Health Consultation

Analysis of Contaminants in Drinking Water and Air

PADEN CITY GROUNDWATER

PADEN CITY, WETZEL COUNTY, WEST VIRGINIA

EPA FACILITY ID: WVN000304985

January 31, 2024

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Agency for Toxic Substances and Disease Registry
Office of Community Health and Hazard Assessment
Atlanta, GA 30333

Health Consultation: A Note of Explanation

An ATSDR health consultation is a verbal or written response from ATSDR to a specific request for information about health risks related to a specific site, a chemical release, or the presence of hazardous material. In order to prevent or mitigate exposures, a consultation may lead to specific actions by ATSDR or other agencies, such as restricting use of or replacing water supplies; intensifying environmental sampling; restricting site access; or removing the contaminated material.

In addition, consultations may recommend additional public health actions, such as conducting health surveillance activities to evaluate exposure or trends in adverse health outcomes; conducting biological indicators of exposure studies to assess exposure; and providing health education for health care providers and community members. This concludes the health consultation process for this site, unless additional information is obtained by ATSDR which, in the Agency's opinion, indicates a need to revise or append the conclusions previously issued.

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Prepared By:

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Executive Summary

Introduction

The Paden City Groundwater Site, located in Paden City, Tyler and Wetzel Counties, West Virginia, was added to the National Priorities List (NPL) on March 16, 2022. Under the Comprehensive Environmental Resources Conservation Act (CERCLA), the Agency for Toxic Substances and Disease Registry (ATSDR) is required to perform a public health evaluation for sites proposed to the NPL. Starting in 2017, ATSDR provided public health technical assistance and health education for specific environmental exposure pathway questions related to this site to the Environmental Protection Agency (EPA), the West Virginia Department of Environmental Protection (WV DEP), the West Virginia Bureau for Public Health (WVBPH), and community members. This public health assessment document includes a review of environmental data across multiple exposure pathways, including air and drinking water, to comprehensively assess the community's potential environmental public health risks.

Perchloroethylene (PCE), also known as tetrachloroethylene, was first detected in Paden City's drinking water source in 2010. Further investigation determined that contaminated groundwater was the source of PCE in Paden City's drinking water wells. The existing basic drinking water treatment system removed much of the PCE from the final treated water provided to residential and commercial taps. Water that is treated and introduced to the public water system is called finished water. Although the finished water had lower levels of PCE than untreated water, the city still found PCE in finished water at levels close to or above EPA's maximum contaminant level (MCL) for PCE of 5 μg/L. MCLs are regulatory values that represent the highest concentration of a contaminant that is allowed in drinking water. The city continued to monitor its drinking water and in 2018 determined that the extent of PCE contamination could not be controlled through basic water treatment. The city then asked environmental agencies to help further characterize the source and extent of the PCE contamination. In 2020, Paden City Water Department installed a more extensive treatment system to remove PCE and associated volatile organic compounds (VOCs) from the municipal drinking water supplied to taps.

In August 2023, EPA informed ATSDR that PCE released due to a malfunction with the air stripper treatment system was found in Paden City drinking water. Based on that information, PCE might have been present in the drinking water from July 2023 to September 2023. The treatment system malfunction allowed PCE to enter the drinking water supply at levels above the MCL. Because the water system was not in compliance with this regulatory value, Paden City issued a cautionary notice to residents. This notice advised residents to avoid drinking or using the water to shower during this period to avoid exposures to PCE. ATSDR will evaluate data from this period in an addendum to this document when the validated data become available. Paden City's drinking water treatment system is currently treating the drinking water to meet state and federal standards.

In 2018, EPA began installing and monitoring of groundwater wells. It also began investigating former dry-cleaning facilities in the community to determine the source of the PCE contamination. EPA identified the source of the PCE groundwater plume, at least in part, as the former Band Box Cleaners facility. Band Box Cleaners operated as a dry cleaner in Paden City from approximately 1969 to 1997.

EPA also assessed the vapor intrusion pathway through soil gas and indoor air evaluations (EPA 2021). Vapor intrusion occurs when vapor-forming chemicals release vapors from a subsurface source (i.e., the PCE-contaminated groundwater and soils in Paden City) into an overlying building.

Conclusions

ATSDR assessed all potential exposure pathways for past exposures through June 2023 (see section II of the document for exposure pathway discussion). Surface water and soil were eliminated from further assessment due to being incomplete exposure pathways (i.e., no exposures occurring). Completed exposure pathways include past exposure to drinking water and household water and past and current exposures to indoor air from vapor intrusion. ATSDR also considered exposures to contaminants through ambient (outdoor) air.

Conclusion 1	ATSDR concludes that Paden City residents who ingested or used Paden City municipal water through June 2023 are unlikely to experience harmful health effects from the contaminants sampled in the drinking water, including PCE, trihalomethanes, haloacetic acids, and other VOCs. ATSDR cannot at this time provide a conclusion regarding exposures to drinking water between July 2023 and September 2023.
Basis for conclusion	Although PCE and other VOCs were detected in multiple municipal wells and in untreated water, the air stripper water treatment system successfully removed these contaminants through June 2023. Paden City Water Department continues to maintain and monitor the treatment system to ensure the effective removal of PCE. ATSDR does not expect past levels of contaminants in Paden City water to have resulted in harmful health effects. However, if the treatment system fails, such as the 2023 malfunction, or is taken offline, residents could potentially be exposed to PCE. An event like this would require further evaluation to determine whether the exposures could result in harmful health effects.
Conclusion 2	ATSDR concludes that for locations where air sampling has occurred, residents are unlikely to experience harmful health effects due to

exposures through vapor intrusion to PCE and other related contaminants at the concentrations detected in indoor air.

Basis for conclusion

For indoor air exposure due to soil vapor intrusion, PCE and related contaminant concentrations in currently occupied spaces were determined to be nondetectable or below ATSDR's health-based screening values. However, the soil vapor intrusion assessment was limited in scope, and ATSDR could not draw conclusions for exposure where indoor air data are not available. Effects of changes in occupancy, building use, building foundational integrity due to aging, and seasonal variability require further evaluation. Although PCE and 1,2-dichloroethane (1,2-DCA) were detected in ambient (outdoor) air, maximum concentrations were well below health-based inhalation screening values.

Recommendations

ATSDR recommends that environmental agencies;

- Continue to monitor the PCE plume, including PCE degradation products, in Paden City. Based on the plume extent and underlying geology, additional sampling locations can be identified for vapor intrusion assessment, including residential, sensitive receptor (i.e., schools), and commercial locations not previously evaluated. Additional monitoring for seasonal variability is also recommended at locations previously monitored, including at the Paden City High School. This is because vapor intrusion might be greater when outdoor temperatures are hot or cold and windows and doors remain mostly closed to maintain indoor climate control. Environmental agencies may consider developing a long-term plan to monitor vapor intrusion or to preemptively install vapor mitigation systems in properties that have high levels of volatile contaminants in soil or groundwater.
- Perform sub-slab soil gas and outdoor air sampling along with indoor sampling to assist with identifying background sources of chemicals that could also contribute to indoor air levels in addition to vapor intrusion (EPA 2020b, 2020c).
- Consider measuring indicators, tracers, and surrogates, measurements that help understand indoor conditions, to assist with identifying whether vapor intrusion conditions were active or dormant during sampling (EPA 2020b, 2020c).
- Continue to monitor indoor air in occupied spaces above the PCE plume, including Paden City High School.
- If occupancy or building use changes at the Wissmach Glass facility, the Band Box cleaners building, or the former athletic complex, evaluate indoor air that might be affected by vapor intrusion.

ATSDR recommends that Paden City officials;

- Continue to operate the air stripper water treatment system and monitor finished drinking water to ensure effectiveness of the treatment system.

- Develop contingency plans to provide uncontaminated water to consumers if the treatment system malfunctions.

ATSDR recommends that Paden City residents;

- Allow EPA access to their homes and other structures to conduct sampling and further characterize the PCE plume.
- Monitor their home's foundations for any cracks that might permit vapors to enter the home. Residents may consider additional means of reducing their PCE exposure: https://www.atsdr.cdc.gov/toxfaqs/tfacts18.pdf
- Consider minimizing the use of indoor sources of solvents (i.e., home cleaning supplies, degreasers, dry cleaned products) to reduce exposure to detected VOCs that were unrelated to the groundwater contamination. ATSDR provides ways of lowering VOCs in indoor air in this online resource: https://www.atsdr.cdc.gov/vapor-investigation.html
- For buildings and properties that had high PCE levels in soil vapor or groundwater but were unoccupied at the time of assessment, consider further evaluation before commercial or residential use. If current use status changes for any of these buildings, particularly the athletic complex and the former Band Box Cleaners property, further indoor air evaluation is recommended to ensure that levels of PCE would not cause harmful health effects to building occupants.

Next Steps

- ATSDR will continue to provide, upon request, technical assistance to EPA and WV DEP during the ongoing site investigations.
- ATSDR will evaluate the drinking water data from the 2023 treatment system malfunction in an addendum to this health consultation document and provide updated conclusions, recommendations, and proposed future actions, as applicable.
- ATSDR will review, upon request, any new data that may indicate a need to revise ATSDR's conclusions, recommendations, and proposed future actions.
- ATSDR will coordinate and attend future public meetings and present the findings of this document to the community. ATSDR will remain available to discuss community health concerns upon request.

Limitations

This public health assessment document is subject to several limitations. First, the preliminary vapor intrusion assessment was limited in scope. Further, conclusions within this evaluation are based only on data intermittently collected between 2010 and 2021. Drinking water data collected during the 2023 air stripper failure are not included within this assessment. That information will be addressed in an addendum to this document when the validated data become available. These limitations are discussed in detail in Section VII.

I. Background

PCE has been used in dry cleaning solvents for decades. Even after dry cleaning facilities close operations, PCE from past chemical disposal or runoff might still be found in groundwater and soils. After PCE was detected in the public drinking water supply in Paden City, the Environmental Protection Agency (EPA) and West Virginia state officials investigated the chemical's source and the extent of environmental contamination. Among the three dry cleaning facilities in Paden City, EPA determined from environmental sampling that the PCE plume — the underground area of contaminated groundwater and soil — was concentrated in the area surrounding Band Box Cleaners.

