Health Consultation

EAST TROY CONTAMINATED AQUIFER SITE
(VAPOR INTRUSION)

TROY, MIAMI COUNTY, OHIO

EPA FACILITY ID: OHN000510096

JULY 29, 2008

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service
Agency for Toxic Substances and Disease Registry
Division of Health Assessment and Consultation
Atlanta, Georgia 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, 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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HEALTH CONSULTATION

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Prepared By:
Ohio Department of Health
Under Cooperative Agreement with the
The U.S. Department of Health and Human Services
Agency for Toxic Substances and Disease Registry

STATEMENT OF ISSUES

In June 2006, the Health Assessment Section (HAS) of the Ohio Department of Health (ODH) was asked by U.S. EPA Emergency Response Branch staff to participate in a multi-agency response team to evaluate the potential health impacts to the community posed by the detection of elevated levels of tetrachloroethylene (also known as perchloroethylene or PCE) in shallow groundwater underlying residential and commercial properties within the city limits of Troy, Ohio. The results of an environmental study funded by the city of Troy indicated the presence of PCE in indoor air samples collected from several public buildings, including the Troy police station, a church, and a school. Ohio EPA requested U.S. EPA assistance to carry out a Time-Critical Removal Action in the neighborhood to address these concerns.

The U.S. EPA On-Scene Coordinator requested HAS assistance in establishing indoor air “action levels” for PCE and to evaluate the public health threat posed by these contaminants to area residents. In a letter (Appendix A), dated September 11, 2006, the Agency for Toxic Substances and Disease Registry (ATSDR) and HAS recommended to the U.S. EPA health-based screening levels for residential and non-residential buildings for PCE and proposed that interim measures be taken at those properties that exceeded the screening criteria to disrupt or eliminate the vapor intrusion pathway.

BACKGROUND

Site Location and Description

The East Troy Contaminated Aquifer (ETCA) Site consists of a 24-block portion of the city of Troy, located adjacent to the downtown portion of the city east of Market Street, south of the Great Miami River, west of Williams Street, and north of Race Street (Figure 1). The area of concern includes urban-density residential neighborhoods with primarily single-family homes and a mix of commercial and industrial properties. A majority of homes in the area are in excess of 70-years old and consist of multi-story houses; most with concrete-floored basements. Industrial facilities (Hobart Cabinet, Spinnaker Products) occur to the north along Water Street, adjacent to the Great Miami River. Commercial properties are located primarily to the west towards Market Street and downtown Troy. Two churches, three schools, and police station are also within the area impacted by the VOC plume.

The 2000 Census data indicate that about 1,263 people reside within the area of concern. A total of 548 housing units fall within the area of concern, according to demographic statistics (Figure 1).

Area Geology and Hydrogeology

The area of concern is located on the level floodplain of Great Miami River. Groundwater-bearing sands, gravels, and clays fill a buried bedrock valley under the city to depths in excess of 140 ft. Groundwater from these floodplain sand and gravel deposits serves as the primary source of drinking water for the city and its residents. City public water supply wells are located on the north side of the Great Miami River, within a 1,000 ft of the impacted area. City water wells draw groundwater from sand and gravel at depths of between 80 and 125 ft below the ground surface. Individual water wells can pump up to 2,100 gallons of water per minute (ODNR well logs, 2007). All of the residents in the area of concern get their drinking water from the city of Troy public water supply (city of Troy, pers. comm. 2006). Site-related contaminants have not been detected in the city of Troy production wells or the public water supply. Groundwater flow in the area is naturally to the southeast, following the course of river. However, groundwater pumping by the city's water wells and high-yield industrial production wells in the area may alter groundwater flow locally, pulling the groundwater towards the individual wells and the well field.

In the vicinity of the city of Troy well field, the depth to the groundwater surface is only 11 to 15 ft below the ground surface (ODNR well logs, 2007). Ohio EPA (pers. comm., 2006) indicated that water table in the vicinity of Franklin and Clay Streets on the south side of the Great Miami River was between 15 and 17 ft below the ground surface. The intervening soils usually consists of a thin layer of topsoil (less than 2 ft thick) and a clay layer of variable thickness (0 -12 ft thick) followed by highly porous and permeable sand and gravel down to the water table (ODNR well logs, 2007). The floors of most basements in area homes appear to penetrate the upper clay layer and extend into the underlying sand and gravel layer.

