 15 feet thick and are generally overlain by 65 to 135 feet of clay, which reduces aquifer susceptibility to surface contamination (Maier, 2005).

The nearby Needham and Webb schools, the former Webb Wellfield and some of the housing developments are located within the White River and Tributaries Outwash Aquifer System which runs along Hurricane Creek, Sugar Creek and the Big Blue River. This system contains large volumes of outwash and alluvial deposits that filled the river valleys of the White River and its major tributaries. Total thickness of the deposits can be as much as 165 feet with up to 110 feet
of continuous sand and gravel. This System has the greatest aquifer potential in Johnson County. Areas where there is no overlying clay or silt can leave the aquifer open to surface contamination. Some areas are overlain by clay or silt, which reduces aquifer susceptibility to surface contamination (Maier, 2005).

Importantly, both aquifers consist of coarse-grained materials including sands and gravels. Once contamination reaches these materials, it has the potential to migrate with groundwater to great distances from the original source due to the coarse nature of the aquifer soils.

1.4 INVESTIGATIVE TEAM

Headquartered in Indianapolis, Indiana, Mundell & Associates, Inc. (MUNDELL) was founded in 1995 to provide professional earth and environmental consulting services to industry, municipalities, governmental agencies, engineering firms, the legal community and non-governmental organizations. MUNDELL personnel act as project engineers, scientists, program directors, senior technical consultants, and expert witnesses throughout the United States, Canada, Mexico, South America, Europe and Asia.

Groundswell Technologies, Inc. (Groundswell) is a professional company specializing in automated monitoring and visualization of environmental sensor network data. Groundswell provided support with the data collection and analytical aspects of this project using the VaporSafe™ system, discussed in Section 3 of this report.

Founded in 1989, Edison Wetlands Association, Inc. (EWA) is a leader in toxic waste site cleanups, environmental restoration, and conservation of natural resources in New Jersey and beyond. EWA works in several critical areas cleaning and restoring the longest river solely in New Jersey, the Raritan River; preserving natural areas including the Dismal Swamp Conservation Area (DSCA); and helping to empower communities throughout the nation that suffer negative impacts from environmental injustices and inequities. Through its Community Assistance Remediation Program (CARP), EWA provides communities like Franklin, Indiana with resources and technical assistance to address environmental concerns. EWA has testified before the U.S. Congress on toxic waste-related issues and received the U.S. Environmental Protection Agency’s (U.S. EPA) Environmental Quality Award for its successful work on the Chemical Insecticide Corporation Superfund Site.

2. SCOPE OF WORK AND OBJECTIVES

The main purpose of this project is to continue to identify and map chlorinated volatile organic compound (cVOC) impacts that have the potential to pose unacceptable vapor intrusion risks to the residents of Franklin, Indiana.
The scope of work was prepared based upon the following project goals provided by EWA:

1) To expand on previous data by further delineating where vapors are currently migrating into residences, or may pose a future risk;

2) To identify residences where selected contaminants (i.e., cVOCs) are detected above human health criteria;

3) To design and coordinate a rapid indoor air screening event for residences to broadly evaluate the spatial distribution of buildings where concerns may exist both within and outside of the current U.S. EPA Franklin Vapor Intrusion Study Area;

4) In residential locations that have evidence of cVOC impacts, to further ascertain vapor pathway(s) and entry point(s) as well as any human activities or natural causes that may facilitate vapor intrusion;

5) To evaluate sewer laterals to determine if this is a significant preferential pathway for vapor migration into residential buildings; and

6) To identify potential site-related impacts to Hurricane Creek.

3. AIR TESTING EQUIPMENT AND PROCEDURES

3.1 VAPORSAFE™ SYSTEM

In conjunction with air canister and passive sampler air samples were also collected and analyzed using the VaporSafe™ system. VaporSafe™ is a real-time monitoring technology which uses a mobile gas chromatograph unit and ultrapure nitrogen carrier gas to analyze air samples. Samples can be introduced into the unit as grab samples collected using specialized glass syringes, or monitored continuously using 1/8” outside diameter Nylarow tubing runs laid out to each sample location through which air is pulled via a pump. In continuous mode, the VaporSafe™ unit can analyze samples from up to 16 locations. VaporSafe™ is able to identify vapor intrusion trends and potential entry points and can help to determine whether mitigation alternatives are required. VaporSafe™ can also be used for mitigation confirmation and adaptive remediation strategies. Analyses performed via VaporSafe™ are in accordance with U.S. EPA SW-846 Test Method TO-14.

For the Franklin project, the VaporSafe™ unit was calibrated for PCE and TCE prior to being deployed using laboratory standards. As part of QA/QC procedures, several calibration checks were performed using laboratory standards while operating in the field to ensure the unit maintained an acceptable calibration. The method detection limit (MDL) for the VaporSafe™ unit for PCE was 0.1 µg/m³ and 0.5 µg/m³ for TCE, with the reporting limit (RL) at 1 µg/m³.
3.1.1Grab Sampling

Grab sampling was coordinated to initially screen indoor air, sub-slab soil gas, and sewer cleanouts of residences in a wide range of locations upgradient and downgradient of the Site for cVOCs (see Figure 1 for the sample collection area). A total of thirty (30) houses were included in the collection of air grab sampling for initial screening purposes performed using the VaporSafe™ system. The houses tested had varying residential construction features including basements, crawl spaces and slab-on-grade. Samples were collected using glass syringes into which 40 milliliters of air was drawn. Samples were injected into the sampling port of the VaporSafe™ unit for analysis, which was completed in approximately 10 minutes per sample.

3.1.2Continuous Sampling

A total of five (5) houses were selected for continuous air monitoring using the VaporSafe™ system. Nylaflow tubing was run to the selected monitoring location inside the residence and connected to the inlet selector of the VaporSafe™ system. Each tubing run was labeled to indicate the sample location. Once all tubing runs were established, the VaporSafe™ system was directed to operate in automatic mode. The system pump pulled air through the tubing at a rate of approximately 150 milliliters per minute for 8 minutes (or approximately 1.2 liters of air), after which it injects an aliquot of that air into the gas chromatograph for analysis. The inlet selector cycled between locations in order, completing a full cycle of sampling at all locations approximately every hour, depending upon the number of sample locations being tested.

Inset Figure 1. Running Nylaflow tubing through residential living room on February 28, 2019.
Inset Figure 2. Nylaflow tubing connected to six inlets on VaporSafe™ unit. Each line of tubing runs to indoor location.

Inset Figure 3. Differential pressure measured through sub-slab port installed in residential bathroom.
Residents were asked to remove any household materials containing chemicals that could potentially interfere with testing approximately 48 hours before testing commenced. The general areas where sampling occurred were surveyed for conditions that could affect sample results. An Indoor Air Quality Survey Form was completed at each of the five houses, per IDEM Remediation Closure Guide (RCG) recommendations.

3.2 24 HOUR TIME-WEIGHTED AVERAGE TECHNOLOGIES

3.2.1 Air Canister Sampling

Air canisters were deployed at four (4) of the houses where continuous monitoring via the VaporSafe™ system was also occurring. Air samples collected via air canister were collected using batch-certified air canisters of 6-liters in volume, equipped with a regulator allowing for up to 24 hours of sampling time.

As with the VaporSafe™ testing, residents were asked to remove any household materials containing chemicals that could potentially interfere with testing approximately 48 hours before testing commenced. The general areas where sampling occurred were surveyed for conditions that could affect sample results. An Indoor Air Quality Survey Form was completed at each of the houses, per IDEM Remediation Closure Guide (RCG) recommendations.
Air sample canisters were labeled with a unique sample designation number. Air canister samples were submitted to a certified laboratory (LSAI Labs located in Indianapolis, Indiana) for short list cVOC analysis of six compounds: PCE, TCE, 1,1,1-TCA, cis 1,2-DCE, trans 1,2-DCE and vinyl chloride using U.S. EPA SW-846 Test Method TO-15.