In 2010, PCE was detected above the EPA maximum contaminant level (MCL) in municipal drinking water in Paden City. Further sampling of additional drinking water wells in 2013 showed levels of PCE higher than previous detections in 2010. EPA conducted a removal assessment in 2018, investigated the area surrounding three former dry cleaners, and found that the contamination was concentrated in groundwater and subsurface soil within 0.25 miles of the former Band Box Cleaners. After other former dry-cleaning businesses were eliminated as a source by groundwater sampling and analysis, EPA determined that Band Box Cleaners caused PCE contamination of the public water supply in Paden City. Band Box Cleaners was in operation from 1969 to 1997 and was regulated under the Resource Conservation and Recovery Act (RCRA). Since the dry-cleaning business closed, the property has been used as storage by the property owner and is zoned as commercial/retail.

EPA conducted additional investigations in 2019 and 2021 to assess concentrations of PCE and other associated contaminants in groundwater, drinking water, subsurface soil, and potential indoor air pathways (i.e., vapor intrusion assessment). Residents in Paden City are connected to the municipal drinking water supply system and do not rely on private drinking water wells. EPA determined that PCE contamination of private wells outside of Paden City would be unlikely because of the distance from the site and environmental site characteristics (i.e., upgradient from the source). EPA assessed Paden City soil gas for the potential for vapor intrusion and indoor air for PCE and associated contaminant vapors. Vapor intrusion is a process by which chemicals with a high tendency to become vapor (volatize) move from environmental media (i.e., groundwater or soil) into the air as the chemical's vapor. After data collection was completed in early 2021, EPA asked ATSDR to assist in evaluating community exposures and addressing community health concerns. EPA screened water and vapor intrusion pathways for PCE, its breakdown products, and other VOCs.

In January 2020, a New Martinsville, West Virginia, resident wrote a letter to WVBPH, ATSDR, and federal elected officials stating concerns about a connection between amyotrophic lateral sclerosis (ALS) and Paden City drinking water contamination. New Martinsville is approximately 6 miles away from Paden City, and some New Martinsville residents are served by Paden City public water. On February 17, 2020, WVBPH asked that ATSDR evaluate the public health implications of non-ingestion household use of Paden

City drinking water (e.g., showering, washing dishes, etc.). In April 2020, ATSDR developed a letter response back to the New Martinsville resident. This official letter addressed the resident's questions and provided a preliminary comparison of Paden City PCE drinking water contamination levels to cancer and noncancer screening values. However, the letter was not an ATSDR public health assessment or health consultation document and did not comprehensively assess all available data.

Additional Paden City community members organized to collect health conditions data after learning about their PCE exposure. With the assistance of local academic institutions, Paden City residents created a voluntary web and phone survey. ATSDR received emails from residents, participated in conference calls with community members, and compiled their concerns to address within this document. ATSDR has addressed these community health concerns and their relevance to PCE exposure within this health consultation. However, ATSDR does not provide medical advice. ATSDR recommends that residents with specific medical concerns consult their physician.

On September 9, 2021, EPA proposed the Paden City Groundwater Site to the National Priorities List (NPL), and ATSDR began public health assessment work.

Paden City, West Virginia, is a city in Tyler and Wetzel Counties. According to 2019 U.S. census data, approximately 3,100 residents make up the city, with more than 98% of the community identifying as non-Hispanic White, English-speakers. The remaining 2% of Paden City's population is composed of Black residents, multiracial (two or more races) residents, or other those of other races. Although income among city residents is similar to the median in Wetzel County and in West Virginia, approximately 20% of the community lives below the poverty level.

The Centers for Disease Control and Prevention (CDC) categorizes Tyler and Wetzel counties as low to moderately vulnerable on the Social Vulnerability Index (SVI) (ATSDR 2022a). SVI is a measure of a community's relative ability to prepare for and recover from a hazardous event (ATSDR 2022b). ATSDR also considered Paden City's ranking on the Environmental Justice Index (EJI) (ATSDR 2022a). The EJI uses environmental, socioeconomic, transportation/infrastructure, and health factors to interpret patterns of vulnerability and burden within communities. Paden City is located in two counties and two census tracts. The EJI suggests that the census tracts comprising Paden City experience worse effects from social and environmental burden than approximately 80% of all other census tracts in the nation. These factors point to health equity concerns in the Paden City community. ATSDR is committed to ensuring a healthy environment for all, including communities like Paden City that are economically and socially marginalized.

II. Exposure Pathway Evaluation

ATSDR begins the evaluation of potential public health hazards by characterizing the exposure pathways in the community. Determining whether residents in the community

are exposed or were exposed in the past to contaminants in the environment requires the presence of five exposure factors. All five of the following factors must be present for an exposure pathway to be complete:

1) A contaminant's source.
2) The contaminant's environmental fate and transport – how the nature of contaminants might change and where they go end up in environmental media.
3) An exposure point.
4) A route for human exposure.
5) People who might be exposed.

PCE and associated contaminants migrated from the Band Box Cleaners through the groundwater to the public drinking water supply wells and household taps. Residents could be exposed to those contaminants by drinking water, skin contact, or through inhalation while showering, or inhalation while inside the home during a different household member's shower. Thus, the completed exposure pathway at the Paden City Groundwater Site included consuming drinking water (ingestion) and household water use (skin contact and inhalation during showering) (Table 1). Since installing an air stripper water treatment system in May 2020 at the water treatment plant, this ingestion and household water use exposure pathway has been eliminated.

The PCE and associated contaminant plume is located under portions of Paden City, with the potential for vapors to move through the ground and up into structures above and near the plume. This pathway, known as vapor intrusion, from Band Box Cleaners through groundwater and subsurface soils into the indoor air of structures above or near the PCE plume has not been eliminated (Table 2). Further assessment of the groundwater contaminant plume and vapor intrusion is underway. Based on the limited scope of sampled buildings, seasonal variation, and other important aspects of the vapor intrusion data assessed to date, vapor intrusion has been and continues to be a completed exposure pathway in the Paden City site area.

Table 1. Drinking and Household Water Exposure Pathways

Exposure Pathway	Contaminant Source	Environmental Fate and Transport	Exposure Point	Exposure Route	Exposed Population	Exposure Pathway Determination
Drinking water	Groundwater plume from former Band Box cleaners	PCE plume contaminates drinking water well that supply household taps	Drinking water	Ingestion	Paden City and New Martinsville residents drinking Paden City's public drinking water	Before May 2020: Complete Between May 2020 and June 2023: Incomplete Between July 2023 and

-	-	-	-	-	-	September 2023: Complete
Household water use	Groundwater plume from former Band Box cleaners	PCE plume contaminates drinking water well that supply household taps	Household water used in cooking, showering, bathing, etc.	Dermal absorption of PCE in water and/or inhalation of PCE vapor during household use	Paden City and New Martinsville residents using Paden City's water	Before May 2020: Complete Between May 2020 and June 2023: Incomplete Between July 2023 and September 2023: Complete

New Martinsville residents are not at risk for vapor intrusion exposure because the plume is localized to a portion of Paden City. This vapor can enter a building through cracks and other openings in the foundation. Environmental models can estimate a contaminant's potential to move from groundwater and subsurface soil into indoor air. The public water supply's treatment system does not prevent indoor air exposures from vapor intrusion, because the vapor intrusion occurs from untreated groundwater or soil off-gassing.

The extent of vapor intrusion is affected by many factors beyond the concentration of PCE in groundwater and soil. A building's construction and spacing of cracks or holes in the building's foundation can affect how much PCE vapor enters the indoor environment. Volatile chemicals, including PCE, turn to vapor more readily in warmer temperatures, so concentrations might be higher in the summer months. HVAC system use in a building also can affect the concentration of PCE by increasing or decreasing vapor flow from below ground. A "stack effect," also known as a "chimney effect," can influence indoor vapor concentrations by pushing up warmer air and pulling vapors from underground.

Table 2. Vapor Intrusion Exposure Pathways

Exposure Pathway	Contaminant Source	Environmental Fate and Transport	Exposure Point	Exposure Route	Exposed Population	Exposure Pathway Determination
Vapor Intrusion	Groundwater plume from former Band Box cleaners	PCE plume in subsurface soil and groundwater, volatilizes, and migrates into a building's indoor air	Indoor air	Inhalation	Residents living, working, or going to school in buildings above plume	Complete pathway for buildings where contaminants were detected in sub-slab soil gas and indoor air

Other exposure pathways that were eliminated include outdoor air, groundwater, and soil (ingestion and dermal). PCE can enter outdoor air through vaporization from water and soil, but the concentration of PCE in the outdoor air will be greatly diluted from the volume

of air outdoors. Residents are not expected to come into contact with contaminated groundwater because the contaminated groundwater plume is many feet below the ground's surface. The contaminated soil is also subsurface, and residents would only be exposed to the top layer surface soil through recreation and gardening. Surface soil was not sampled for PCE and associated contaminants, so ATSDR cannot assess its public health significance at this time. Although some areas close to the source area have contaminated soil, physical barriers (i.e., concrete or asphalt) prevent exposure to that contamination in the soil (EPA 2021).

III. Environmental Data and Health Screening

ATSDR evaluated all available environmental data, including drinking water (ingestion and household use) and vapor intrusion pathways (groundwater, soil gas, and indoor air). The data discussed below include results that were detected above ATSDR's health-based screening values. Data below screening values were not retained for further evaluation because the presence of contaminants below health-based screening levels are not expected to result in harmful health effects for any person.

The Public Health Assessment Site Tool (PHAST) and the ATSDR Showering and Household Water Use (SHOWER) model were used to evaluate exposure to contaminants in the water supply through ingestion, inhalation, and skin contact as the result of household use of water (ATSDR 2020). PHAST is an ATSDR tool used to screen contaminants for further assessment, calculate exposure doses and concentrations, compare site doses and concentrations to relevant toxicological values (such as minimal risk levels [MRLs]), and calculate cancer risks and hazard quotients (HQs).

Drinking Water Data and Screening

Paden City's water system includes three active wells and serves approximately 3,000 residents (EPA 2021). Well #1 was taken out of service and replaced by Well #5 when the water treatment plant was built in 2000. Well #2 was abandoned due to PCE contamination. Wells #3, 4, and 5 are still in use (EPA 2019a). This water distribution system covers most of Paden City; however, a few private wells are in use outside of Paden City's municipal distribution boundary. Any homes using private wells are upgradient of the PCE plume and are not expected to be affected by the Band Box Cleaners' PCE plume (EPA 2021).

In November 2003, the West Virginia Bureau of Public Health (WVBPH) published a source water assessment and protection report (WVBPH 2003). This report evaluated Paden City's drinking water source susceptibility to contamination, which was determined based on local environmental and geological factors as well as the drinking water wells' integrity. At the time of the report, WVBPH could not determine whether the entire length of the wells' surface casing was grouted. A grouted surface casing can prevent contaminants from entering the well from the surface or any depths above the screened interval where source water infiltrates. All of the city's wells are located in the flood plains of the Ohio River.