Ohio EPA Groundwater Investigation

The Ohio EPA conducted groundwater monitoring in 2002, 2003 and 2004 to determine if groundwater contaminants posed a threat to water quality in the well field. Groundwater sample results indicated that the aquifer was contaminated with PCE (Figure 2). PCE concentrations were greater than 800 parts per billion (ppb) in a plume area along Franklin Street and greater than 40 ppb in a plume area along Water Street.

In 2006, the Ohio EPA completed soil-gas and monitoring well sampling along Franklin and Main Streets on the city's east side. PCE levels were found to be as high as 801 ppb in groundwater and as high as 58 ppb in soil-gas in residential yards along Franklin Street (Figure 3).

Ohio EPA requested U.S. EPA assistance in conducting an assessment of the East Troy plume site to determine the extent of vapor intrusion under the neighborhood and, as part of a Time-Critical Removal Action, to mitigate impacted homes, schools and businesses.

U.S. EPA Soil Gas/Indoor Air Investigation

From July through September 2006, as part of the Time-Critical Removal Action, U.S. EPA collected sub-slab and indoor air samples from the east Troy residential area near Franklin Street in order to determine the extent of vapor intrusion on area homes, schools and businesses. Vapor intrusion is the migration of vapor phase volatile chemicals such as PCE from contaminated ground water to subsurface soils and into indoor air spaces of overlying buildings. A total of 19 locations were sampled, including 14 residential locations, 3 schools, a church, and the City of Troy Police Station.

Along with representatives of the U.S. EPA and the Ohio EPA, HAS staff met individually with residents and representatives of St. Patrick's Church and Troy City Schools to discuss their sub-slab and indoor air sampling results at Troy City Center on August 24, 2006. HAS presented information on the toxicology of PCE and answered health-related questions.

HAS participated in a public meeting hosted by the U.S. EPA on October 25, 2006 at the Van Cleve School. The U.S. EPA updated residents on its investigation of chemical pollution underneath sections of Troy, Ohio and offered free sampling to the residents of the neighborhood. HAS presented information on PCE, the chemical of concern, and its toxicology and answered health-related questions from the audience. Further expanding the Phase 2 investigation, the U.S. EPA sent letters to 400 residents in December 2006, asking for access to conduct sub-slab and indoor air sampling. About 60 more residents, or about 15% of the total, agreed to allow access for the sub-slab and indoor air sampling. It must be emphasized that participation is dependent upon the owner, who can consent or deny access to the residence. As part of the investigation, the U.S. EPA required a signed access agreement to enter a residence and collect samples.

From July 2006 through April 2007, U.S. EPA collected sub-slab and indoor air samples from a total of 85 locations, which included 78 residences, 2 churches, 4 schools and the Troy Police Station during Phase 1 and Phase 2 air sampling activities. All owners of properties with elevated indoor air levels (16 residential locations and one elementary school - Table 1 and Figure 4) were contacted with regard to their results. HAS attended several meetings with impacted residents conducted by the U.S. EPA in February 2007 and May 2007 to explain sample results, health issues, and the installation of the proposed vapor abatement systems.

U.S. EPA Removal Action

The U.S. EPA, HAS and Ohio EPA met with 16 property owners and school representatives on May 31, 2007 with a plan for a vapor abatement system (VAS) to be designed and installed at each location. HAS staff were available to answer health questions from owners. Property owners and school representatives signed an agreement with U.S. EPA for VAS installation.

Vapor abatement systems were installed at 16 residences in June-July 2007, and a multi-unit vapor abatement system was installed in the St. Patrick's school July 9-17, 2007. The school's system went into operation July 17 and following consultations with HAS, 10-day confirmation samples were collected for the sub-slab gas and indoor air in the school on July 25, 2007. Preliminary results from the confirmation sampling were received by HAS on July 31, 2007 and indicated that the system was working. Results indicated that sub-slab levels of PCE had been reduced from 230 ppb to 2.3 ppb. Indoor air levels for the solvents PCE and trichloroethylene (TCE) were at undetectable levels. School was scheduled to start back up by the middle of the month. HAS provided the school staff with a draft letter they could use to communicate the results of the system operation to parents prior to the start of the school year. HAS staff participated in a meeting Friday August 3, 2007 between U.S. EPA, its contractors, and representatives of the St. Patrick's advisory board to discuss the results of the installation and subsequent operation of the vapor abatement system in the St. Patrick Elementary School.