3.2.2 Radiello RAD-130 Sampling

Radiello RAD-130 passive samplers were deployed at four (4) houses where continuous monitoring via the VaporSafe™ system was also occurring. The samplers were deployed per manufacturer instructions and were exposed for a 24 hour period. The Radiello samplers were collected at the end of the 24 hour period, packaged and shipped to a certified laboratory (Eurofins Air Toxics located in Folsom, California) where they were analyzed via U.S. EPA Modified Method TO-17 for the following compounds: PCE, TCE, 1,1,1-TCA, cis-1,2-DCE and trans-1,2-DCE. Results for cis-1,2-DCE and trans-1,2-DCE are provided as estimates only.
4. SEDIMENT AND WATER TESTING PROCEDURES

4.1 HURRICANE CREEK SAMPLING

This task included the collection of surface water and creek sediment samples at select locations along Hurricane Creek (see Figure 2 for map of sampling locations). Creek bank sediment samples were collected from three (3) locations: one upstream of the Amphenol site and two downstream. Surface water samples were collected from four (4) locations: two locations upstream of the Amphenol site and two locations downstream. Sediment samples were collected from a depth of approximately 2 to 4 inches along the bank of the creek close to the water line. The water samples were collected using a long-handled sampling rod with a sample scoop on the end. The water samples were packaged on ice and transported to a certified laboratory where they were analyzed for the following compounds: volatile organic compounds (VOCs) via U.S. EPA SW-846 Method 8260; semi-volatile organic compounds (sVOCs) via U.S. EPA Method 8270; Target Analyte List (TAL) Metals via U.S. EPA Method 6010; mercury via U.S. EPA Method 7470; 1,4-dioxane via U.S. EPA Method 8270 SIM; cyanide (free) via U.S. EPA Method 9014, and polychlorinated biphenyls (PCBs) via U.S. EPA Method 8082. The soil samples were packaged on ice and transported to a certified laboratory where they were analyzed for the following compounds: volatile organic compounds (VOCs) via U.S. EPA SW-846 Method 8260; semi-volatile organic compounds (sVOCs) via U.S. EPA Method 8270; Target Analyte List (TAL) Metals via U.S. EPA Method 6010; mercury via U.S. EPA Method 7471; 1,4-dioxane via U.S. EPA Method 8260 SIM, and polychlorinated biphenyls (PCBs) via U.S. EPA Method 8082.

Matrix spike, matrix spike duplicate and duplicate soil and water samples were also collected. A chain of custody form was completed for all samples and analyses were completed by Pace Analytical located in Indianapolis, Indiana. Weather during the collection event was 34 degrees Farenheit with occasional snow flurries.

5. GRAB INDOOR AIR RESULTS

MUNDELL mobilized to Franklin on February 25th, 2019 to co-ordinate with EWA and VaporSafe™ to conduct indoor air grab sampling at a total of thirty (30) residences. The houses had varying construction features including basements, crawl spaces and slab-on-grade.

The grab sample results are presented in Table 1. Grab samples are a “snapshot” in time, but are a useful tool to rapidly screen residences for vapor intrusion concerns and help focus on homes for additional testing. Therefore, it should be noted that the concentrations detected during the grab portion of this sampling event are not necessarily the minimum nor the maximum concentration of vapors that occur in indoor air sampling over a longer period of time, but represent an initial indication of the “presence” or “absence” of impacts.
Ten (10) of the thirty (30) houses that had grab sampling performed had detectable levels of TCE in indoor air. Four (4) of the houses had results that suggested the presence of TCE above IDEM’s Residential Indoor Air Screening Level (RIASL) of 2.1 µg/m³ (see Table 1).

Grab samples collected from sewer cleanouts located at five (5) residences indicated concentrations of TCE and/or PCE in exceedance of residential indoor air screening levels. The presence of high concentrations of cVOCs in sewer air could pose a potential threat to indoor air in the event that sewer gases enter a house through faulty plumbing.

6. CONTINUOUS INDOOR AIR RESULTS

MUNDELL conducted continuous monitoring using a combination of the VaporSafe™ system, air canisters and passive samplers to measure indoor air at five (5) selected residences. The sampling results are presented in Table 2, with the VaporSafe™ data illustrated graphically in Attachments A through E. Ambient air canister samples were also collected at each home (or, if the homes were adjacent to one another, one ambient air can was shared between the two homes). All ambient air samples were non-detect for the contaminants of concern (see Table 2).

The residences were selected on the basis of proximity to the former Amphenol site, known soil and groundwater impacts in the area surrounding the sewer line along North Forsythe Street, and the results of VaporSafe™ grab samples. One (1) residence was monitored using the VaporSafe™ system by itself, while the other four (4) house locations were sampled using a combination of the VaporSafe™ system, air canisters and Radiello RAD-130 passive samplers.

Comparison of data from these three distinct technologies was intended to provide a “check-and-balance” during the investigation and provide invaluable information about variability of vapor concentrations across short-term exposure periods. One does not expect all three methods to give identical results, due to the inherent variability associated with measuring vapors, differences in sample collection methods and in the three analytical methods used (U.S. EPA SW-846 Test Methods TO-14, TO-15 and TO-17). In several cases, the results agreed closely with one another, while in other cases, they did not. The details of these cases and their implications for the larger investigation will be discussed below and in Section 8.

6.1 LOCATION 5 (HERITAGE TRAIL)

Location 5 (Heritage Trail) was monitored for approximately 24 hours from February 28th to March 1st, 2019, using a combination of the VaporSafe™ system, air canisters and RAD-130 passive samplers (see Table 2 and Attachment A). The VaporSafe™ data indicated the presence of TCE above the Indiana Department of Environmental Management’s (IDEM’s) Residential Indoor Air Screening Level (RIASL) of 2.1 µg/m³ at all six locations in the house that were tested. A RAD-130 passive sampler placed in the main bedroom also indicated the presence of TCE below the screening level. The air canister placed in the main bedroom indicated exceedances of IDEM RIASLs for both PCE and TCE, with the reported TCE
concentration of 40.6 \mu g/m^3 exceeding the IDEM Residential Indoor Air Action Level (RIAAL) of 21 \mu g/m^3.

Due to the much higher concentration of TCE indicated by this batch-certified air canister sample compared to the VaporSafe™ and passive sampler data, a retest of the residence was performed on April 4th, 2019 using individually-certified canisters. This retest was performed to both confirm the March 1st result and to evaluate sub-slab conditions. Two sub-slab ports were installed in the slab of the residence. Six (6) air samples [three (3) indoor air, two (2) sub-slab soil gas, and one (1) ambient air] were collected using air canisters of 6-liters in volume equipped with a regulator allowing for up to 24 hours of sampling time. A sewer cleanout sample was also collected using a batch-certified air canister of 1-liter volume set for an intake rate of 5 minutes (i.e., a grab sample). Results of the retest are presented in Table 2.

While results of the retest indicated lower concentrations of TCE and PCE compared to the main bedroom sample from March 1, 2019, the results indicate that the TCE concentration in the main bedroom indoor air is still in exceedance of the IDEM RIAAL. The concentration of TCE observed during the air canister retest event was very close to the VaporSafe™ value recorded during the March 1, 2019 event. Additionally, the air canister results detected 1,2-DCA concentrations at or above the indoor air screening level of 1.1 \mu g/m^3 at three locations.

The sub-slab air results were lower in concentration for TCE than that of the indoor air, suggesting that there may be another potential source. The sewer cleanout sample contained TCE at a concentration of 7.5 \mu g/m^3. The main bedroom of the residence has an attached bathroom. It is possible that TCE may have entered the house through plumbing in the bathroom. MUNDELL recommends that the house plumbing be tested for potential sewer gas leaks to assess this possible pathway.