These factors contribute to an overall high susceptibility to contamination for Paden City's water system (WVBPH 2003). Paden City Water Department first discovered the presence of PCE in drinking water in 2010, and EPA began to characterize the contaminant plume in 2018. EPA continues to define the boundaries of the plume as of the publishing date of this document.

Types of water
Finished water is public water in the distribution lines that has been treated at the Paden City water treatment plant.
Raw water is groundwater from public water supply wells that has not been treated.
Well water is water collected directly from the public water supply well that has not been treated.

PCE was not continually monitored since its first detection in 2010. After a gap in sampling, PCE was detected again in finished drinking water in 2013 at levels higher than in 2010. PCE was intermittently monitored multiple times per year from 2013 onward, although finished water in 2014, 2015, and 2016 did not contain PCE above EPA's MCL. However, several raw and finished drinking water samples since 2017 have contained PCE above the MCL. EPA conducted a removal assessment in 2018 and further characterized the PCE plume.

In addition to these drinking water wells; one industrial well was also affected by the PCE plume. Of the three groundwater wells used for Paden City's drinking water resources, two of the wells had PCE above state and federal MCLs. An air stripper treatment system was installed in May 2020. When operating effectively, this system removes PCE and associated contaminants completely or to concentrations below health-based screening levels. Any systemic malfunctions, including the 2023 malfunction, can affect the air stripper's ability to remove contaminants.

Although PCE is the primary contaminant of concern at the Paden City Groundwater Site, EPA's site inspection and removal assessment included PCE breakdown products and other VOCs. ATSDR screened the drinking water data for these compounds and evaluated any VOCs that were detected above health-based screening values. Exposure to a contaminant at a concentration below a screening value is not expected to result in harmful health effects.

Table 3. Screening Summary for Contaminants Detected in Drinking Water, Paden City, 2010-2019

Analyte Name	2010 Maximum (µg/L)	2013-18 Maximum (µg/L)	2019 Maximum (µg/L)	Drinking Water CV (µg/L)	CV Source	Retain for Further Evaluation?
Perchloroethylene (PCE)	5.60	9.92	17.0*	12.0	CREG	Yes
Trichloroethylene (TCE)	3.00*	N/A	N/A	0.43	CREG	Yes
Trichloroacetic acid	N/A	4.70*	N/A	0.35	CREG	Yes
Bromodichloromethane	N/A	0.36	N/A	0.39	CREG	No
Dibromochloromethane	N/A	1.01*	N/A	0.29	CREG	Yes

Abbreviations: cEMEG = chronic duration environmental media evaluation guideline; CREG = cancer risk evaluation guide; CV = comparison value; EMEG = environmental media evaluation guide; N/A = not tested or not reported; RMEG = remedial media evaluation guide.
* = maximum detected value higher than recommended CV.

The concentration of PCE exceeded the EPA MCL in the raw and finished drinking water in several sampling events. However, the MCL for PCE is lower than ATSDR's health-based screening values. Contaminants that are detected below screening values are not expected to result in harmful health effects. The lowest ATSDR screening value for PCE is the cancer risk evaluation guide (CREG) of 12 µg/L. The ATSDR CREG is the contaminant concentration where one in 1 million persons exposed continuously for 78 years are expected to develop cancer. Health-based, non-cancer screening values for PCE are greater than the CREG. As shown in Table 3, PCE concentrations were well below ATSDR's screening values before 2019. The other VOCs detected above a screening value included trichloroethylene (TCE), trichloroacetic acid, and dibromochloromethane. TCE is a breakdown product of PCE, and trichloroacetic acid and dibromochloromethane are disinfectant biproducts. Other VOCs were not detected or were detected below screening values.

Household Water Data and Screening

With its SHOWER model, ATSDR screened household water exposure using the maximum concentration of PCE detected in Paden City's water, 17 µg/L. The SHOWER model uses the concentration in water to predict the 24-hour inhalation exposure concentration and the daily skin exposure dose in the household. The SHOWER model can be modified for the number of residents in the home and time spent showering. The SHOWER model predicted an exposure concentration of 0.63 ppb for the default four-person household scenario, which exceeded ATSDR's CREG for indoor air of 0.57 ppb. ATSDR conducted further evaluation of PCE exposures through household use to assess non-cancer and cancer harmful health effects (see Section IV: Health Effects).

Vapor Intrusion Data and Screening

EPA completed a removal assessment in 2018 and a site inspection in 2020. EPA collected groundwater samples in 2018 that were used to estimate the potential for vapor intrusion. In April and November 2020, EPA also conducted several rounds of soil gas and indoor air vapor intrusion sampling and sampled outdoor air. Because many factors affect indoor air and soil gas vapor intrusion values, ATSDR evaluated all relevant media for potential vapor intrusion. Only indoor air data were used to estimate the health implications from vapor intrusion exposures.

The 2018 removal assessment included exterior subsurface soil gas sampling (within 5 feet of surface) and photoionization detector (PID) screening, sub-slab soil gas sampling, and groundwater sampling near sources and other buildings. The only values above ATSDR's screening values for soil vapor intrusion were from the sub-surface PID screenings for Band Box Cleaners, the former athletic complex, and Residence 1. EPA conducted additional sampling for indoor air at Residence 1; this home is further assessed below. However, PID screenings include other VOCs and are not limited to the chlorinated solvents related to the site. Because Band Box Cleaners and the former athletic complex are not open to the public, EPA did not collect additional data that could be used to estimate

exposures. The former athletic complex has been closed since EPA conducted its assessments and does not present a complete exposure pathway to the public. The Band Box Cleaners property is currently zoned as commercial/retail, but the property owner uses the property for storage and the public does not have access to the property. Any potential brief and occasional exposures at Band Box Cleaners are not considered to be of public health significance. Further investigation might be needed if building use changes in the future.

EPA's 2018 removal assessment was mostly limited to characterizing the PCE plume and focused on environmental media in and around the three former dry-cleaning facilities: Band Box Cleaners, Rockwell Cleaners, and Budd Cleaners. These 2018 data did not focus on human exposure. The 2020 site inspection involved multiple rounds of environmental sampling at two residences and two schools (Paden City High School and Paden City Elementary School). EPA also assessed groundwater and sub-slab soil gas, respectively, at two commercial properties (Wissmach Glass, the former athletic complex, and on and around the former Band Box Cleaners property) but did not evaluate indoor air at these properties.

Many factors can affect the extent of vapor intrusion within an indoor environment. Seasonality (i.e., weather trends) and building-specific factors strongly influence the vapor intrusion pathway and indoor air contaminant concentrations. ATSDR always recommends conducting multiple rounds of vapor intrusion sampling throughout a calendar year to account for seasonal variability and building use. EPA conducted its formal vapor intrusion assessment as part of the site inspection, with rounds of vapor intrusion sampling occurring in April and November. Exposures from vapor intrusion can pose greater risk in winter months if building users keep windows closed, reducing ventilation that might dilute indoor air concentrations. ATSDR recognizes that full vapor intrusion data were not available, especially for the winter season, and proceeded with its assessment of all available data.

ATSDR evaluated environmental data within the PCE plume, which originated at the former Band Box Cleaners property and flowed west toward the Ohio River. Some locations, such as Paden City Elementary School, were sampled for sub-slab soil gas and indoor air as background data. ATSDR screened these locations but did not find any chemical concentrations of health concern. Soil gas measurements were taken from a sub-slab level and not surface level. Measurements were taken at this depth because soil vapor intrusion occurs due to contaminants evaporating from groundwater deep below the ground's surface.

Although indoor air vapor measurements might show the actual exposure within a particular building, sub-slab soil vapor data provide important risk assessment information. Because the extent of vapor intrusion into indoor air depends on building construction and integrity, sub-slab soil vapor measurements can only show the potential for intrusion. A building's foundation might crack over time, and other changes in structural or environmental conditions might increase the risk for vapor intrusion. These changes might increase the indoor air concentrations of contaminants within a building.

ATSDR evaluated all relevant environmental data, including sub-slab soil gas, indoor air, and groundwater, for vapor intrusion. However, indoor air concentrations are the only data used for exposure assessment in this consultation. ATSDR screened the environmental sub-slab soil vapor and soil gas data as well as groundwater data for vapor intrusion potential and included the screening summary in Appendix B.

Vapor intrusion is not the only source of indoor air contaminants. If sub-slab air concentrations of contaminants are less than indoor air levels, then the contaminant source is unlikely to be from a plume or other underground source. In this case, the source might originate indoors. Conversely, if contaminant levels in indoor air are less than sub-slab air, vapor intrusion might be the source of the contaminant in the indoor environment.

Table 4. Summary Data Screening – Maximum Detected VOCs in Indoor Air with CVs, Paden City, 2018-2020

Analyte/Location	Date of Analysis	Type of Building	Current Occupancy	Maximum Indoor Air (ppb)	Indoor Air CV* (ppb)
Perchloroethylene (PCE) –, Band Box Cleaners	Nov. 2018	Commercial	Unoccupied	N/A	0.57
1,2-Dichloroethane – Residence 2	Nov. 2020	Residential	Occupied	0.25†	0.0095
1,2-Dichloroethane – Paden City Elementary School	Nov. 2020	School	Occupied	0.074†	0.0095
Perchloroethylene (PCE) – Residence 1	April 2020	Residential	Occupied	0.099	0.57
Perchloroethylene (PCE) – Residence 2	Nov. 2020	Residential	Occupied	0.15 K	0.57
Perchloroethylene (PCE) – Paden City High School	Nov. 2020	School	Occupied	0.28	0.57

Abbreviations: CV = comparison value; K = estimated concentration, biased high; N/A – not tested or not reported; ppb = parts per billion; VOC – volatile organic compound.
* CV source = cancer risk evaluation guide.
† = maximum detected value higher than recommended CV.
Indoor air was evaluated for other VOCs, but none were detected above screening values.