Most of the impacted residences showed reductions in PCE and TCE after installation of the vapor abatement systems; however, six of the residences still exceeded HAS/ATSDR screening levels, as shown in Table 1. The contractor added dampers to draw basement air for some residences and increased fan size in others in order to reach screening level requirements. One of these homes had holes in the floor and a sub-slab sample had not been taken. Additional system upgrades were required for four residences in October 2007 and again in January and February 2008. All 16 residences were in compliance (no indoor air exceedances of ATSDR/HAS screening levels) by April 2008. The indoor air quality at the St. Patrick School has remained in compliance since July 2007 (U.S. EPA 2008).

On September 19, 2007, the U.S. EPA proposed the East Troy Contaminated Aquifer site for addition to the Superfund National Priorities List.

DISCUSSION

Potential Exposure Pathways

For the public to be exposed to elevated levels of chemical contaminants in and around the Troy site they must first come into contact with the contaminated groundwater, soils or air. To come into contact with the contaminated media there must be a completed exposure pathway. A completed exposure pathway consists of five main parts, which must be present for a chemical exposure to occur.

A **completed exposure pathway** consists of five main parts:

1. **A source of contamination**;
2. **Environmental transport**, which is a way for the chemical to move away from its source (soil, air, groundwater, surface water);
3. **A point of exposure**, which is a place where people come into physical contact with the chemical (on-site, off-site);
4. **A route of exposure**, which is how people come into physical contact with the chemical (breathing, drinking, eating, touching); and
5. **People who could be exposed**, which are people likely to come into physical contact with site-related chemicals.

Physical contact with a chemical contaminant does not necessarily result in adverse health effects. A chemical's ability to affect a resident's health is also controlled by a number of factors including:

- How much of the chemical a person is exposed to (dose).
- How long a person is exposed to the chemical (duration).
- How often a person is exposed to the chemical (frequency).
- The toxicity of the chemical of concern (how a chemical affects the body).

Other factors affecting a chemical's likelihood of causing adverse health effects upon contact include the resident's:

1. Past exposure
2. Smoking, drinking alcohol, or taking certain medications
3. Current health status, sensitivity to certain substances
4. Age
5. Family medical history

Vapor Intrusion Pathway

PCE and TCE are volatile organic compounds (VOCs). VOCs are chemicals that can vaporize from contaminated groundwater or soil and migrate as a gas to the indoor environment of nearby buildings (see Vapor Intrusion Fact Sheet).

Factors that favor the transport of these chemicals at the Troy site include elevated concentrations of PCE in groundwater and elevated levels of PCE in soil gas underlying residential and commercial portions of the city of Troy; shallow depth to the groundwater table; and intervening porous and permeable soils that readily facilitate movement of vapor-phase solvent up from underlying groundwater.

Chemicals of Concern

The primary contaminant of concern at the Troy site is tetrachloroethylene, also known as perchloroethylene (PCE). Another contaminant at the site is another chlorinated solvent – trichloroethylene (TCE). PCE, the primary contaminant of concern at the Troy site, was found in the groundwater and soil gas. Additional sampling showed PCE detected in sub-slab and indoor air samples, indicating a completed exposure pathway.

Exposure Evaluation

Access to 85 locations provided the collection by U.S. EPA of sub-slab and indoor air samples at 78 homes, 2 churches and 4 schools and the Troy Police Station (U.S. EPA 2008). Table 1 shows the data for those properties that exceeded recommended screening levels and were selected for the installation of vapor abatement systems. Figure 4 shows the U.S. EPA indoor air sampling locations at the Troy plume site and marks those locations with PCE or TCE concentrations that were above long-term screening levels.

It is unknown how long the contamination has existed under the impacted neighborhood or whether or not residents were being exposed to these chemicals in the past by the vapor intrusion pathway. The source(s) of contamination are currently unknown. The aquifer was confirmed to be contaminated based on a report completed in 2002. Elevated levels of PCE were indicated in the soil gas in the residential area in 2006.

Health Evaluation

Tetrachloroethylene (PCE)

Discussion

Tetrachloroethylene (also known as perchloroethylene, PCE or PERC) is a nonflammable liquid at room temperature and was widely used for dry cleaning of fabrics and for metal degreasing. Other major uses of PCE were as a solvent in some consumer products and as a building block to make other chemicals. It evaporates easily into the air and has a sharp, sweet-smelling odor. At levels in excess of 1 part PCE per million parts of air (1 ppm or 1000 ppb), PCE can be detected by most people. Much of the PCE that gets into surface water and soil evaporates into the air. In the air, it is broken down by sunlight into other chemicals or brought back to the soil and water by rain. Because PCE can travel through soils quite easily, it can make its way into underground water, where it may remain for a long time. Under oxygen-poor conditions and with time, bacteria will break down some of the PCE that is in soil and groundwater, leading to the formation of breakdown products, including 1,2-dichloroethylene and vinyl chloride.