The VaporSafe™ data also demonstrated variability in indoor air vapor concentrations that may be ‘missed’ by 24-hour air canister sampling alone (see Attachment A). All locations in the house experienced a brief appearance of PCE and disappearance of TCE between 4:00pm and 8:00pm on February 28th. This event is so far unexplained but indicates how indoor air concentrations can shift suddenly in response to several possible environmental factors including changes in air and building pressure from operation of HVAC systems or changes in weather.

6.2 LOCATION 7 (NORTH FORSYTHE)

Location 7 (North Forsythe) was monitored for approximately 24 hours from March 1st to 2nd, 2019, using a combination of the VaporSafe™ system, air canisters and RAD-130 passive samplers (see Table 2 and Attachment B). The VaporSafe™ data indicated the presence of PCE below the IDEM RIAAL of 42 \mu g/m^3 at all four locations in the house that were tested. The concentration of PCE detected remained largely stable throughout the monitoring event. A
singular detection of TCE below the screening level was noted by the VaporSafe™ system in the bathroom.

The RAD-130 passive sampler and two air canisters that also collected samples at this residence were non-detect for PCE and TCE. The air canisters and the passive sampler may have ‘missed’ the PCE reported by the VaporSafe™ system, as the concentrations detected by the VaporSafe™ system were less than the reporting limits for these two methods.

During the grab sampling phase, three sewer cleanout samples were collected. One sample was non-detect; however, the other two samples had detections of TCE and PCE at levels above indoor air screening levels. Although sewer air is not indoor air, the presence of such concentrations in the sewer that connects the house to the main sewer line is cause for concern. In particular, there is a potential for vapor invasion into the house in the event that the plumbing does not successfully keep sewer gases out of the residence. A vapor leak test on house plumbing may be beneficial to verify that the significant VOC concentrations in the sewer system do not pose a current or future risk to the indoor air of the building.

6.3 LOCATION 8 (ROSS COURT)

Location 8 (Ross Court) was monitored for approximately 24 hours from March 2nd to 3rd, 2019, using a combination of the VaporSafe™ system, air canisters and RAD-130 passive samplers (Table 2 and Attachment C). The VaporSafe™ data indicated the presence of TCE at all three locations in the house that were tested in concentrations ranging from below the IDEM RIASL of 2.1 µg/m³ to just above the screening level. PCE was also detected at all three locations generally between 2 and 3 µg/m³, below the indoor air screening level. An apparent relationship between barometric pressure and TCE concentrations was observed, with decreasing barometric pressure correlating with slight increases in TCE concentration. This illustrates how weather conditions can impact vapor concentrations inside buildings, which conventional sampling methods are not able to discern.

The RAD-130 passive sampler and two air canisters that also collected samples at this residence were non-detect for PCE and TCE. As described in Section 3, the passive sampler and air canister data represent 24-hour time-weighted average concentrations, while the VaporSafe™ system collects and analyzes a high frequency of samples and tracks changes in concentrations over time. Time-weighted average sampling methods have inherent limitations due to their inability to ‘see’ these fluctuations and key exposure times. While this home has not had prior sampling performed and more testing was recommended due to the observed TCE exceedances and its location within the contaminated groundwater plume zone, the implications of these results are significant. The potential for impacted homes, including those with cVOC concentrations above health-based criteria, to be overlooked due to averaged concentrations underestimating risk, is an important factor to review as the Franklin investigation progresses.

Also, although a sewer cleanout grab sample collected at this location on February 26th was non-detect for TCE and contained PCE at a concentration of just 1 µg/m³, this residence is
connected to the same sewer main as Locations 7 and 21, whose sewer cleanout samples exhibited much higher concentrations of both chemicals. This suggests that sewer line concentrations can vary widely over time and that a single low concentration sewer sample may not provide a full picture of potential sewer contamination impacts.

6.4 LOCATION 13 (NORTH FORSYTHE)

Location 13 (North Forsythe) was monitored for approximately 20 hours from late evening on February 26th to early morning February 28th, 2019, using the VaporSafe™ system by itself (see Table 2 and Attachment D). Please note that there were several interruptions that resulted in periods of non-recording. PCE was detected at all four locations that were tested, and although the detections remained under the indoor air screening level of 42 µg/m³, they were among the highest persistent concentrations of PCE observed in indoor air during the project. A grab sample collected from a sub-slab port installed in the basement slab of the house contained TCE at a concentration of 2.1 µg/m³, and PCE at a concentration of 379 µg/m³. A grab sample collected from the sewer cleanout of the house on February 26th contained PCE at a concentration of 6.7 µg/m³. Again, this residence is connected to the same sewer main as Locations 7 and 21, whose sewer cleanout samples exhibited much higher concentrations of both chemicals.

The graphs of the VaporSafe™ data demonstrate how variable vapor concentrations can be inside different structures. PCE concentrations appear to have a rising trend from the evening of February 26th to the morning of February 27th, with a declining concentration toward evening of February 27th, with concentrations exhibiting a slow increasing trend until the morning of February 28th when monitoring ceased. There was a notable pattern of PCE concentration fluctuations between 8:00pm on February 27th and 8:00am on February 28th that was exhibited by the basement bathroom location. PCE in the basement bathroom exhibited four peaks of concentration during this period which have yet to be fully explained. The peaks may have occurred due to indoor air pressure changes caused by operation of the house HVAC system. A similar fluctuation in PCE concentration was present to a lesser degree in the basement floor drain and upstairs bedroom. An apparent relationship was also observed between barometric pressure and PCE concentrations, with decreasing barometric pressure correlating with increases in PCE concentration. This once again illustrates how weather conditions can impact vapor concentrations inside buildings.

Given the concentrations present underneath the basement slab of the house and the observed indoor air concentrations, MUNDELL concludes that this house is experiencing some degree of vapor intrusion, with some possible contribution from the sewer line. Prior to MUNDELL sampling, this home had two rounds of data collected by IWM Consulting in September 2018 and February 2019. The data from these events showed elevated levels of PCE and TCE in the sewer cleanout, and concentrations of PCE and TCE in the sub-slab that were consistent with the February 26th – 28th VaporSafe™ results. The homeowner indicates that basement cracks and drains were filled in/sealed in response to the previous sampling data, but more permanent
mitigation, such as installation of a vapor mitigation system, may be warranted to ensure VOC levels remain below indoor air screening levels.

6.5 LOCATION 15 (ROSS COURT)

Location 15 (Ross Court) was monitored for approximately 24 hours from March 2nd to 3rd, 2019, using a combination of the VaporSafe™ system, air canisters and RAD-130 passive samplers (see Table 2 and Attachment E). The VaporSafe™ data indicated the presence of TCE at all three locations in the house that were tested in concentrations that were consistently above the indoor air screening level (RIASL) of 2.1 µg/m³. PCE was also detected, ranging from non-detect to 3.4 µg/m³, below the IDEM RIASL.

A RAD-130 passive sampler and two air canisters were also used to collect samples at this residence. The RAD-130 sample from the living room recorded a TCE concentration of 1 µg/m³, while the air canister from the living room was non-detect for TCE. The air canister placed in the bathroom location did detect TCE at a concentration of 4.3 µg/m³, and 1,2-DCA at a concentration of 5.6 µg/m³, both exceeding their respective IDEM RIASLs.

A grab sample was also collected from the sewer cleanout, with a TCE concentration of 3 µg/m³ and a PCE concentration of 5.7 µg/m³ observed. This residence is connected to the same sewer main as Locations 7, 8, 13 and 21, whose sewer cleanout grab samples exhibited widely ranging concentrations of both chemicals.

MUNDELL recommends that this home receive additional monitoring due to TCE concentrations detected above IDEM screening levels, and that it be included in the ongoing U.S. EPA community vapor intrusion monitoring program.