Table 5. Summary Data Screening – Maximum Detected VOCs in Ambient Air, Paden City, 2018-2020

Analyte/Location	Date of Analysis	Type of Building	Current Occupancy	Maximum Ambient Air (ppb)
Perchloroethylene (PCE) –Band Box Cleaners	Nov. 2018	Commercial	Unoccupied	N/A
1,2-Dichloroethane – Residence 2	Nov. 2020	Residential	Occupied	0.025†
1,2-Dichloroethane – Paden City Elementary School	Nov. 2020	School	Occupied	0.025†
Perchloroethylene (PCE) – Residence 1	April 2020	Residential	Occupied	ND
Perchloroethylene (PCE) – former athletic complex	April 2020	Commercial	Occupied	0.16

Analyte/Location	Date of Analysis	Type of Building	Current Occupancy	Maximum Ambient Air (ppb)
Perchloroethylene (PCE) – Residence 2	Nov. 2020	Residential	Occupied	0.1 K
Perchloroethylene (PCE) – Paden City High School	Nov. 2020	School	Occupied	0.015

Abbreviations: K = estimated concentration, biased high; ppb = parts per billion; N/A = not tested or not reported; VOC = volatile organic compound.
† = maximum detected value higher than recommended comparison value.
Ambient air was evaluated for other VOCs but were not detected above screening values.

Varying levels of PCE were found in sub-slab soil gas in residential and non-residential locations (see Appendix B, Table 1). The highest concentration of PCE was around the Band Box Cleaners property. Soil gas concentrations at the former athletic complex, which is next to the Band Box Cleaners property, were also above screening levels. Residential soil gas concentrations were lower than those found at non-residential locations, but still exceeded vapor intrusion pathway screening levels under Residence 1. Despite the sub-slab soil gas screening above ATSDR's health-based CVs, PCE was not detected above CVs in indoor or outdoor air at Band Box Cleaners or any other location.

The highest concentration of PCE in sub-slab soil gas at a currently occupied structure (residential or non-residential) was at Residence 1. However, indoor air measurements of PCE did not exceed any CVs at this residence or any other location. The indoor air concentrations indicate that exposures are currently not expected to result in harmful health effects. However, ATSDR recommends further assessment of indoor air to determine the significance of seasonal variability on vapor intrusion at this and other locations that have sub-slab PCE contamination.

Although PCE was detected in outdoor air, the maximum concentration was well below ATSDR's CVs for indoor air. The maximum concentration of PCE was 0.16 ppb, which is below the CREG of 0.57 ppb for PCE in indoor air. 1,2-DCA was detected at a maximum concentration of 0.025 ppb in outside air, which was above the CREG of 0.0095 ppb for 1,2-DCA in indoor air. Comparing ambient air concentrations to indoor air screening values is a health-protective approach because the dynamic nature of outdoor air tends to dilute air contaminants, resulting in much lower contaminant exposures over time. ATSDR also considers whether outdoor concentrations of contaminants can contribute to indoor air contamination.

One of PCE's breakdown products, 1,2-DCA, was detected above ATSDR's CREG at the residential and non-residential locations. 1,2-DCA was found in indoor air at target locations in the PCE plume's path and at background locations (locations outside of the contaminant plume boundary). Levels of 1,2-DCA in indoor air are greater than those in sub-slab soil gas, indicating that indoor air concentrations of 1,2-DCA at these locations are due, at least in part, to sources other than vapor intrusion from underground contamination. Other potential sources of 1,2-DCA could include cleaning agents and gasoline (ATSDR 2019). Regardless of the contaminants' source, ATSDR completed its

health assessment for these indoor air exposures. Other breakdown products of PCE include TCE and vinyl chloride, but the measured concentrations of these contaminants were below screening levels and did not require additional evaluation.

ATSDR also evaluated groundwater data for vapor intrusion potential (see Appendix B, Table 2). Groundwater samples were all taken from a depth of 70 feet or less below ground surface. Groundwater close to the surface has a greater likelihood for vapor intrusion into the building above than does groundwater found deeper below the surface.

Chemical-specific groundwater screening levels for vapor intrusion were exceeded in samples collected below the Band Box Cleaners area and below the Paden City High School. Although several groundwater levels at Paden City High School exceeded screening levels for vapor intrusion, sub-slab soil vapor and indoor air concentrations at Paden City High School were below respective screening levels. Groundwater and soil vapor levels in the Band Box Cleaners area also exceeded screening levels for vapor intrusion. However, because the property is currently only used for storage, exposure to anyone in the building would be of very short and intermittent duration (i.e., occasionally entering building to access storage items). These exposure scenarios are not expected to result in exposures of health significance. If the facility is used for other purposes or occupants plan to be inside the facility for longer durations than currently described, reassessment of this exposure pathway is recommended. Groundwater at Wissmach Glass, a commercial property, also exceeded screening levels for vapor intrusion from groundwater. However, EPA did not collect sub-slab soil gas or indoor air measurements at this location, so ATSDR was unable to evaluate this property further for vapor intrusion.

IV. Health Effects

Drinking Water Ingestion

As discussed in the previous section, ATSDR determined that the maximum concentration of PCE and TCE in the untreated drinking water was above health-based screening levels. However, Paden City's air stripper treatment system effectively removed these contaminants from the finished drinking water and thereby mitigated this exposure pathway from 2020 until July 2023. Before the treatment system was installed, data for Paden City's drinking water supply showed PCE at varying levels below 17 ppb. Although most detected results were lower than ATSDR's CVs, there were some detections above these CVs. As such, ATSDR estimated past exposures to the public water supply.

There are many factors that contribute to whether contaminants with toxic properties will have harmful effects to the person who is exposed to them. Some of these factors include *concentration* of the contaminant, *frequency* of exposure, and *duration* of exposure.

Although PCE in drinking water was not monitored or reported before 2013, and all concentrations from

2013-2020 were below 17 ppb, ATSDR continued with a chronic exposure scenario with the maximum concentration of 17 ppb as a worst-case scenario (see Table 6). HQs were calculated by comparing the exposure dose to the MRL. ATSDR calculated exposure doses for PCE based on a central tendency exposure (CTE) and a reasonable maximum exposure (RME) scenario for each age group. These exposure doses were used to calculate non-cancer HQs, which were all below 1. HQs below 1 indicate that non-cancer health effects are unlikely. Cancer risks were also calculated for a child scenario (from birth up to 21 years of exposure) and adult scenario (33 years of exposure) as 4.6E-7 and 5.8E-7, respectively, for the RME worst-case scenario. These risks indicate that ingestion exposure to PCE in Paden City drinking water would result in less than one cancer in 1 million persons exposed daily for their lifetime. **ATSDR does not consider this cancer risk to be at a level of public health concern.**

Table 6. Perchloroethylene Drinking Water Ingestion – Chronic Exposure

Exposure Group	Chronic Dose – CTE (mg/kg/day)	Chronic Dose – RME (mg/kg/day)	Chronic HQ CTE	Chronic HQ RME	Cancer Risk CTE	Cancer Risk RME	ED (years)
Birth to <1 year	0.0011	0.0024	0.14	0.30	1.7E-7	4.6E-7	1
1 to <2 years	0.00046	0.0013	0.057	0.17			1
2 to <6 years	0.00037	0.00095	0.046	0.12			4
6 to <11 years	0.00027	0.00075	0.034	0.094			5
11 to <16 years	0.00019	0.00059	0.024	0.074			5
16 to <21 years	0.00018	0.00058	0.023	0.073			5
Total exposure duration for child cancer risk	-					21	
Adult	0.00026	0.00066	0.033	0.082	2.3E-7	5.8E-7	33
Pregnant Women	0.00020	0.00060	0.025	0.075	NC	NC	NC
Breastfeeding Women	0.00039	0.00084	0.048	0.10	NC	NC	NC

Abbreviations: CTE = central tendency for exposure; ED = exposure duration; mg/kg/day = milligrams of contaminant per kilogram of body weight per day; NC = not calculated; RME = reasonable maximum exposure; NC = not calculated

In 2010, TCE was also found in drinking water above screening levels. However, TCE was not measured or reported in any other drinking water samples since 2010. ATSDR continued with a chronic exposure scenario with this maximum of 3 ppb as a worst-case scenario. HQs were below 1.0 for all age groups except for the RME dose for infants younger than 1 year. ATSDR determined an HQ of 1.3 for infants younger than 1 year based on a chronic MRL of 0.0005 mg/kg/day. Cancer risks were also calculated for a child scenario (from birth up to 21 years of exposure) and adult scenario (33 years of exposure) as 4.6E-7 and 5.8E-7, respectively, for the RME worst-case scenario.

The exposure duration of 33 years represents the assumed amount of time that a resident lives in their home; actual duration might vary from person to person. TCE was only detected at this maximum level in 2010; pre-2010 levels of TCE remain unknown. **Based on the available information about exposures, ATSDR concludes that these worst-case TCE exposure scenarios are not expected to result in harmful health effects or to significantly increase the risk for cancer.**

Table 7. Trichloroethylene Drinking Water Ingestion: Chronic Exposure

Exposure Group	Chronic Dose – CTE (mg/kg/day)	Chronic Dose – RME (mg/kg/day)	Chronic HQ – CTE	Chronic HQ – RME	Cancer Risk CTE	Cancer Risk RME	ED (years)
Birth to <1 year	0.00030	0.00067	0.61	1.3*	1.7E-6*	4.6E-6*	1
1 to <2 years	0.00013	0.00037	0.25	0.74			1
2 to <6 years	0.00010	0.00026	0.20	0.53			4
6 to <11 years	7.6E-05	0.00021	0.15	0.42			5
11 to <16 years	5.3E-05	0.00016	0.11	0.33			5
16 to <21 years	5.1E-05	0.00016	0.10	0.32			5
Total exposure duration for child cancer risk	-						21
Adult	7.2E-05	0.00018	0.14	0.36	1.4E-6*	3.6E-6*	33

Abbreviations: CTE = central tendency for exposure; ED = exposure duration; mg/kg/day = milligrams of contaminant per kilogram of body weight per day; RME = reasonable maximum exposure; * = retained for further evaluation.

Other volatile organic compounds (VOCs) found in Paden City's finished drinking water included dibromochloromethane (a trihalomethane [THM]) and trichloroacetic acid (a haloacetic acid [HAA]). THM is a biproduct of using chlorine as a disinfectant. THMs can cause adverse health effects at high exposure levels. EPA regulates total THMs to 80 µg/L, which is a cumulative number that accounts for four specific THM chemicals: bromoform, bromodichloromethane, chloroform, and dibromochloromethane. The MCL for THMs is based on potential effects on the liver, kidneys, and central nervous system, as well as increases in cancer risk from ingesting the water (EPA 2019b). Dibromochloromethane, at 1.01 µg/L, and trichloroacetic acid, at 4.7 µg/L, were detected above screening levels; all other THMs and HAAs that had detections were found below screening levels. ATSDR used the concentrations detected in Paden City water sources to calculate exposure doses for each of these contaminants.