There does not appear to be any evidence of either breakdown product in the groundwater in the area of concern in Troy, although some dichloroethylene was found at the edge of the plume in monitoring wells at the outer perimeter of the city well field, which is located across the Great Miami River to the north of the plume areas.

There are three ways that people are typically exposed to PCE; 1) from occupational sources, 2) from consumer products, and 3) from environmental sources. PCE in the environment is found most frequently in the air and less often in drinking water. It does not appear to bioaccumulate in fish or other animals that live in water (see Fact Sheet for PCE).

Acute Effects

PCE has been used safely as a general surgical anesthetic agent at concentrations high enough to cause a loss of consciousness. Single exposures in air at high concentrations (greater than 100,000 ppb in air) can cause dizziness, headache, sleepiness, confusion, nausea, difficulty in speaking and walking, unconsciousness, and death. Skin irritation may result from repeated or prolonged exposure to this chemical. High exposures have occurred in work or hobby environments where there have been accidental exposures to concentrated PCE. Elevated exposures have also occurred from intentional chemical abuse to get “high.” Animal studies, with exposures to high concentrations of PCE, have concluded that such exposures may cause liver and kidney damage and cancers. The relevance of these animal studies to humans however, is unclear (ATSDR, 1997).

For the workplace, OSHA has set an occupational exposure limit of 100,000 ppb in air for an 8-hour day. ATSDR has established 200 ppb as a Minimal Risk Level (MRL), based on protection from neurological effects associated with acute (short-term) exposure to PCE. A MRL is an estimate of daily human exposure to a substance that is not expected to cause non-cancer health effects during a specified duration of exposure.

PCE concentrations in East Troy homes, schools and businesses do not pose a short-term health threat to the residents. The levels of PCE detected in the indoor air of the basements of Troy are in the low ppb range (up to 22 ppb PCE) and no non-cancer health effects are expected.

Chronic Effects (Noncancer)
Animal studies have reported effects on the liver, kidney, and CNS from chronic inhalation exposure to PCE. ATSDR has calculated a chronic-duration inhalation minimal risk level (MRL) of 40 ppb for PCE based on neurological effects in humans. The MRL is an estimate of the daily human exposure to a hazardous substance that is likely to be without appreciable risk of adverse noncancer health effects over a specified duration of exposure.

The levels of PCE detected in the indoor air of the basements of Troy are in the low ppb range (up to 22 ppb PCE) and are below the chronic MRL (40 ppb).

Cancer Risk
PCE's classification as a human carcinogen is under review by the U.S. EPA. Although exposure to PCE has not been directly shown to cause cancer in humans, the U.S. Department of Health and Human Services has determined that PCE may reasonably be anticipated to be a carcinogen (National Toxicology Program, 2005). The International Agency for Research on Cancer (IARC) has classified PCE as a Group 2A carcinogen (IARC, 1995); probably carcinogenic to humans (limited human evidence, sufficient evidence in animals).

PCE tends to be retained in the body for a longer period of time than TCE, having the ability to accumulate to a limited extent in fatty tissues (NIOSH, 1976; 1978). Several studies of workers at dry-cleaning businesses have suggested associations between the development of elevated occurrence of urinary tract, kidney, and cervical cancers and chronic exposures to high levels (parts per million range) of PCE and other dry-cleaning chemicals in the air at their places of work (Katz and Jowett, 1981; Brown and Kaplan, 1987). These studies were confounded by the presence of carbon tetrachloride, TCE, and several petroleum-based solvents, in addition to PCE, in these indoor air environments.

The Woburn, Massachusetts study (Lagako et al., 1984), the New Jersey study (Fagliano et al., 1990), and ATSDR studies of PCE and TCE contaminated water supplies at the Camp Lejuene Marine base (ATSDR, 2003) have associated exposure to these chemicals through ingestion of contaminated water with increased levels of leukemia in specific populations within these communities.

Thirteen Troy residences and one elementary school had indoor air levels of PCE exceeding the 1.2 ppb screening level.

ODH and ATSDR recommended a long-term screening level of 1.2 ppb for PCE, based on a calculated 10^{-5} cancer risk. Of the residences and public buildings tested, 13 homes and one school (St. Patrick School) had exceeded this value and were recommended for sub-slab vapor abatement systems.