6.6 SUMMARY

Three (3) of the five (5) houses that underwent monitoring had IDEM Residential Indoor Air Screening Level exceedances of TCE recorded by one or more of the technologies utilized. Locations 5, 8, and 15 had detections of PCE, TCE and/or 1,2-DCA that exceeded IDEM RIASLs (see Table 2). Continuous monitoring with the VaporSafe™ system demonstrated the variability in PCE and TCE concentrations over time in a manner that traditional air canister sampling is not able to demonstrate. Several of these residences are connected to the main sewer line that travels down North Forsythe Street, which is known to have impacts from both PCE and TCE. Sewer cleanout samples from houses connected to this sewer line vary from non-detect to concentrations exceeding IDEM residential indoor air standards.

These observed exceedances indicate the necessity for further vapor intrusion monitoring for residences located over or near the off-site groundwater plume associated with the Amphenol site and those that are connected to the impacted sewer line.
7. HURRICANE CREEK SOIL AND WATER RESULTS

The water and soil sample analytical results for Hurricane Creek are presented in Tables 3A and 3B, respectively. Soil sampled at the crossing point of North Forsythe Street and Hurricane Creek (closest to the former Amphenol site) exhibited a TCE concentration of 0.041 µg/kg, which is just above the IDEM soil migration-to-groundwater screening level of 0.036 µg/kg. This sampling was not meant to fully delineate the extent of potential impacts, but suggests that occasional discharges of TCE have occurred historically to Hurricane Creek, and that TCE soil and groundwater impacts beyond those currently identified may exist in the vicinity of Hurricane Creek. This detection in a limited data set suggests the need for those overseeing the regulatory aspect of the Amphenol investigation/remediation to expand the scope of sampling to include surface water and sediments in Hurricane Creek.

Arsenic was detected above the 2019 IDEM Soil Migration to Groundwater Screening Level in a soil sample from Location 2 along Hurricane Creek. However, arsenic is a naturally-occurring element found in rocks, soil, water, and plants in many areas of the United States, including Indiana. It is known to occur in glacial deposits of the Midwest, and as such, this sample result is not considered an anomaly (Thomas, 2003).

It should be noted that Hurricane Creek is listed in IDEM’s 2018 303(d) List of Impaired Waters due to the presence of E. Coli.

8. CONCLUSIONS & RECOMMENDATIONS

8.1 TRACING VAPOR INTRUSION FLUCTUATIONS

Vapor intrusion (VI) studies are a notoriously intricate part of environmental investigations. Vapor concentrations, particularly in indoor air, but also in subsurface soil gas, can fluctuate dramatically over the course of seasons, weeks, days, and even hours. Influences on vapor concentrations including barometric pressure differences, seasonal variance in soil-moisture and temperature, Heating Ventilation and Air Conditioning (HVAC) system operation, and other factors have been well-documented.

This variability is the reason why many conventional VI investigation timelines are lengthy, and that selection of any single sampling event to be representative of the long-term or reasonable maximum exposure “worst case” risk to receptors is difficult. This is due in part to analytical data from more ‘traditional’ vapor intrusion sampling methods, such as air canisters and passive samplers, that can only present the dynamic concentrations as a single 24-hour time-weighted average value. Averaging concentrations in this way can mask or entirely ‘miss’ key exposure times and underestimate risks. This concept is reinforced in a recent publication by Henry J. Schuver (an environmental scientist with U.S. EPA’s RCRA Program), et al. (2018) which states:
“Simple probability calculations illustrate the difficulty of being confident that an upper percentile of an unknown underlying distribution has been observed in a subsample of a given size... For example, 58 samples are needed to observe the 95th percentile of the underlying distribution with a 5 percent risk of underestimation. Thus, observing the RME [reasonable maximum exposure] concentration directly with random sampling of indoor air, of any duration, becomes impractical.”

In other words, in order to achieve a 95% level of confidence that the reasonable maximum exposure in a building was measured, 58 randomly timed samples would be required. This is a profound acknowledgement of vapor intrusion variability and the significant implications of drawing decisions from limited datasets that do not adequately account for this variability.

Consider Location 8 (Ross Court) of this sampling event. Consistent concentrations of TCE, including exceedances of IDEM indoor air screening levels, were observed with the VaporSafe™ technology that were reported as non-detect by the air canister and passive sampler technologies. While any single dataset, no matter the methods used, has some limitations, this provides a new perspective on the Franklin investigation: that the factors that influence vapor intrusion variability may not be getting adequately addressed or tracked, and decisions to protect human health may therefore not accurately reflect the real level of risk.

Emerging real-time continuous vapor intrusion monitoring techniques such as the VaporSafe™ system are successfully being demonstrated in several U.S. EPA regions. Use of these technologies can increase the understanding of temporal and spatial variabilities that standard Summa canister 24-hour averages may not discern. Key considerations for future investigations include:

- Dispatching a continuous technology to Franklin, beginning with the most high-risk residences may reveal patterns of intrusion and peak concentrations that may be missed by traditional sampling methods alone. This can identify vapor intrusion concerns more rapidly and reduce response time. Residences within a certain radius (for example, 100 feet) of other buildings with evidence of impacts should also be prioritized for sampling.

- Measuring barometric pressure, as was done as part of this project, in future sampling events can be a useful tool to highlight patterns of intrusion. Organizing sampling events around, for instance, approaching storm events when barometric pressure tends to drop, may assist in scientifically determining reasonable maximum exposure, when residences are most vulnerable.

Recently, TCE has become a dominant driver of vapor intrusion investigations after the publication of EPA’s 2011 peer-reviewed Toxicity Assessment. The assessment found that pregnant women exposed to TCE face an unacceptable risk of adverse birth outcomes, notably
fetal heart defects. For the purposes of risk assessment, EPA assumes that even a single or short-term exposure is enough to potentially cause harm, highlighting the significance of tracking short-term fluctuations of TCE and other contaminants of concern in indoor air.

8.2 RAPID SCREENING TO IDENTIFY HUMAN HEALTH RISKS

One lesson learned in this investigation is the efficiency of a large-scale residential screening program using grab samples combined with near real-time field technology. During this study, a van was converted into an operational mobile laboratory for this sampling event that could mobilize throughout Franklin and allow for decision-making in the field. In this manner, the team was able to screen 30 homes for vapor intrusion concerns in less than one week. A similar sampling strategy can be a significant tool to rapidly identify additional human health risks that may be present outside the current U.S. EPA priority study area.

The U.S. EPA already has “brick and mortar labs on wheels” in the form of TAGA (Trace Atmospheric Gas Analyzer) buses and PHILIS (Portable High-Throughput Integrated Laboratory Identification System) vehicles. The regulatory agencies responsible for the ultimate decision-making aspects of this investigation can greatly benefit from taking advantage of these “instant-result” tools.

Simply put, if one wants to determine whether there is “widespread” contamination, one must collect widespread data – at least to find a consistently ‘clean’ zone outside of the known impacted areas. Though discrete samples are a “snapshot in time” and should not be the only sampling strategy used, a large-scale screening program can help the U.S. EPA define its uncertainties – such as the impacted area’s spatial distribution – with respect to vapor intrusion.

Several important observations not previously considered were made during this sampling event. These include the following:

1) The sampling results for a home currently outside of the U.S. EPA vapor intrusion Study Area (Location 5 Heritage Trail) suggested the home is consistently at or above the screening level for TCE. This section of Franklin has had little-to-no data collected to date, and opens the possibility for there being impacted areas beyond the Study Area that are not currently identified.

2) As discussed in Section 6, this sampling event provided evidence of potentially wide fluctuations of vapor concentrations in the sewer line that may not be seen without multiple samples being taken in a short timeframe (for instance, before and after storm events).