As shown in Table 8, ATSDR calculated exposure doses for trichloroacetic acid for a CTE and a RME for each age group. These exposure doses were used to calculate non-cancer HQs, which were all below 1. HQs below 1 indicate that non-cancer health effects are not expected. A cancer risk of 4.3 E-6 was calculated for a child's exposure to trichloroacetic acid and 5.4E-6 for an adult's lifetime exposure, based on the RME, or worst-case exposure scenario. Cancer risks were also calculated for a child (from birth up to 21 years of exposure) and adult scenario (33 years of exposure) as 4.3E-6 and 5.4E-6, respectively.

This excess cancer risk of approximately four excess cancers per 1 million children exposed and five excess cancers per 1 million adults exposed is considered a low risk. **ATSDR does not consider this cancer risk to be at a level of public health concern.**

Table 8. Trichloroacetic Acid Drinking Water Ingestion: Chronic Exposure

Exposure Group	Chronic Dose – CTE (mg/kg/day)	Chronic Dose – RME (mg/kg/day)	Chronic HQ – CTE	Chronic HQ – RME	Cancer Risk CTE	Cancer Risk RME	ED (years)
Birth to <1 year	0.00030	0.00067	0.015	0.034	1.6E-6*	4.3E-6*	1
1 to <2 years	0.00013	0.00037	0.0063	0.018			1
2 to <6 years	0.00010	0.00026	0.0051	0.013			4
6 to <11 years	7.6E-05	0.00021	0.0038	0.010			5
11 to <16 years	5.3E-05	0.00016	0.0026	0.0082			5
16 to <21 years	5.1E-05	0.00016	0.0025	0.0080			5
Total exposure duration for child cancer risk	-						21
Adult	7.2E-05	0.00018	0.0036	0.0091	2.1E-6*	5.4E-6*	33

Abbreviations: CTE = central tendency for exposure; ED = exposure duration, mg/kg/day = milligrams of contaminant per kilogram of body weight per day; RME = reasonable maximum exposure; * retained for further evaluation.

ATSDR also calculated exposure doses for dibromochloromethane. As shown in Table 9, all HQs for CTE and RME were below 1. A cancer risk of 1.1E-6 was calculated for a child's exposure to dibromochloromethane and 1.E-6 for and adult's lifetime exposure, based on the RME. This excess cancer risk of approximately one excess cancers per 1 million people exposed (1E-6) is considered a low risk. **ATSDR does not consider this cancer risk to be at a level of public health concern.**

Table 9. Dibromochloromethane Drinking Water Ingestion: Chronic Exposure

Exposure Group	Chronic Dose – CTE (mg/kg/day)	Chronic Dose – RME (mg/kg/day)	Chronic HQ – CTE	Chronic HQ – RME	Cancer Risk CTE	Cancer Risk RME	ED (years)
Birth to <1 year	6.5E-05	0.00014	0.00073	0.0016	4.0E-7	1.1E-6*	1
1 to <2 years	2.7E-05	7.9E-05	0.00030	0.00088			1
2 to <6 years	2.2E-05	5.7E-05	0.00024	0.00063			4
6 to <11 years	1.6E-05	4.5E-05	0.00018	0.00050			5
11 to <16 years	d1.1E-05	3.5E-05	0.00013	0.00039			5
16 to <21 years	1.1E-05	3.4E-05	0.00012	0.00038			5
Total exposure duration for child cancer risk	-						21
Adult	1.5E-05	3.9E-05	0.00017	0.00043	5.5E-7	1.4E-6*	33

Abbreviations: CTE = central tendency for exposure; ED = exposure duration; mg/kg/day = milligrams of contaminant per kilogram of body weight per day; RME = reasonable maximum exposure; * = retained for further evaluation.

Household Water Use Evaluation

ATSDR used the maximum concentration of PCE detected in finished water to run the SHOWER model for inhalation and skin exposure. Because ATSDR did not have specific household size information, we used the SHOWER model's default assumption of a four-person household. ATSDR evaluated the SHOWER model under a worst-case scenario, with the assumption that all showers were being taken consecutively in the morning. Results were reported for the most highly exposed person, who is assumed to remain at home all day and not use a bathroom fan. Children younger than 1 year of age are not evaluated for shower scenarios because they do not shower. According to EPA's 2011 Exposure Factor Handbook, 9% of children between the ages of 1 year to less than 2 years and 14% of children ages 2 years to less than 6 years take showers (EPA 2011). For a four-person household, the SHOWER model estimates an average daily exposure concentration of 0.63 ppb PCE. This information can be used to determine doses for each person in the four-person household. Table 10 presents the inhalation and dermal doses from contact with water for the target person in each scenario. Table 10 also shows the average daily PCE exposure concentration for the target person in each scenario converted to a daily dose in micrograms of PCE per kilogram of body weight per day (mg/kg/day).

Table 10. Average daily PCE inhalation dose and administered dermal dose in each household for all age groups that shower in mg/kg/day

Exposure Group[i]	Inhalation 1-Person	Inhalation 2-Person	Inhalation 3-Person	Inhalation 4-Person	Dermal 1-Person	Dermal 2-, 3-, or 4-Person
Birth to <1 year	NC	NC	NC	NC	NC	NC
1 to <2 years	NC	0.0031	0.0044	0.0055	NC	0.00026
2 to <6 years	NC	0.0020	0.0028	0.0035	NC	0.00022
6 to <11 years	NC	0.0012	0.0016	0.0020	NC	0.00018
11 to <16 years	NC	0.00078	0.0011	0.0013	NC	0.00015
16 to <21 years	NC	0.00059	0.00081	0.0010	NC	0.00014
Adult	0.00029	0.00053	0.00073	0.00091	0.00013	0.00013
Pregnant and lactating women	0.00042	0.00076	0.0010	0.0013	0.0013	0.0013

Abbreviations: NC = not calculated; µg/kg/day = micrograms chemical per kilograms body weight per day.

The total household use exposure is calculated by combining inhalation and skin exposures. Because doses are based on body weight, the worst-case scenario is for a child aged between 1 year and less than 2 years, for a combined total household exposure of 0.00576 mg/kg/day. This dose is then compared with the MRL, which is derived from data

in epidemiologic and toxicologic literature and includes uncertainty factors. Comparison with an MRL is used to indicate whether further evaluation is necessary. The dose of 0.00576 mg/kg/day for that child is below the chronic ingestion MRL for PCE (0.008 mg/kg/day). Even when assuming a highest likely exposure scenario (i.e., RME), ATSDR does not expect harmful health effects to occur from household exposure to PCE. ATSDR also calculated a total exposure dose for all exposure routes (ingestion, inhalation, and dermal) for a child aged between 1 year and less than 2 years using the maximum, worst-case scenario (i.e., RME dose). This combined exposure dose of 0.0071 mg/kg/day is below the MRL of 0.008 mg/kg/day.

Further, these exposure doses were determined assuming long-term chronic exposure. Although Paden City does not have PCE data from before 2013, all monitoring data between 2013 and 2019 were below 17 µg/L. Actual chronic exposure doses and the risk for harmful health effects to Paden City residents were likely even lower than those determined in this document.

An inhalation cancer risk of 4.6E-7 was calculated by multiplying the average daily inhalation exposure concentration (i.e., chronic exposure point concentration) by the inhalation unit risk. These risks indicate that exposure to PCE would result in approximately five excess cancers per 10 million persons (5E-7). Combining this inhalation cancer risk with the cancer risk from ingesting PCE in drinking water results in a total cancer risk of 1E-6. This excess cancer risk of approximately one excess cancer per 1 million people exposed (1E-6) is considered a low risk. **ATSDR does not consider this cancer risk to be at a level of public health concern.**

ATSDR also assessed exposure to other VOCs through household water use for inhalation and dermal pathways. The trichloroacetic acid concentration in air for a four-person household was estimated using the SHOWER model as 0.0013 ppb. Exposure doses for inhalation and dermal exposure were also calculated with a maximum dose for children less than 2 years old. These exposure doses were determined to be 0.000011 mg/kg/day for inhalation and 0.000015 mg/kg/day for combined inhalation and dermal exposure. Although ATSDR does not have a chronic inhalation MRL for trichloroacetic acid, the Texas Commission on Environmental Quality established an effects screening level (ESL) of 1 ppb. ESLs are chemical-specific air concentrations developed by the commission to protect human health and welfare. Exposure to an air concentration at or below the ESL is not likely to cause health effects in the general public, including sensitive subgroups such as children, the elderly, pregnant women, and people with pre-existing health conditions. **Because air concentrations at this site are estimated to be much lower than this ESL, ATSDR does not expect harmful health effects to occur from trichloroacetic acid inhalation exposures from household use.**

The dibromochloromethane concentration in air for a four-person household was estimated using the SHOWER model as 0.00028 mg/m^3. RME doses for inhalation and skin exposure were also calculated for children ages 1 year to less than 2 years and determined to be 0.00036 mg/kg/day for inhalation and 0.000362 µg/kg/day for combined inhalation and dermal exposure, which are both below the chronic MRL of 0.09 mg/kg/day. **ATSDR does not expect harmful health effects to occur from dibromochloromethane inhalation exposures from household use.**

Vapor Intrusion and Ambient Air Evaluation

Susceptible buildings for vapor intrusion are expected to be within 100 feet of the contaminant plume. From available data, ATSDR identified Residence 1, Residence 2, Paden City High School, Paden City Elementary School, the former athletic complex, and Wasatch Glass as locations requiring further evaluation. All other locations did not warrant further evaluation. EPA plans to assess additional locations for vapor intrusion but does not yet have an estimated data delivery date. ATSDR may evaluate future vapor intrusion data as it becomes available.