Estimated theoretical cancer risks for those exposed to PCE through vapor intrusion at the East Troy site were based on EPA's inhalation unit risk factor of 3×10^{-6} per microgram per cubic meter (µg/m^3) for PCE obtained from the U.S. EPA OSWER Vapor Intrusion Guidance Appendix D Table D-1. The inhalation unit risk represents the increase in the lifetime cancer risk of an individual who is exposed to 1 µg/m^3 PCE (0.15 ppb) in air. The calculated theoretical cancer risk is based on a hypothetical residential exposure scenario that assumes an inhalation rate of 20 m^3/day, an adult body weight of 70 kg, and an exposure of 24 hours a day, 350 days/year for 30 years.

Theoretical cancer risk can be defined as the number of additional cases of cancer in a population, usually written as a negative power of 10. For example, one additional case of cancer per one hundred thousand individuals is written as 1×10^{-5}.

Based on these assumptions, the theoretical cancer risk due to exposure to PCE in indoor air in the home with the highest level of PCE (22 ppb = 150 µg/m^3) can be calculated to be 2×10^{-4} or 2 in 10,000. The home with the lowest PCE concentration that was recommended for the installation of a vapor abatement system had an estimated theoretical cancer risk of 1×10^{-5} or 1 in 100,000. The true risk is likely to be far less, considering that most people do not live in their basements and that exposure would be intermittent.

Trichloroethylene (TCE)

Discussion

The primary use of trichloroethylene has been the degreasing of metal parts and its use has been closely associated with the automotive and metal-fabricating industries from the 1950's through the 1970's. It is an excellent solvent for removing greases, oils, fats, waxes, and tars. As a solvent it was used alone or blended with other solvents, such as PCE. These solvents were also added to adhesives, lubricants, paints, varnishes, paint strippers, pesticides, and cold metal cleaners. When in surface soils, TCE will form a gas faster than many other volatile organic compounds. It has been shown that the majority of the TCE spilled on top of soils will vaporize into the air. When TCE is released into the air, it reacts relatively quickly with other chemicals with about half of it breaking down to simple chemical compounds in about a week. TCE sorption to soil is largely dependent on the organic carbon content of the soil, as soils with a higher organic carbon content tend to more effectively adsorb the TCE. TCE is known to be only slightly soluble in water, but there is ample evidence that dissolved TCE remains in groundwater for a long time. Studies show that TCE in water will rapidly form a gas when it comes into contact with air. In a sand and gravel aquifer, TCE in the groundwater would rapidly vaporize into the air spaces between soil grains. Studies indicate that it would then disperse by two primary routes; first, diffusion through the soil air spaces and then be re-adsorbed by groundwater or infiltrating rainwater, or second, it would migrate to the surface and be released to the atmosphere. The primary means of degradation of trichloroethylene in groundwater is by bacteria, but the breakdown product by this means is vinyl chloride, a known human carcinogen that potentially can be more of a health concern than TCE (Vogel and McCarty, 1985).

Acute Effects

Breathing large amounts of TCE may cause impaired heart function, unconsciousness, and death. Breathing it for long periods may cause nerve, kidney, and liver damage. Breathing small amounts of TCE may cause headaches, lung irritation, dizziness, poor coordination, and difficulty concentrating. OSHA has set an occupational limit of 100,000 ppb for TCE for an 8-hour workday, 40-hour workweek. ATSDR has established a 2000 ppb acute MRL for TCE. The levels of TCE (up to 1.3 ppb TCE) detected in the indoor air of the basements of Troy do not pose a short-term health threat to the residents.

Chronic Effects (Noncancer)

ATSDR does not have a chronic-duration inhalation minimal risk level for TCE; however, ATSDR has established a 100 ppb MRL based on protection from neurological effects to intermediate exposure (15-365 days) to TCE. The intermediate ATSDR value of 100 ppb has been used by HAS as a "short term action level" that would trigger immediate action to reduce exposure levels in homes affected by vapor intrusion. The indoor air levels of TCE detected in Troy were in the low ppb range (up to 1.3 ppb TCE); no noncancer adverse health effects are expected.

Cancer Risk

TCE was most recently classified by the U.S. EPA as a B2 carcinogen – a probable human cancer-causing agent. However, the cancer classification of TCE has been withdrawn and is currently under review by U.S. EPA. IARC has classified TCE as: *probably carcinogenic to humans (Group 2A).*

Occupational exposure to TCE, based on the analysis of seven studies, was associated with excess incidences of liver cancer, kidney cancer, non-Hodgkin's lymphoma, prostate cancer and multiple myeloma, with the strongest evidence for the first three cancers (NTP 2005). Agreement between animal and human studies supports the conclusion that TCE is a potential kidney carcinogen. High doses are needed to induce liver toxicity and cancer in animals; however differences in the mode of action of the major metabolites in humans suggest that humans would be less susceptible to liver cancer (NAS 2006).