3) Concentrations of TCE/PCE in sewer cleanouts of some homes located upgradient of the Amphenol site were observed to exceed IDEM RCG indoor air screening levels (see Table 1).
Beyond the technical aspects, vapor intrusion investigations on residential properties can be a sensitive process. Collection of a large set of baseline screening data, with minimal disruption to residents can (1) quickly help narrow the focus to locations in need of more detailed sampling within a short timeframe, and (2) for homes that will need additional investigation/mitigation efforts, a positive relationship with residents can be established on the front-end through a quick and ‘painless’ effort that may make residents more responsive to future activities that will require more time and interruption.

8.3 FURTHER ASSESSMENT OF SEWER VAPOR PATHWAYS

According to historic site documents (see MUNDELL August 15, 2018 “Review of Available RCRA File Documents and Outline of Key Apparent Data Gaps/Deficiencies for the Former Amphenol Site”), sanitary sewer lines were a primary disposal point for plating sludges and solvents at the former Amphenol Corporation (Bendix) site for approximately 20 years. More recent 2018-2019 investigations conducted by IWM Consulting (on behalf of Amphenol) and EnviroForensics (on behalf of the City of Franklin) have confirmed significant impacts to sewer air and sewer backfill soil-gas immediately south of the site, with the highest concentrations of cVOCs found along Hamilton Avenue and North Forsythe Street.

This MUNDELL “Phase III” sampling event revealed several important considerations for future investigations needed to further evaluate risk from the sewer lines to residences. These key considerations include: (1) sewer line concentrations can vary widely over time and that a single low concentration sewer sample may not provide a full understanding of the potential sewer contamination effects, and (2) PCE and TCE concentrations exceeding IDEM RCG Residential Indoor Air Screening Levels were detected in sewer cleanouts outside of the current Amphenol Study Area and Expanded Study Area.

Until recently, evaluation of the sewer vapor pathway was not a traditional aspect of most vapor intrusion investigations and was poorly understood. Given the evidence from the current body of data and data gaps that still need to be closed, MUNDELL recommends the following next investigative steps for the sewer system network:

1) Additional Testing of the Sewer System Liquid and Sludge - Work up to this point has focused on sampling sewer air and sewer backfill soil-gas for vapor phase VOCs. Due to the high concentrations of PCE and TCE observed in several residential sanitary sewer cleanouts, robust sampling efforts should be initiated to also trace constituents of concern in sewer water and sludge where VOCs may have remained sequestered for an extended time period. VOC-contaminated sludge existing within the sewer lines, because of historic discharges into the system, can pose a continuing source above and beyond contaminated groundwater infiltration where the sewer passes through the plume.

2) Sewer System Evaluation Beyond the Immediate Study Area - Sewer sampling has largely been limited to the current U.S. EPA Study Area and Extended Study Area. Exceedances of cVOCs in sewer cleanout air have been found outside of these boundaries, including
upgradient of the Amphenol site (see Table 1). The consideration for a coordinated comprehensive program by the U.S. EPA, IDEM, and even the City of Franklin to fully delineate sewer contamination extent, including potential sources beyond the Amphenol site, would promote effective and timely remedial communication and decision-making.

3) Evaluation of Leaks from the Sewer System to Residential Structures - Due to the observed high variability observed in sewer line concentrations, strategically pressurizing the sewer line segments to identify leaks and following up with residential indoor air monitoring can improve the understanding of the sewer system as a vapor intrusion pathway. Evaluating the effects of both concentration and pressure gradients (from high to low) can help assess building-specific contaminant entry points that require remediation.

8.4 HURRICANE CREEK TESTING

To date, no extensive media testing has been performed along Hurricane Creek. The limited data collected indicate that there is detectable TCE present in Hurricane Creek soil where North Forsythe Street crosses the creek. Given that the TCE impact was detected with such a limited dataset suggests that additional testing of the creek soil sediment and water should be undertaken to determine whether the impacts are isolated or wider spread. This also allows the further assessment of the potential risk to human health exposure through a number of exposure pathways (e.g., dermal contact and ingestion).

Surface water and sediment impacts to Hurricane Creek had historically been detected in the 1980's as part of Site Assessments conducted for the former Amphenol site. The most recent Creek sampling report made available is from an August 2018 surface water testing event conducted by IDEM, limited to the Webb Wellfield and Needham/Webb Elementary schools areas. MUNDELL recommends that more focused surface water/sediment sampling of Hurricane Creek should be conducted south of the Amphenol site and the known cVOC plume area near the existing sewer main where prior discharges occurred. As the groundwater cVOC plume is located immediately north of the creek, it is possible that under certain hydrological situations, groundwater enters Hurricane Creek from the north, potentially contributing contamination from the plume to the creek.

Additional testing of Hurricane Creek will also address the concerns expressed by the community regarding the potential environmental impacts of past Hurricane Creek flooding events that have occurred, including the severe June 2008 floods that infiltrated and damaged more than 100 homes.

8.5 ENHANCING UNDERSTANDING OF GROUNDWATER IMPACTS

Updated groundwater plume maps including the most recent March 2019 IWM Consulting data unveiled by the U.S. EPA at the June 5, 2019 Public Information Session presented the estimated extent of groundwater impacts from the Amphenol Site. This assessment has been largely arrived at from the analytical testing results of groundwater grab samples collected using
direct push technology. As such, this interim delineation is not considered reliable and reproducible by U.S. EPA standards until groundwater samples are collected and tested from a permanent monitoring well network. In addition, in order to monitor the positive impacts of any type of remediation that will occur, it is necessary to have monitoring wells that will be sampled on a periodic basis (typically quarterly). Because of this, MUNDELL recommends that an extensive monitoring well network be installed south of the Amphenol Site that will confirm the interim delineation and provide confidence in the results presented to date. This network should include wells along North Forsythe Street near the location of the proposed sewer line remediation as well as in the areas east and west of North Forsythe Street within the residential neighborhoods. The final number and location of wells needed to fully confirm this delineation should be determined after a review of the initial round of sampling results.

It should be noted that additional sampling and installation of monitoring wells further south beyond the cross point of North Forsythe Street and Hurricane Creek will likely be needed to further delineate the plume in this direction. As previously discussed, TCE exceeding the soil migration-to-groundwater screening level was detected in this area. One residence sampled as part of this current event was located in this part of Franklin (Heritage Trail), and concerning levels of TCE were observed in this home’s indoor air. There may be other potentially-vulnerable residences located on this side of Hurricane Creek due to groundwater and/or soil impacts.

Beyond the current U.S. EPA study area, EnviroForensics and IDEM have concluded from March/April 2019 sewer investigations near Needham and Webb Elementary schools that the sewer lines do not appear to be currently acting as a preferential pathway for contaminants found beneath the slab of the schools. Given the uncertainty of how past pumping and subsequent abandonment of the wells in the Webb Wellfield have influenced (or ‘pulled’) the Amphenol plume or other potential plumes in the area, and the lack of robust groundwater data on the school properties, MUNDELL recommends the installation of permanent monitoring wells in this area. Even if a groundwater plume is not currently found to have migrated onto the school properties, these wells can serve as sentinel wells to provide advance warning of the movement of contamination to this area, as multiple investigation and remediation projects are ongoing at sites throughout Franklin.

9. ADDITIONAL REMEDIATION ALTERNATIVES

As indicated by the U.S. EPA at the June 5, 2019 Public Information Session, remedial measures are currently proposed for additional study and implementation to address the existing identified soil and groundwater impacts. These include:

1) Sewer Line Remedy – removal of impacted soil and sewer line, and sewer replacement.
2) On-site (Amphenol) Area Remedy
3) Groundwater Pump and Treat Optimization
4) Off-site Groundwater Remedy
Various remediation alternatives should be considered as additional investigation continues on the Amphenol Site and off-site to locate and confirm all remaining chemical source areas and delineate impacted groundwater. It is apparent that the on-site pump and treat system has not been effective in reducing the on-site cVOC groundwater concentrations primarily because the actual chemical source areas have not been remediated. This may require the excavation and removal of additional impacted soils beneath the site structures, or the use of in-situ treatment technologies that inject liquids containing chemicals into the ground to enhance degradation through either chemical or biologically-mediated reactions.