Residence 1

Sub-slab soil vapor concentrations at Residence 1 exceeded the screening value for PCE, which indicates the potential for vapor intrusion at levels associated with harmful health effects. However, all indoor air measurements were well below applicable screening levels, indicating that exposures in the home were unlikely to cause harmful effects. Actual vapor concentrations in indoor air are highly variable, particularly due to seasonal weather changes and, as a building ages, cracks or other changes in the building's foundation can allow for greater vapor infiltration. Because of that, residents in this home might be exposed to higher concentrations of PCE in indoor air in the future; however, additional sampling would be required to determine changes in indoor vapor concentrations. **Based on the available data, ATSDR does not expect exposures at this residence to result in harmful health effects.**

Residence 2

Although PCE was not detected above vapor intrusion screening values in any environmental media, 1,2-DCA was detected in indoor air and ambient air above ATSDR's air screening value at 0.025 ppb (0.1 µg/m^3), which exceeds the CREG for 1,2-DCA of 0.0095 ppb. ATSDR multiplied the detected level by the carcinogenic inhalation unit risk for 1,2-DCA of 2.6 x 10^{-5} per µg/m^3 (6.4 x 10^{-6} per ppb) to calculate the predicted number of excess cancer cases per million people after a lifetime of exposure. This excess cancer risk of approximately three excess cancers per 1 million people exposed (3E-6) is considered a low risk. **ATSDR does not consider this cancer risk to be at a level of public health concern. ATSDR does not expect exposures at this residence to result in harmful health effects, including increased cancer risk.**

Paden City High School

Groundwater PCE and TCE levels near Paden City High School were above the respective screening values for soil vapor intrusion. However, indoor air concentrations in several locations within the building were all below air screening values. Based on these data, any vapor intrusion occurring at the Paden City High School is not expected to result in harmful health effects. Actual vapor intrusion-related indoor air concentrations are highly variable, particularly due to seasonal weather changes. As a building ages, cracks can form in the foundation, permitting greater vapor infiltration. Because of those factors, additional sampling is recommended to understand PCE and TCE inhalation exposures over time. **Based on the available data, ATSDR does not expect exposures at the high school to result in harmful health effects, including increased cancer risk.**

Paden City Elementary School

Paden City Elementary School was selected for PCE sampling as a background location because it is outside the path of the PCE plume. However, 1,2-DCA, which can be found in gasoline and various cleaning agents, was detected in indoor air at the school at 0.074 ppb (0.3 µg/m^3), which exceeds ATSDR's air screening value (the CREG) for 1,2-DCA of 0.0095 ppb. ATSDR multiplied the detected level by the carcinogenic inhalation unit risk for 1,2-DCA of 2.6 x 10^{-5} per µg/m^3 (6.4 x 10^{-6} per ppb) to calculate the predicted number of excess cancers cases per million people over a lifetime of exposure. This excess cancer risk of 8 x 10^{-6} is equivalent to approximately eight excess cancers per 1 million people. **ATSDR does not consider this increased cancer risk to be at a level of public health concern**.

Matthew Barker Memorial Athletic Complex and Band Box Cleaners

The athletic complex facility has been indefinitely closed, and the Band Box Cleaners building is only accessed by the owner for storage. However, ATSDR recommends that Paden City consider the potential for harmful health effects from PCE exposures if there are any plans to reopen or change building use for either property. Although indoor air was not assessed at either location, a sub-slab soil vapor concentration above ATSDR CVs indicates vapor intrusion might present unacceptable health risks in the overlying building. If the properties' use or occupancy status were to change in the future, potential vapor intrusion of PCE might pose the risk for harmful health effects to occupants. For the athletic complex, occupants might be at risk for harmful health effects because they would be breathing more air during athletic activities. **Should either facility open to the public, ATSDR would need to assess indoor air data from the facility to make conclusions regarding risk to occupants.**

Wissmach Glass

Because soil vapor and indoor air concentrations at Wissmach Glass are not available, ATSDR cannot assess current exposure at this commercial location. However, groundwater concentrations of PCE suggest that vapor intrusion could occur at this building. Sampling of

this location was part of EPA's plume characterization and source determination. VOCs are often used in industrial and commercial applications, including glass production. EPA analyses determined that this location was not the primary PCE plume source, and further environmental sampling was not conducted. ATSDR cannot evaluate current exposures in this facility without indoor air data. Because PCE was detected in groundwater below this building and greater vapor infiltration might occur as buildings age and foundations crack, there is a potential for unhealthy PCE inhalation exposures inside the Wissmach Glass facility. **Should the building use change from commercial to residential, school, or recreational, ATSDR would need to assess indoor air from this facility to make conclusions regarding risk to occupants.**

V. Community Concerns

The Paden City community has expressed concerns about their environmental exposures in relation to their health conditions, beginning in 2018. In spring 2018, a New Martinsville resident with health concerns about amyotrophic lateral sclerosis (ALS) was referred to ATSDR in Region 3 via the EPA Region 3 Public Information Center hotline. New Martinsville is adjacent to Paden City to the northeast. ATSDR shared emails about ATSDR's ALS registry and additional information, including a summary of previously evaluated ALS data in West Virginia, and residential soil sampling information. However, it is unknown whether long-term exposure to PCE and related contaminants might be associated with ALS. This resident followed up with state and federal partners in early 2020 about the ALS and Paden City drinking water contamination concerns. ATSDR developed a technical assistance letter response back to the resident in April 2020 that included a preliminary comparison of Paden City PCE drinking water contamination levels against cancer and non-cancer screening values.

In February 2020, residents in the community organized a community health survey. The survey involved calling Paden City residents to gather information about what health issues residents experience, how long they have lived in Paden City, whether they drink the tap water and for how long, whether they use a filtration system, whether they use water for household uses, perceptions about safety, whether pets drink the water, and if their pets experience health issues.

Additional residents expressed concerns in an email to EPA in September 2021. ATSDR and EPA provided responses to each of these concerns, provided below:

What about the poison we have been drinking for over 20 years – for some it has been for their lifetime?

> Paden City's drinking water treatment system is currently treating the drinking water to meet state and federal standards. Under EPA's CERCLA authorities, at National Priorities List sites like Paden City, EPA identifies the extent of current environmental contamination and conducts long-term remedial response actions to

permanently and significantly reduce the dangers associated with releases of hazardous substances for the future.

There are many factors that contribute to whether contaminants with toxic properties will have harmful effects to the person who is exposed to them. These factors include concentration of the contaminant, frequency of exposure, and duration of exposure. Contaminants at Paden City Groundwater Site were generally below harmful concentrations. EPA and WV set their drinking water standards for PCE at 5 ppb; this value is protective of human health and the environment. This level can be used as a conservative target for cleanup and remedial actions. However, ATSDR's lowest health-based screening level is the CREG at 12 ppb. Several detections that were above EPA and WV maximum contaminant level (MCL) of 5 ppb were below ATSDR's health-based screening levels. These screening levels are even further below actual health effect levels observed in toxicological studies. As discussed within this document, besides one water sample in 2019, PCE levels in Paden City drinking water were below levels at which harmful health effects might occur. No PCE data are available before 2010. Band Box Cleaners operated from 1969 to 1997, which indicates the potential for groundwater impacts began after 1969 (EPA 2021).

What are the long-term effects of the chemical to the body?

PCE exposure has been related to nervous and ocular effects in occupationally exposed adults and to cancer (liver) in a rodent study (ATSDR 2019). However, attributing past exposures to observed effects in the body is very difficult and is not within the scope of public health assessment activities. The main focus of this document is the evaluation of the available environmental sampling information and the public health implications.

Exposure for longer periods to low levels of PCE might cause changes in mood, memory, attention, reaction time, and vision. Studies in animals exposed to PCE have shown liver and kidney effects, and changes in brain chemistry, but we do not know what these findings mean for humans. Studies in humans suggest that exposure to PCE might lead to a higher risk of getting bladder cancer, multiple myeloma, or non-Hodgkin's lymphoma. In animals, PCE has been shown to cause cancers of the liver, kidney, and blood system (ATSDR 2019). As with any chemical exposure, these potential health effects depend on the dose, the exposure duration, how you are exposed, personal traits and habits, and whether other chemicals are present. The levels of PCE in drinking water that Paden City residents were exposed to were below levels that would cause these harmful health effects.

Will all of our medical issues be addressed?

Personal medical care is not part of ATSDR's public health assessment process or the CERCLA (Superfund) site process. You should continue to receive care and advice about your specific medical issues with your family physician. Public health

professionals from ATSDR are available to speak with you privately about your individual situation and exposure history and discuss information you may wish to share with your physician, if you think that might be helpful.

Community members have brought up concerns with rates of cancer, kidney disease, and ALS. As discussed in the previous section, the data currently available indicate concentrations of PCE in drinking water and inhalation exposure pathways are not at levels associated with harmful noncancer (kidney or neurological) or cancer health effects. ATSDR will continue to assess new data as they are received for their health implications. In addition to site-related exposures, there are many other factors that can contribute to disease development. Some of these factors include occupational hazards, hobbies, other industry in the area, and genetics.

ATSDR also attended a Superfund workshop on September 27, 2022, at Paden City High School to meet with the community and hear their concerns, and to explain ATSDR's health assessment process. During this event, residents raised additional health concerns. Those concerns are summarized, with answers, below:

Does ATSDR plan on conducting a health study?

ATSDR is not planning on conducting a health study to collect biospecimens, canvass the community, or use data from a community health survey in a report. Based on the conclusions of this ATSDR health consultation, adverse health effects and increased cancer risks are not expected from exposures to the site-related contaminants. WVBPH collects data on reportable diseases, including cancer. Residents can request this information from their state health agency; ATSDR has already informed WVBPH of this request for cancer statistics in the affected Paden City community. ATSDR will continue to assess new environmental exposure data as it is received (i.e., drinking water and indoor air data). If new data are received that indicate exposures are of public health concern, ATSDR may make additional recommendations.

What about PCE breakdown products, such as TCE, benzene, and vinyl chloride?

Benzene is not a breakdown product of PCE and is not associated with dry cleaning activities. Although benzene is a common contaminant due to its use in gasoline, it was not detected in samples above health-based screening values. ATSDR assessed more than 50 targeted VOCs in soil and water, including PCE and its breakdown products (i.e., 1,2-dichloroethane, TCE, and vinyl chloride). Vinyl chloride was not detected in any sample that EPA collected. PCE, TCE, and 1,2-dichloroethane were assessed and were identified at levels above health-based screening levels. ATSDR determined that these breakdown products were present at levels below which harmful health effects would occur.

I tested my water and found heavy metals, such as arsenic, cadmium, and chromium. Are EPA and ATSDR addressing these contaminants?

EPA listed Paden City to the NPL for the PCE and associated contaminants from Band Box Cleaners that were found in the groundwater. Heavy metals are not associated with dry cleaning waste. Some metals are naturally occurring in groundwater due to local hydrogeology. However, these contaminants are not considered contaminants related to the EPA Superfund site. The Paden City Water Department is required to adhere to Safe Drinking Water Act (SDWA) standards, which includes monitoring heavy metals to be sure they comply with all regulatory MCLs. If the public water supply meets SDWA standards, exposures to metals, including those detected below SDWA standards in the drinking water, are not expected to result in harmful health effects. Arsenic, cadmium, and chromium are heavy metals regulated under the SDWA and meet those standards in the Paden City water supply.