The health effects from drinking and inhaling low levels of TCE over long periods of time remain poorly-documented and controversial (ATSDR, 1997B).

A study of residents in Woburn, Massachusetts associated excessive cases of acute lymphocytic leukemia in children with their mothers' exposure to elevated levels of TCE (183 – 267 ppb) in a public drinking water well over a course of 5 to 10 years (Lagako et al., 1984). The impacted well also contained low levels (<50 ppb) of PCE, 1,2-DCE, and chloroform. Statistically significant excess leukemia cases in females were associated with residents exposed to TCE and other chemicals in their drinking water supply in New

Jersey (Fagliano et al., 1990). A health study conducted by ATSDR (2003) of birth defects and childhood leukemia in children born to parents stationed at Camp Lejeune Marine base between 1975 and 1988 linked an increased incidence of these adverse health effects to the parents' exposure to high levels of TCE (up to 1,400 ppb), PCE (up to 407 ppb), and 1,2-DCE (up to 215 ppb) in the base public drinking water supply (ATSDR, 2003). Further investigations of the Camp Lejuene exposures are being carried out by ATSDR.

In contrast, consecutive surveys of self-reported health effects from over 4,000 residents at 15 sites in five states exposed to TCE through their drinking water supplies (of levels of 3 to 24,000 ppb) for varying periods of time (7-20 years) failed to link these exposures with the development of excess cancer cases. Non-cancer health effects tentatively linked to these exposures included an increased incidence of strokes, increased incidence of diabetes, some increased incidence in liver and kidney disease, and urinary tract disorders (ATSDR, 1999).

Three Troy residences and the elementary school had indoor air levels of TCE exceeding the 0.4 ppb screening level.

> ODH and ATSDR recommended a long-term screening level of 0.4 ppb for TCE in indoor air, based on a calculated theoretical cancer risk of 1 in 10,000 (10^{-4}). Three homes and the St. Patrick School in Troy, Ohio exceeded the long-term screening level for TCE and were recommended for sub-slab mitigation systems.

Estimated theoretical cancer risks for those exposed to TCE through vapor intrusion at the East Troy site were based on EPA's inhalation unit risk factor of 1.1×10^{-4} per $\mu g/m^3$ ($1\ \mu g/m^3 = 0.19$ ppb) for TCE. The cancer risk due to exposure to TCE in indoor air in the home with the highest level of TCE ($1.0\ ppb = 5.4\ \mu g/m^3$) can be calculated to be 2×10^{-4} or 2 in 10,000. The home with the lowest TCE concentration that was recommended for the installation of a vapor abatement system had an estimated theoretical cancer risk of 1×10^{-4} or 1 in 10,000.

<u>Mixture Assessment</u>

Exposures to mixtures of both tetrachloroethylene and trichloroethylene are likely to be additive in nature in producing nervous system effects or noncancer and cancer kidney or liver effects (ATSDR Interaction Profile 2004). However, TCE was not detected in most residences in Troy where PCE was the major contaminant of concern.

Long-Term Health-Based Guidelines

In a letter dated September 11, 2006 to the U.S. EPA, ATSDR and ODH recommended 1.2 ppb as a screening level for residential indoor air for PCE. The 1.2 ppb screening level would apply to homes and schools. For building spaces that are not used for residences or where children are not continuously present, such as churches, commercial businesses and public buildings; then the recommended screening level for PCE for indoor air was 5 ppb. The levels for PCE were derived from target concentrations listed in the U.S. EPA “OSWER Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils (Subsurface Vapor Intrusion Guidance), 2002,” based on a calculated 10^{-5} theoretical cancer risk.

A long-term screening level of 0.4 ppb was applied for TCE for indoor air for residences and 1.7 ppb for commercial buildings, based on a calculated 10^{-4} theoretical cancer risk. The levels for TCE were also derived from target concentrations listed in the U.S. EPA 2002 OSWER Draft Vapor Intrusion Guidance. These target indoor air concentrations are based on an adult residential exposure scenario that assumes exposure of an individual for 24 hours per day for 350 days per year over a period of 30 or more years.