Once the extent of off-site groundwater impacts have been confirmed, remedial technologies using in-situ methods of treatment should be given priority consideration because of their ability to achieve cleanup goals in reasonable periods of time without significant engineered system needs or disruption of neighborhood activities. Three primary in-situ technologies include:

**In-Situ Chemical Reduction (ISCR)** – is usually applied by injecting chemically reductive additives in liquid form into contaminated groundwater or placing solid media of chemical reductants in permeable reactive barriers (PRBs) in the pathway of a moving contaminant plume. In ISCR, reducing compounds such as Zero Valent Iron (ZVI) accept electrons given by other compounds in a reaction to change the contaminants into harmless compounds. The primary advantages of this technology are that it is relatively non-disruptive in nature, does not require on-going maintenance activities, and does not present a threat to human health or environmental quality. Since impacted groundwater is not removed from the subsurface or treated and then discharged above the ground surface (as in a classic pump and treat system), there are no concerns with direct contact with the water or chemical vapors coming off an aboveground treatment system and, as such, no possibility of direct human or ecological exposure.

**In-Situ Bioremediation** - involves injecting a catalyst into the groundwater and/or smear zone soil for the purposes of enhancing natural biotic degradation of contaminants. These technologies add a carbon substrate to groundwater to promote the growth of native microorganisms that degrade cVOCs. The injections infuse carbon substrates into the saturated and smear zones through multiple injection points to promote anaerobic conditions and enhance microbial degradation of both adsorbed and dissolved cVOCs. PRBs can be oriented perpendicular to the flow of groundwater to treat the plume as it passes through the barrier.

**In-situ chemical oxidation (ISCO)** - involves the subsurface injection of reagents that are designed to destroy organic contaminants through chemical oxidation. ISCO can deliver a rapid treatment time when used in favorable conditions and is capable of treating contaminants present at high concentrations. There are several different ISCO-based technologies, ranging from more powerful but shorter-lived oxidants to less powerful reagents with longer periods of effectiveness. The applicability of this technology relies to some extent on the permeability of the media being treated and the type of contaminant to be oxidized. The relatively short-term reactivity of this alternative requires that treatment occur throughout a plume area and not via
the use of PRBs. Advantages of this technology are the potential for a rapid rate of reaction (e.g., in some cases as little time as 20 weeks of treatment are required in optimal subsurface conditions), and the lack of the requirement for remaining on-site treatment equipment.

The field implementation schedule for the application of in-situ treatment remedial technologies will vary depending on the size of the impacted groundwater area and the pattern of injections. In general, these programs can often be completed over a period of several weeks to a couple of months. Post-implementation activities typically involved several years of quarterly groundwater monitoring to confirm the reduction of chemical concentrations throughout the plume and verify the achievement of remediation goals. Depending on the observed results, additional injections may be required in key areas to further reduce recalcitrant concentrations.

10. REFERENCES


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2019 IDEM Residential Indoor Air Screening Level

2019 IDEM RCG Residential Subslab Air Screening Level (0.03 attenuation factor)

Notes:
1) Bold yellow highlighting indicates exceedance of the IDEM Residential Indoor Air Screening Level
2) ND indicates not detected
3) *Estimated result below reporting limit of 1µg/m³ and method detection limit of 0.2µg/m³ for PCE and 0.5 µg/m³ for TCE (VaporSafe)
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<th>cis-1,2-Dichloroethylene (µg/m³)</th>
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<td>ND</td>
<td>ND</td>
<td>ND</td>
</tr>
</tbody>
</table>
# Hurricane Creek Surface Water Analytical Results

## Phase III Residential Vapor Intrusion Testing

Franklin, Indiana

MUNDELL Project: M18027

<table>
<thead>
<tr>
<th>Location ID</th>
<th>Sample Collection Date</th>
<th>2019 Residential Tap</th>
<th>2019 Residential Vapor Intrusion</th>
<th>2019 Com/Ind Vapor Intrusion</th>
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</thead>
<tbody>
<tr>
<td></td>
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<td>2019 Residential Tap</td>
<td>2019 Residential Vapor Intrusion</td>
<td>2019 Com/Ind Vapor Intrusion</td>
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<tr>
<td></td>
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<td>Cyanide</td>
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<td>20,900 0.0</td>
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<td></td>
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<td>Xyleno Toluene</td>
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<td>0.001 0.001</td>
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<tr>
<td></td>
<td></td>
<td>Tetrachloroethylene</td>
<td>0.01</td>
<td>0.001 0.001</td>
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<tr>
<td></td>
<td></td>
<td>1,2,4-Trichlorobenzene</td>
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<td>0.001 0.001</td>
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<tr>
<td></td>
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<td>n-Pentane</td>
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<td>0.001 0.001</td>
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<td>m-Pentane</td>
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<td>n-Butane</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>t-Butylmethyl ether</td>
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<td>Chloroform</td>
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<td></td>
<td></td>
<td>Trimethylbenzene</td>
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<td>1,3,5-Trimethylbenzene</td>
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<tr>
<td></td>
<td></td>
<td>all other VOCs</td>
<td>0.01</td>
<td>0.001 0.001</td>
</tr>
</tbody>
</table>

**Notes:**

1) < indicates sample concentration below method reporting limit
2) Concentrations in bold are reported above the IDEM RCG groundwater tap residential
3) Concentrations highlighted in YELLOW are reported above the IDEM RCG Vapor Exposure Groundwater Residential
4) Concentrations in bold and highlighted in PURPLE are reported above the IDEM RCG Vapor Exposure Groundwater Commercial/Industrial
5) * indicates the screening level of PCBs: Aroclor 1232 is utilized.
6) BDL = Below detection limit
### Hurricane Creek Bank Sediment Analytical Data

#### Phase III Residential Vapor Intrusion Testing

**Franklin, Indiana**

**MUNDELL Project: M18027**

<table>
<thead>
<tr>
<th>Location</th>
<th>Sample Collection Date</th>
<th>mg/kg</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1,4-dioxane</strong></td>
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<tr>
<td><strong>Aluminum</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Antimony</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Arsenic</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Barium</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Beryllium</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Cadmium</strong></td>
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<td></td>
</tr>
<tr>
<td><strong>Calcium</strong></td>
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<td><strong>Chromium</strong></td>
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<td><strong>Cobalt</strong></td>
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<tr>
<td><strong>Copper</strong></td>
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<td></td>
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<tr>
<td><strong>Iron</strong></td>
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<td></td>
</tr>
<tr>
<td><strong>Lead</strong></td>
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<tr>
<td><strong>Magnesium</strong></td>
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<tr>
<td><strong>Manganese</strong></td>
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</tr>
<tr>
<td><strong>Nickel</strong></td>
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<td></td>
</tr>
<tr>
<td><strong>Potassium</strong></td>
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<td></td>
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<tr>
<td><strong>Selenium</strong></td>
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<td></td>
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<tr>
<td><strong>Silver</strong></td>
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<td></td>
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<tr>
<td><strong>Sodium</strong></td>
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<tr>
<td><strong>Thallium</strong></td>
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<td></td>
</tr>
<tr>
<td><strong>Vanadium</strong></td>
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<td><strong>Zinc</strong></td>
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<tr>
<td><strong>Mercury</strong></td>
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<tr>
<td><strong>PCBs</strong></td>
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<td><strong>VOCs</strong></td>
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<tr>
<td><strong>Naphthalene</strong></td>
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<tr>
<td><strong>Trichloroethene</strong></td>
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<td></td>
</tr>
<tr>
<td><strong>1,2,4-Trimethylbenzene</strong></td>
<td></td>
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<tr>
<td><strong>1,3,5-Trimethylbenzene</strong></td>
<td></td>
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<tr>
<td><strong>Xylene (Total)</strong></td>
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</tr>
<tr>
<td><strong>all other VOCs</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Notes:**

1) < indicates sample concentration below method reporting limit
2) Concentrations in bold are reported above the IDEM RCG Residential Screening level for migration to groundwater
3) Concentrations in bold and highlighted in YELLOW are reported above the IDEM RCG Residential Screening level for soil exposure direct contact
4) Concentrations in bold and highlighted in PURPLE are reported above the IDEM RCG Commercial/Industrial Screening level for soil exposure direct contact
5) * indicates the screening level of PCBs: Aroclor 1232 is utilized.
6) ** indicates the screening level of PCBs: Aroclor 1254 is utilized.
7) BDL = Below detection limit
Map is provided for site reference only. No claim is made as to the accuracy or completeness of this information.