Harmful health effects from exposures depend on many factors, including;

- the duration and frequency of exposures,
- the concentration and exposure route for which a person is exposed to the chemical,
- the toxicity of the chemical,
- and other factors related to the individual exposed (age, weight, underlying health conditions, etc.).

Exposure alone does not mean a health effect will develop.

Would an at-home pitcher filter remove contaminants from my water?

A point-of-use water filter system, such as an at-home filter pitcher, can reduce the levels of PCE, its associated contaminants, and any other VOCs from drinking water in the water supply. However, it is important to use these point-of-use water filters as recommended by the manufacturer. If you used a water filter before 2020, when the air stripper treatment system was installed, then levels of contaminants in your drinking water might have been reduced or eliminated. ATSDR cannot provide recommendations for the use of specific brands of water filtering devices.

What effects will the PCE plume have on the Paden City High School garden next to Band Box cleaners?

Environmental data at the school garden are not currently available for ATSDR assessment. Based on the site history and our preliminary understanding of the contamination released by Band Box Cleaners, surface soil contamination at the school is not expected. ATSDR will assess surface soil data for the site should it become available. Surface soil contamination is generally of most concern for exposure when using the ground for gardening. However, PCE and other volatile contaminants are not readily taken up into plants, including vegetables. Watering plants with contaminated water is not a concern because the water treatment system removes contaminants. Without additional information on the garden for

before the air stripper treatment installation, ATSDR cannot evaluate past exposures to contaminants within the garden. Any potential surface soil contamination on garden produce can be reduced or removed by cleaning vegetables and hands after harvesting and using other appropriate precautions.

Further, any ambient VOC vapors from the adjacent Band Box Cleaners would likely be diluted in outdoor air to levels below those of health concern. EPA plans additional environmental sampling of this area, and ATSDR will review any relevant data that become available, upon request.

VI. Conclusions

ATSDR assessed all potential exposure pathways for past and current exposures to determine conclusions for each completed pathway. Surface water and soil were eliminated from further assessment because those exposure pathways are incomplete (i.e., no exposures are occurring). Completed exposure pathways include past exposure to drinking water and household water and past and current exposures to indoor air from vapor intrusion. ATSDR also considered exposures to contaminants through outdoor air.

Drinking Water

ATSDR concludes that Paden City residents who ingested or used Paden City municipal water through June 2023 are unlikely to experience harmful health effects from the contaminants sampled in the drinking water, including PCE, trihalomethanes, haloacetic acids, and other VOCs. Although PCE and other VOCs were detected in multiple municipal wells and in untreated water, the air stripper water treatment system successfully removed these contaminants through June 2023. ATSDR cannot at this time provide a conclusion regarding exposures to drinking water between July 2023 and September 2023. Paden City Water Department continues to maintain and monitor the treatment system to ensure the effective removal of PCE. ATSDR does not expect past levels of contaminants in Paden City water to have resulted in harmful health effects. However, if the treatment system fails, such as the 2023 malfunction, or is taken offline, the uncontrolled release of contaminants could potentially expose residents to PCE at levels that require further evaluation to determine whether they could result in harmful health effects. ATSDR recommends intermittent monitoring of PCE in finished drinking water to confirm that the treatment system remains effective.

Vapor Intrusion and Ambient Air

ATSDR concludes that where sampling has occurred, residents are unlikely to experience harmful health effects from exposures to PCE in indoor air through vapor migration and intrusion. For indoor air exposure from soil vapor intrusion, PCE concentrations in currently occupied spaces were determined to be non-detect or below ATSDR's health-based screening values. However, the soil vapor intrusion assessment was limited in scope,

and ATSDR could not draw conclusions for exposure where indoor air data did not exist. Further, changes in occupancy, building use, building foundations and integrity due to aging, and seasonal variability require further evaluation. ATSDR recommends further PCE exposure evaluation of indoor air that might be affected by vapor intrusion if occupancy or building use changes at select locations, including at the Wissmach Glass facility, the Band Box cleaners building, and the former athletic complex. Future assessment of indoor air is recommended for structures located above the PCE contaminant plume (i.e., residential structures, schools, etc.) until PCE in the environment is removed to levels below vapor intrusion concern.

Although PCE and 1,2-DCA were detected in ambient air, maximum concentrations were well below health-based screening values for indoor air. ATSDR does not have screening values for outdoor air. Comparing outdoor air concentrations to indoor air screening values is a health-protective approach because the dynamic nature of outdoor air tends to dilute air contaminants.

VII. Limitations

This public health assessment document is subject to several limitations. First, EPA's preliminary vapor intrusion assessment was limited in scope. Environmental evaluations occurred in April 2020 and November 2020 and did not capture additional seasonal variation, including the winter and summer months. Conducting the assessment during the winter and summer months could show effects from the colder and hotter seasons on indoor air concentrations of vapors. This preliminary vapor intrusion assessment also was limited to two homes. Although EPA plans to capture seasonal variation and assess additional homes and other buildings close to the underground PCE plume, these data are not yet available. Lastly, ATSDR could not assess exposures to contaminants in surface soil, if any, because there is a lack of surface soil data available for assessment.

Conclusions within this evaluation are based only on intermittently collected data from the period between 2010 and 2021. Drinking water data collected during the 2023 air stripper failure are not included within this assessment. They will be evaluated in an addendum to this document when the validated data become available. Further, the data gap in historical data led ATSDR to extrapolate about past exposure based on maximum levels of PCE detected in treated drinking water. During these years, we do not know whether PCE was in drinking water at concentrations higher than the maximum detected nor how long PCE exposures might have occurred before 2010 but after Band Box Cleaners opened in 1969.

VIII. Recommendations

ATSDR recommends the following for environmental agencies, including EPA and WVDEP:

- Continue to monitor the PCE plume, including PCE degradation products, in Paden City. Based on information about the plume extent and underlying geology, additional sampling locations can be identified for vapor intrusion assessment,

including residential, sensitive receptor (i.e., schools), and commercial locations not previously evaluated. Additional monitoring for seasonal variability is also recommended at locations previously monitored, including at the Paden City High School. Environmental agencies may consider developing a long-term plan to monitor vapor intrusion or to preemptively install vapor mitigation systems in properties that have high levels of volatile contaminants in soil or groundwater.

- Consider offering residential and commercial vapor intrusion monitoring at locations not already evaluated, such as Wissmach Glass and other locations, to ensure that the PCE plume is not affecting additional buildings. This recommendation is particularly important if building use or occupancy changes since the time of this assessment.

- Develop a long-term monitoring plan to evaluate vapor intrusion in properties that have high levels of solvents in soil vapor or groundwater to address potential for vapors to migrate indoors. The plan should account for the plume's possibility to evolve over time.

- Perform sub-slab soil gas and outdoor air sampling and indoor sampling to assist with identifying background sources (EPA 2020b, 2020c)

- Measure indicators, tracers, and surrogates to assist with identifying whether vapor intrusion conditions were active or dormant during sampling (EPA 2020b, 2020c).

- Periodically resample indoor air at Paden City High School, and other structures above the PCE plume, to confirm that structural changes to the building slab and foundation as they age have not resulted in increased PCE vapor intrusion.

ATSDR recommends the following for Paden City:

- Continue to operate the air stripper water treatment system to remove PCE from finished drinking water.

- Consider developing emergency contingency plans to provide uncontaminated water to consumers if the treatment system malfunctions.

- Continue routine testing of finished drinking water to ensure effectiveness of the treatment system. Share testing results in routine customer water quality reports. If water monitoring shows an increase in PCE concentration, take appropriate action to remove PCE and provide alternative water supplies to residents when levels exceed health-based screening values.

- For properties that had high PCE levels in soil vapor or groundwater but were unoccupied at the time of assessment, consider further evaluation before commercial or residential use in the future. Should the current use status change

for any of these buildings, particularly the athletic complex and the former Band Box Cleaners property, further indoor air evaluation is recommended to ensure that levels of PCE would not cause harmful health effects to building occupants.

ATSDR recommends the following for residents:

- Persons who live at Residence 1 should avoid creating modifications to the home's foundation to maintain a structural barrier to vapor intrusion.
- Persons who live at Residence 2 may consider addressing indoor sources of solvents.
- Allow EPA access to their homes and other structures to conduct sampling and further characterize the PCE plume.
- Maintain the integrity of home and building foundations to avoid creating cracks that allow vapor intrusion. Residents may consider additional means of reducing their PCE exposure (see: https://www.atsdr.cdc.gov/toxfaqs/tfacts18.pdf).
- For properties that had high PCE levels in soil vapor or groundwater but were unoccupied at the time of assessment, ATSDR recommends further evaluation before currently vacant commercial or residential spaces are occupied in the future. Should the current use status change for any of these buildings, particularly the athletic complex and the former Band Box Cleaners property, further evaluation is recommended to ensure that levels of PCE would not cause harmful health effects to building occupants.

IX. Next Steps

Upon request, ATSDR will continue to provide technical assistance to EPA and WV DEP during the ongoing site investigations. ATSDR will evaluate additional data collected by environmental agencies during the 2023 the treatment system malfunction to determine the public health significance of the data, which will be reported in an addendum to this document. ATSDR will provide updated conclusions, recommendations, and proposed future actions, as applicable, within the addendum. ATSDR will coordinate and attend future public meetings and present the findings of this document to the community. ATSDR will remain available to discuss community health concerns upon request.