Child Health Issues

Children can be at a greater risk of developing illness due to exposure to hazardous chemicals because of their smaller stature and developing body systems. Children are likely to breathe more air and consume more food and water per body weight than are adults. Children are also likely to have more opportunity to come into contact with environmental pollutants due to being closer to the ground surface and taking part in activities on the ground such as, crawling, sitting, and lying down on the ground.

Children’s exposures and public health implications were considered in this evaluation. As a result of remedial activities with special regard to children’s exposures, a vapor extraction system was installed at the St. Patrick Elementary School. The 90-day performance sampling was conducted on November 23, 2007, and the sample results were “not detected” at detection limits below the PCE and TCE screening levels.

CONCLUSIONS

Based on environmental information for the East Troy Contaminated Aquifer Site and the extent of vapor intrusion into residences and the school, ODH HAS concluded that the site poses a ***public health hazard***. Although no adverse noncancer health effects are expected, there may be a slight increased theoretical cancer risk due to exposure to PCE and/or TCE, which are probable human carcinogens. The source(s) of the VOCs have not been identified or removed, additional homes may be affected by vapor intrusion, the contamination may migrate to the city’s water supply, and the site has been proposed to the National Priorities List. Conclusions for site conditions over time are as follows:

- The East Troy Contaminated Aquifer Site poses a ***public health hazard*** for exposure of nearby residents to contamination by vapor intrusion *at the present*. A completed exposure pathway has been established, and several residential and school locations exceeded the long-term screening levels for PCE and/or TCE. The U.S. EPA has taken actions that will vent the volatile organic compounds from below the structure slab to above the roof line at these 17 locations so that vapor phase solvents pose no apparent public health hazard for these locations. However, less than 15% of the homes in the area of concern have been sampled, and it is likely that other homes in this area could be above the screening levels as well.

- The East Troy Contaminated Aquifer Site posed an ***indeterminate public health hazard*** for exposure of nearby residents to contamination *in the past*. The groundwater plume under the eastern portions of the city of Troy may have been impacting these properties for an extended period of time; however there were no data indicating a vapor intrusion hazard until recently.

- The East Troy Contaminated Aquifer Site poses a ***public health hazard*** for residents living in the area *in the future*. The source(s) of the VOC plumes need to be fully identified and removed or abated. The vapor abatement systems were installed only at a few locations and are only intended to be a temporary solution. Other homes and locations in the area could be at risk through vapor intrusion. In addition, the contaminated ground water plume is migrating towards the well fields of the City of Troy. The U.S. EPA has proposed the site to the National Priorities List.

RECOMMENDATIONS

1. U.S. EPA should continue to take interim measures at known affected properties to disrupt or eliminate the vapor intrusion pathway into homes and buildings and conduct follow-up sampling to determine if the systems are reducing levels to below HAS/ATSDR screening levels.

2. U.S. EPA and Ohio EPA should fully investigate, delineate and remediate or remove the possible sources of PCE and TCE in subsurface soils and groundwater in the neighborhood.

PUBLIC HEALTH ACTIONS

Completed Actions

1. U.S. EPA sampled sub-slab and indoor air in 85 structures in East Troy for site-related chemicals of concern. Sixteen residences and the St. Patrick School had levels of solvents PCE and TCE above HAS/ATSDR's conservative chronic screening values. U.S. EPA installed individual vapor abatement systems in all 16 homes and the school in August 2007.

2. U.S. EPA has conducted follow-up sampling of the school's and residences' sub-slab and indoor air in 2007 and 2008 to insure continued effective operation of the installed vapor extraction systems.

3. HAS and ATSDR evaluated results to confirm that indoor air levels in homes and the school no longer pose a health threat to impacted residents, staff, and students.

4. U.S. EPA has proposed placing the East Troy Contaminated Aquifer Site on the National Priorities List (NPL) of Superfund hazardous waste sites.

Future Actions

1. U.S. EPA will oversee a Remedial Investigation/Feasibility Study to identify source(s) of groundwater contamination in the area and take steps to mitigate or eliminate this contamination.

PREPARERS OF THE REPORT

Health Assessment Section
John Kollman, Environmental Specialist
Robert C. Frey, Chief

CERTIFICATION

The Ohio Department of Health prepared this Health Consultation, EAST TROY CONTAMINATED AQUIFER SITE (VAPOR INTRUSION), under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). At the time this Health Consultation was written, it was in accordance with the approved methodologies and procedures. Editorial review was completed by the Cooperative Agreement partner.