Scale approximately 1” = 0.4 miles

Legend:
- Former Webb Wellfield
- Sample Collection Area
- Sampling Location
- School Location
- Former Amphenol Facility Location

Franklin, Indiana

Former Amphenol Facility Location

Sample Collection Area

Sampling Location

School Location

Former Amphenol Facility Location

LEGEND
ATTACHMENT A

Heritage Trail (Location 5) VaporSafe Graphs
Heritage Trail Location: First Floor Living Room

Feb 28 to Mar 4, 2019
Continuous Monitoring

VAPORSAFE CONTINUOUS MONITORING RESULTS

Maximum detections:
- 3.432 µg/m³ TCE at 10:26 pm on 2/28/2019
- 0.760 µg/m³ PCE at 5:26 pm on 2/28/2019

Minimum detections:
- Non-detect PCE from 12:21 pm – 4:26 pm and 7:26 pm – 11:25 pm on 2/28/2019
- Non-detect PCE from 12:00 am – 9:26 am on 3/1/2019
- Non-detect PCE from 12:21 pm – 5:26 pm on 2/28/2019
- Non-detect PCE from 12:00 am – 9:26 am on 3/1/2019

Maximum detections:
- 0.670 µg/m³ PCE at 5:26 pm on 2/28/2019
- 3.432 µg/m³ TCE at 10:26 pm on 2/28/2019

[Exceeds IDEM RCG Residential Indoor Air Screening Level of 2.1 µg/m³]

Location: First Floor Living Room

Feb 28 to Mar 4, 2019
Continuous Monitoring

Heritage Trail Location: First Floor Living Room

VAPORSAFE CONTINUOUS MONITORING RESULTS

Maximum detections:
- 3.432 µg/m³ TCE at 10:26 pm on 2/28/2019
- 0.760 µg/m³ PCE at 5:26 pm on 2/28/2019

Minimum detections:
- Non-detect PCE from 12:21 pm – 4:26 pm and 7:26 pm – 11:25 pm on 2/28/2019
- Non-detect PCE from 12:00 am – 9:26 am on 3/1/2019
- Non-detect PCE from 12:21 pm – 5:26 pm on 2/28/2019
- Non-detect PCE from 12:00 am – 9:26 am on 3/1/2019

Maximum detections:
- 0.670 µg/m³ PCE at 5:26 pm on 2/28/2019
- 3.432 µg/m³ TCE at 10:26 pm on 2/28/2019

[Exceeds IDEM RCG Residential Indoor Air Screening Level of 2.1 µg/m³]
Maximum detections:

- 1.934 ug/m³ PCE at 5:06 pm on 2/28/2019
- 5.436 ug/m³ TCE at 2:06 am on 3/1/2019

Minimum detections:

- Non-detect PCE from 5:06 pm – 7:06 pm on 2/28/2019
- Non-detect PCE from 1:20 pm – 4:06 pm and 8:06 pm – 11:59 pm on 2/28/2019
- Non-detect PCE from 12:00 am – 9:06 am on 3/1/2019
- Non-detect TCE from 5:06 pm – 7:06 pm on 2/28/2019
- Non-detect TCE from 1:20 pm – 4:06 pm and 8:06 pm – 11:59 pm on 2/28/2019
- TCE at 2:06 am on 3/1/2019
- PCE at 5:06 pm on 2/28/2019

Location: First Floor Master Bedroom

Heritage Trail Location 5

VAPORSAFE CONTINUOUS MONITORING RESULTS

Feb 28 to Mar 1, 2019

Continuous Monitoring:

FINAL DRAFT
Maximum detections:

- 0.849 ug/m³ at 5:16 pm on 2/28/2019
- 3.070 ug/m³ TCE at 12:11 pm on 2/28/2019

Minimum detections:

- Non-detect PCE from 12:00 am – 9:16 am on 3/1/2019
- Non-detect TCE from 5:16 pm – 7:16 pm on 2/28/2019

VAPORSAFE CONTINUOUS MONITORING RESULTS

Location: First Floor Office

Feb 28 to Mar 1, 2019

Heritage Trail Location 5

CONTINUOUS MONITORING RESULTS

Exceeds IDEM RCG Residential Indoor Air Screening Level of 2.1 ug/m³
Maximum detections:
- 2.459 ug/m³ PCE at 9:56 am on 3/1/2019
- 3.115 ug/m³ TCE at 2:56 am on 3/1/2019

Minimum detections:
- Non-detect PCE from 1:10 pm – 4:56 pm and 7:56 pm – 11:59 pm on 2/28/2019; 12:00 am – 8:56 am on 3/1/2019
- Non-detect TCE from 5:56 pm – 6:56 pm on 2/28/2019 and 9:56 am on 3/1/2019

Exceeds IDEM RCG Residential Indoor Air Screening Level of 2.1 ug/m³

Location: First Floor Seating Area

Heritage Trail Location 5

VAPORSAFE CONTINUOUS MONITORING RESULTS

Feb 28 to Mar 1, 2019
Continuous Monitoring:

FINAL DRAFT
Maximum detections:

- 1.261 ug/m³ PCE at 5:36 pm on 2/28/2019
- 2.928 ug/m³ TCE at 5:36 am on 3/1/2019

Minimum detections:

- Non-detect PCE from 12:50 pm – 4:36 pm and 7:36 pm – 11:59 pm on 2/28/2019; 12:00 am – 8:36 am on 3/1/2019
- Non-detect TCE from 5:36 pm – 6:36 pm on 2/28/2019 and 9:36 am on 3/1/2019

Exceeds IDEM RCG Residential Indoor Air Screening Level of 2.1 ug/m³
Maximum detections:
- 1.280 ug/m$^3$ PCE at 9:46 am on 3/1/2019
- 3.123 ug/m$^3$ TCE at 2:46 am on 3/1/2019

Minimum detections:
- Non-detect PCE from 1:00 pm - 4:46 pm on 2/28/2019; 7:46 pm - 11:59 pm on 2/28/2019; 12:00 am - 8:46 am on 3/1/2019
- Non-detect TCE from 5:46 pm - 6:46 pm on 2/28/2019 and 9:46 am on 3/1/2019

[Exceeds IDEM RCG Residential Indoor Air Screening Level of 2.1 ug/m$^3$]
ATTACHMENT B

North Forsythe (Location 7) VaporSafe Graphs
Continuous Monitoring: Mar 1 to 2, 2019

Location: Bathroom

VAPORSAFE CONTINUOUS MONITORING RESULTS

Maximum detections:

- 2.074 ug/m³ PCE at 10:19 pm on 3/1/2019
- 1.081 ug/m³ TCE at 10:19 pm on 3/1/2019

Minimum detections:

- Non-detect PCE at 2:19 pm on 3/1/2019 and 10:36 am on 3/2/2019

Minimum detections:

- Non-detect TCE from 2:39 pm on 3/1/2019 to 10:56 am on 3/2/2019
- Non-detect PCE at 10:56 am on 3/2/2019

Maximum detections:

- 0.769 ug/m³ PCE at 2:16 am on 3/2/2019
- Non-detect TCE from 2:39 pm on 3/1/2019 to 10:56 am on 3/2/2019
- Non-detect TCE from 2:16 am on 3/2/2019 to 10:56 am on 3/2/2019