X. Preparers of the Report

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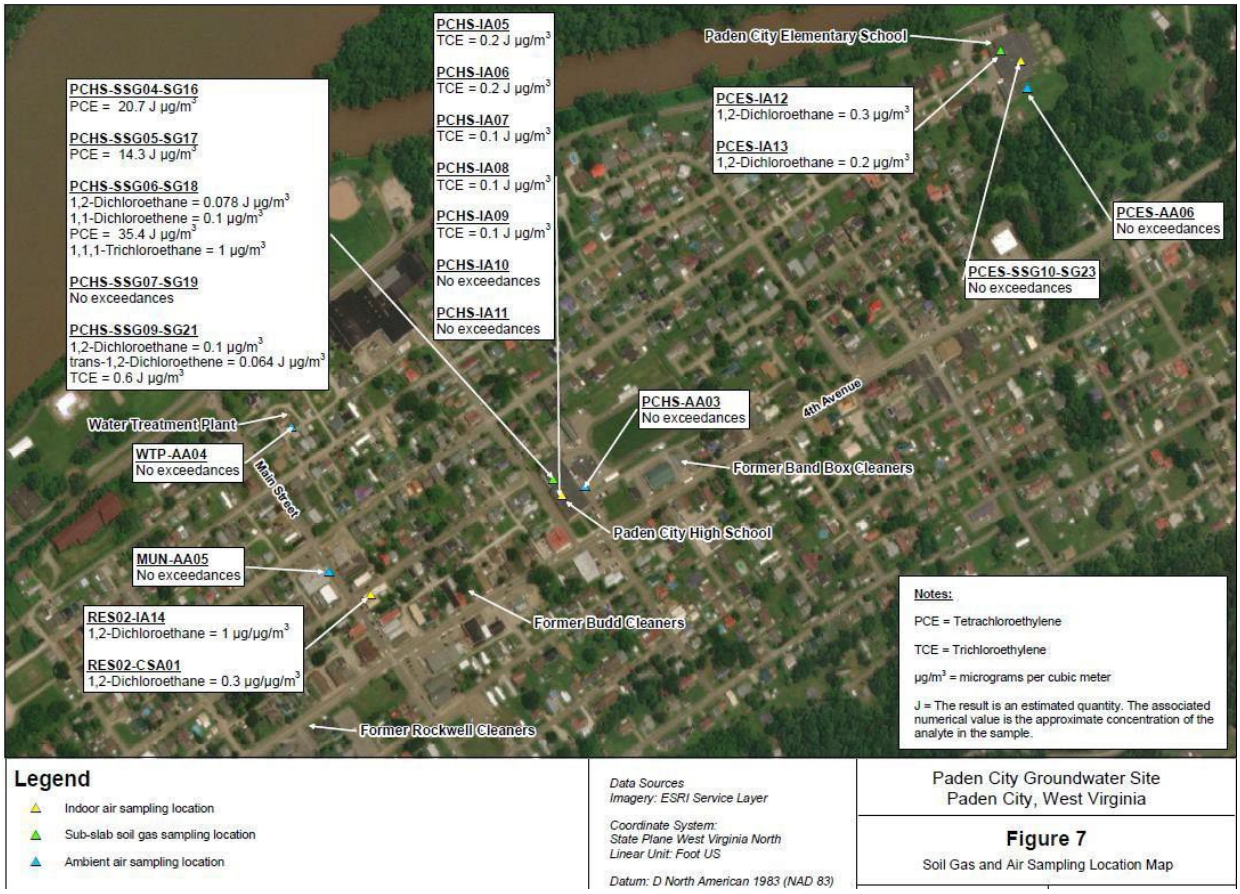
Appendices

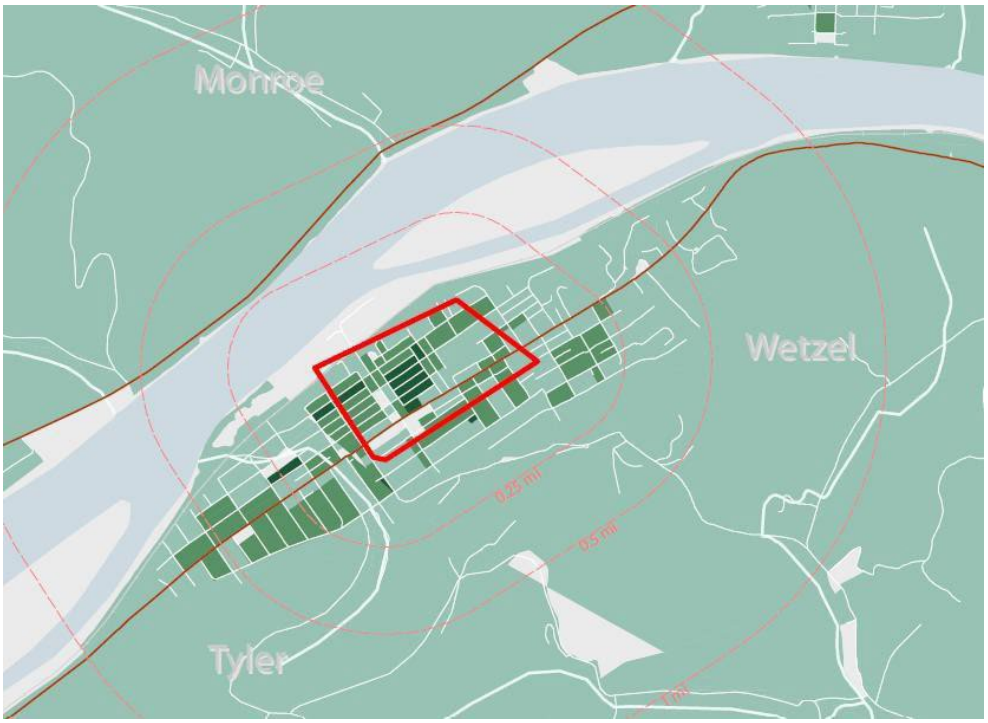
XII. Appendix A. Maps

Map 1. 2021 Vapor Intrusion Assessment Locations



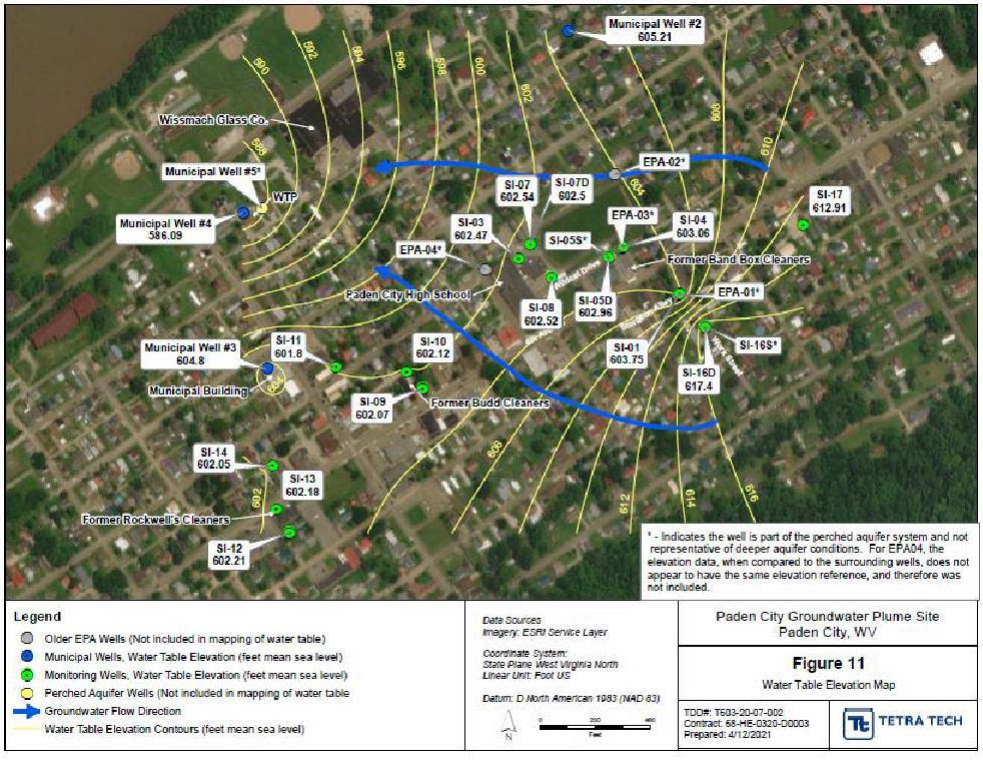
Source: EPA 2021

Map 2. Paden City Site Investigation Area with 1-Mile Buffer



Source: CDC GRASP 2021

Map 3. Paden City PCE Plume Groundwater Flow Map



Source: EPA 2021

Appendix B. Screening Tables

Table 1. Screening Summary for Sub-slab Soil Gas PCE Vapor Intrusion

Location	Date of Analysis	Type of Building	Current Occupancy	Maximum Sub-slab or Soil Gas Value (ppb)	Type of Measurement	Soil Vapor Intrusion CV* (ppb)
Band Box Cleaners	Nov 2018	Commercial	Unoccupied	43,700§	PID screen†	19
Residence 1	April 2020	Residential	Occupied	35§	PID screen	19
Former athletic complex	April 2020	School	Unoccupied	339§	PID screen†	19
Paden City High School	Nov 2020	School	Occupied	5.22‡	Sub-slab soil vapor	19

Abbreviations: CV = comparison value; PID = photoionization detector; ppb = parts per billion; VOC = volatile organic compound.
* CV source = cancer risk evaluation guide.
† PID screen includes all VOCs.
‡ estimated concentration.
§= maximum detected value higher than recommended CV.
Sub-slab vapor/air was evaluated for other VOCs, but none were detected above screening values.

Table 2. Screening Summary for Non-residential PCE Vapor Intrusion from Groundwater, 2018-2020

Location	Property Description	Date of Sample	Groundwater Maximum (µg/L)	Soil Vapor Intrusion Screening Value – Groundwater (µg/L)	CV Source
EPA Monitoring Well 3	Northeast corner of former Band Box Cleaners property	Dec. 2018	4,700*	5.3	CREG
Wissmach Glass	Commercial property	Dec. 2018	12*	5.3	CREG
SI-05D	Northeast corner of former Band Box Cleaners property	June 2020	6,100*	5.3	CREG
SI-05D	Northeast corner of former Band Box Cleaners property	Oct. 2020	6,700*	5.3	CREG
SI-07D	Paden City High School	Oct. 2020	420*	5.3	CREG
SI-08	Paden City High School	June 2020	2,100*	5.3	CREG
SI-08	Paden City High School	Oct. 2020	2,000*	5.3	CREG

Abbreviations: CREG = cancer risk evaluation guide; CV = comparison value; µg/L = micrograms per liter.
* = maximum detected value higher than recommended CV.

Table 3. Screening Summary for Non-residential TCE Vapor Intrusion from Groundwater, 2018–2020

Location	Property Description	Date of Sample	Groundwater Maximum (µg/L)	Soil Vapor Intrusion Screening Value – Groundwater (µg/L)	CV Source
SI-05D	Northeast corner of former Band Box Cleaners property	June 2020	4.7*	0.52	CREG
SI-05D	Northeast corner of former Band Box Cleaners property	Oct. 2020	6*	0.52	CREG
SI-07D	Paden City High School	Oct. 2020	0.78*	0.52	CREG
SI-08	Paden City High School	June 2020	0.66*	0.52	CREG
SI-08	Paden City High School	Oct. 2020	0.65* U	0.52	CREG

Abbreviations: CREG = cancer risk evaluation guide; CV = comparison value; µg/L = micrograms per liter.
***** = maximum detected value higher than recommended CV.
U = analyte was analyzed for, but not detected above the reported sample quantification limit. The associated value is the quantification limit or the estimated detection limit for TCE.