Location: Child bedroom

Continuous Monitoring:

Mar 1 to 2, 2019

VAPORSafe Continuous Monitoring Results

FINAL DRAFT
Maximum detections:

- 0.767 ug/m³ PCE at 3:46 am on 3/2/2019

Minimum detections:

- Non-detect TCE from 2:49 pm on 3/1/2019 to 11:06 am on 3/2/2019
- Non-detect PCE at 2:49 pm and 4:09 pm on 3/1/2019 and 11:06 am on 3/2/2019
- Non-detect PCE at 3:46 am on 3/2/2019

Location: Living Room

Mar 1 to 2, 2019
Continuous Monitoring: N. Forsythe Location 7
VaporSafe Continuous Monitoring Results
Maximum detections:

- 0.850 µg/m³ PCE at 11:25 pm on 3/1/2019

Minimum detections:

- Non-detect TCE at 2:29 pm on 3/1/2019 to 10:46 am on 3/2/2019
- Non-detect PCE at 3:49 pm on 3/1/2019 and 7:26 am, 10:46 am on 3/2/2019

Location: Main Bedroom
ATTACHMENT C

Ross Court (Location 8) VaporSafe Graphs
VAPORSAFE CONTINUOUS MONITORING RESULTS

Continuous Monitoring: March 2 to 3, 2019
Location: Bathroom

Maximum detections:
- 2.819 ug/m³ TCE at 10:10 am on 3/3/2019 [Exceeds IDEM RCG Residential Indoor Air Screening Level of 2.1 ug/m³]
- 1.972 ug/m³ PCE at 6:20 pm on 3/2/2019
- 1.972 ug/m³ TCE at 6:20 pm on 3/2/2019
- 1.592 ug/m³ TCE at 6:20 pm on 3/2/2019

Minimum detections:
- 1.972 ug/m³ PCE at 11:20 pm on 3/2/2019
- 1.592 ug/m³ TCE at 6:20 pm on 3/2/2019
- 1.579 ug/m³ TCE at 1:00 pm on 3/2/2019
- 1.819 ug/m³ TCE at 10:00 am on 3/2/2019

PCE
TCE

Ross Court Location 8

VAPOSAFE CONTINUOUS MONITORING RESULTS
Maximum detections:
• 3.388 ug/m³ PCE at 10:20 am on 3/3/2019

Minimum detections:
• 2.356 ug/m³ TCE at 10:20 am on 3/3/2019

Exceeds IDEM RCg Residential Indoor Air Screening Level of 2.1 ug/m³

LOCATION: Living Room

MAR 2 to 3, 2019
Continuous Monitoring:
ROSS COURT Location B

VAPORSafe CONTINUOUS MONITORING RESULTS
VAPORSAFE CONTINUOUS MONITORING RESULTS

LOCATION: Main Bedroom

MAR 2 to 3, 2019
Continuous Monitoring:
Ross Court Location 8

MAXIMUM DETECTIONS:
- 1.213 µg/m³ TCE at 5:10 pm on 3/2/2019
- 1.739 µg/m³ PCE at 11:10 pm on 3/2/2019

MINIMUM DETECTIONS:
- 1.179 µg/m³ TCE at 8:11 am on 3/3/2019
- 3.135 µg/m³ PCE at 5:10 pm on 3/2/2019

[Exceeds IDEM RCG Residential Indoor Air Screening Level of 2.1 µg/m³]
VAPORSafe continuous monitoring results

Ross Court Location 8

Continuous Monitoring: Mar 2 to 3, 2019

Comparison of TCE concentrations (µg/m³) and Barometric Pressure (mbar)
ATTACHMENT D

North Forsythe (Location 13) VaporSafe Graphs
VAPORSAFE CONTINUOUS MONITORING RESULTS

Location: First floor bathroom

Feb 26 to 28, 2019
Continuous Monitoring: N. Forsythe Location 13

Maximum detections:
- 16.260 ug/m³ PCE at 10:16 am on 2/27/2019
- Non-detect TCE from 10:29 pm on 2/26/2019 to 9:01 am on 2/28/2019

Minimum detections:
- 8.250 ug/m³ PCE at 10:29 pm on 2/26/2019
- Non-detect TCE from 10:29 pm on 2/26/2019 to 9:01 am on 2/28/2019
Maximum detections:

- 22.630 ug/m³ PCE at 11:26 am on 2/27/2019
- 22.630 ug/m³ PCE at 11:26 am on 2/27/2019

Minimum detections:

- Non-detect from 10:19 pm on 2/26/2019 to 8:51 am on 2/28/2019

VAPORSAFE CONTINUOUS MONITORING RESULTS
Maximum detections:
• 29.377 ug/m³ PCE at 1:21 am on 2/28/19
• 7.760 ug/m³ PCE at 10:09 pm on 2/26/2019

Non-detect TCE from 10:09 pm on 2/26/19 to 9:21 am on 2/28/19

Minimum detections:
• 29.377 ug/m³ PCE at 1:21 am on 2/28/19
• Non-detect TCE from 10:09 pm on 2/26/19 to 9:21 am on 2/28/19

Location: Basement floor drain

Feb 26 to 28, 2019
Continuous Monitoring:

N. Forsythe Location 13

VAPORSAFE CONTINUOUS MONITORING RESULTS
Maximum detections:

- 15.930 ug/m$^3$ PCE at 00:26 am on 2/27/2019
- Non-detect TCE from 10:39 pm on 2/26 to 9:11 am on 2/28/19

Minimum detections:

- 7.150 ug/m$^3$ PCE at 10:39 pm on 2/26/2019
- Non-detect TCE from 10:39 pm on 2/26 to 9:11 am on 2/28/19
VAPORSAFE CONTINUOUS MONITORING RESULTS

N. Forsythe Location 13

Continuous Monitoring: Feb 26 to 28, 2019

Comparison of PCE concentrations (µg/m³) and Barometric Pressure (mbar)
ATTACHMENT E

Ross Court (Location 15) VaporSafe Graphs
Continuous Monitoring: Mar 2 to 3, 2019
Location: Bathroom

Maximum detections:
- 3.463 ug/m³ PCE at 9:40 pm on 3/2/2019
- 3.975 ug/m³ TCE at 9:40 am on 3/3/2019
[Exceeds IDEM RCG Residential Indoor Air Screening Level of 2.1 ug/m³]

Minimum detections:
- 1.148 ug/m³ PCE at 9:29 am on 3/3/2019
- 2.432 ug/m³ TCE at 4:40 pm on 3/2/2019
[Exceeds IDEM RCG Residential Indoor Air Screening Level of 2.1 ug/m³]
Maximum detections:

- 1.963 ug/m³ PCE at 11:50 pm on 3/2/2019
- 2.996 ug/m³ TCE at 12:50 pm on 3/3/2019

Exceeds IDEM RCC Residential Indoor Air Screening Level of 2.1 ug/m³.

Minimum detections:

- 1.136 ug/m³ PCE at 9:39 am on 3/3/2019
- 2.315 ug/m³ TCE at 5:50 pm on 3/2/2019

Exceeds IDEM RCC Residential Indoor Air Screening Level of 2.1 ug/m³.
Maximum detections:
- 1.879 ug/m\(^3\) PCE at 12:00 am on 3/3/2019
- 3.117 ug/m\(^3\) TCE at 8:00 am on 3/3/2019

Minimum detections:
- Non-detect PCE at 8:00 pm on 3/2/2019
- 2.243 ug/m\(^3\) TCE at 11:00 pm on 3/2/2019

Exceeds IDEM RCG Residential Indoor Air Screening Level of 2.1 ug/m\(^3\)

VAPORSAFE CONTINUOUS MONITORING RESULTS

Location: Living Room
March 2 to 3, 2019
Continuous Monitoring:
Ross Court Location 15