Technical Project Officer, Cooperative Agreement Team, CAPEB, DHAC, ATSDR

The Division of Health Assessment and Consultation, ATSDR, has reviewed this public health consultation and concurs with the findings.

for Greg Ulirsch

Team Leader, Cooperative Agreement Team, CAPEB, DHAC, ATSDR

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TABLES

Table 1. Indoor Air Sample Results for Houses Requiring Vapor Abatement Systems in Troy, Ohio

Number	*EPA ID #*	*Street*	*Analyte*	*Initial Concentration ppb*	*1-Month After Installation, ppb*	*ODH/ATSDR Screening Level, ppb*
1	EPA-03	Franklin Street	PCE	7.6	1.5	1.2
2	EPA-06	Franklin Street	PCE	22	1.7	1.2
3	EPA-13	Water Street (School)	PCE	2.1	ND	1.2
			TCE	1.3	ND	0.4
4	EPA-18	Water Street	TCE	1.0	1.4	0.4
5	EPA-22	E. Franklin St.	PCE	1.7	ND	1.2
6	EPA-28	E. Franklin St.	PCE	1.3	4.6	1.2
7	EPA-32	E. Franklin St.	PCE	4.5	ND	1.2
8	EPA-39	E. Franklin St.	PCE	4.8	ND	1.2
9	EPA-43	E. Franklin St.	PCE	7.2	ND	1.2
10	EPA-26	E. Main St.	TCE	0.51	0.60	0.4
11	EPA-38	E. Canal St.	TCE	0.61	ND	0.4
12	EPA-16	Franklin Street	PCE	6.6	1.2	1.2
13	EPA-45	Union Street	PCE	2.2	0.57	1.2
14	EPA-49	E. Franklin St.	PCE	11	ND	1.2
15	EPA-50	E. Franklin St.	PCE	3.5	0.33	1.2
16	EPA-72	E. Main Street	PCE	1.4	ND	1.2
17	EPA-59	E. Main Street	PCE	1.4	ND	1.2

Source: EPA 2007

ppb = parts per billion
ND = None Detected
PCE – Perchloroethylene, also known as tetrachloroethylene
TCE – Trichloroethylene

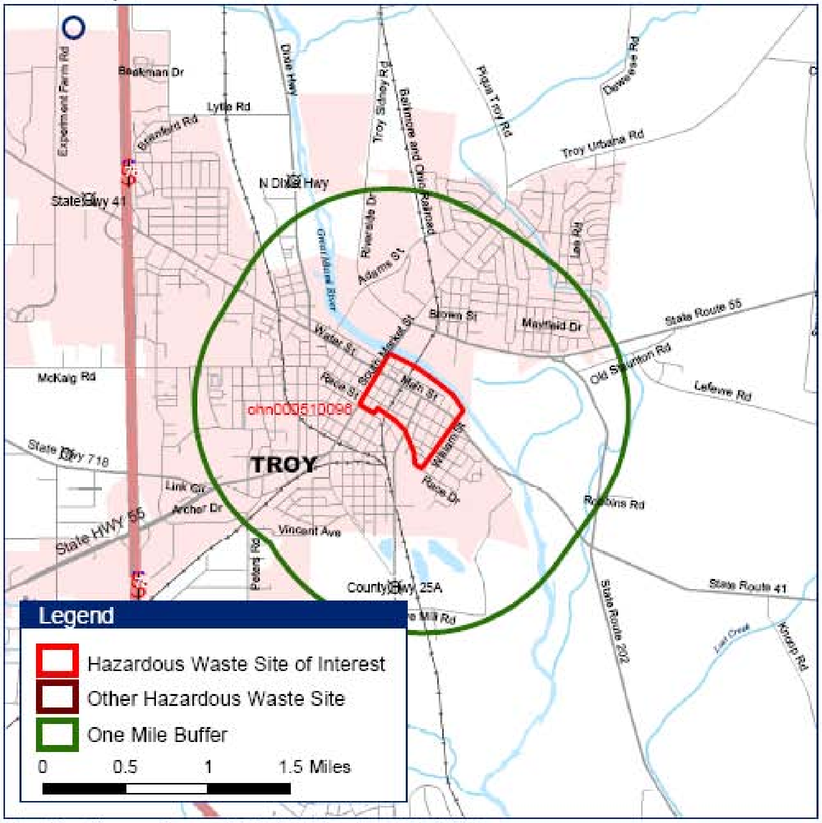
* Note: EPA ID #s 28 and 43 had dirt floors; EPA-50 had a partial dirt floor.

FIGURES

FIGURE 1. Study Area

Troy VOC Plume Site
Troy, OH

EPA Facility ID: OHN000510096

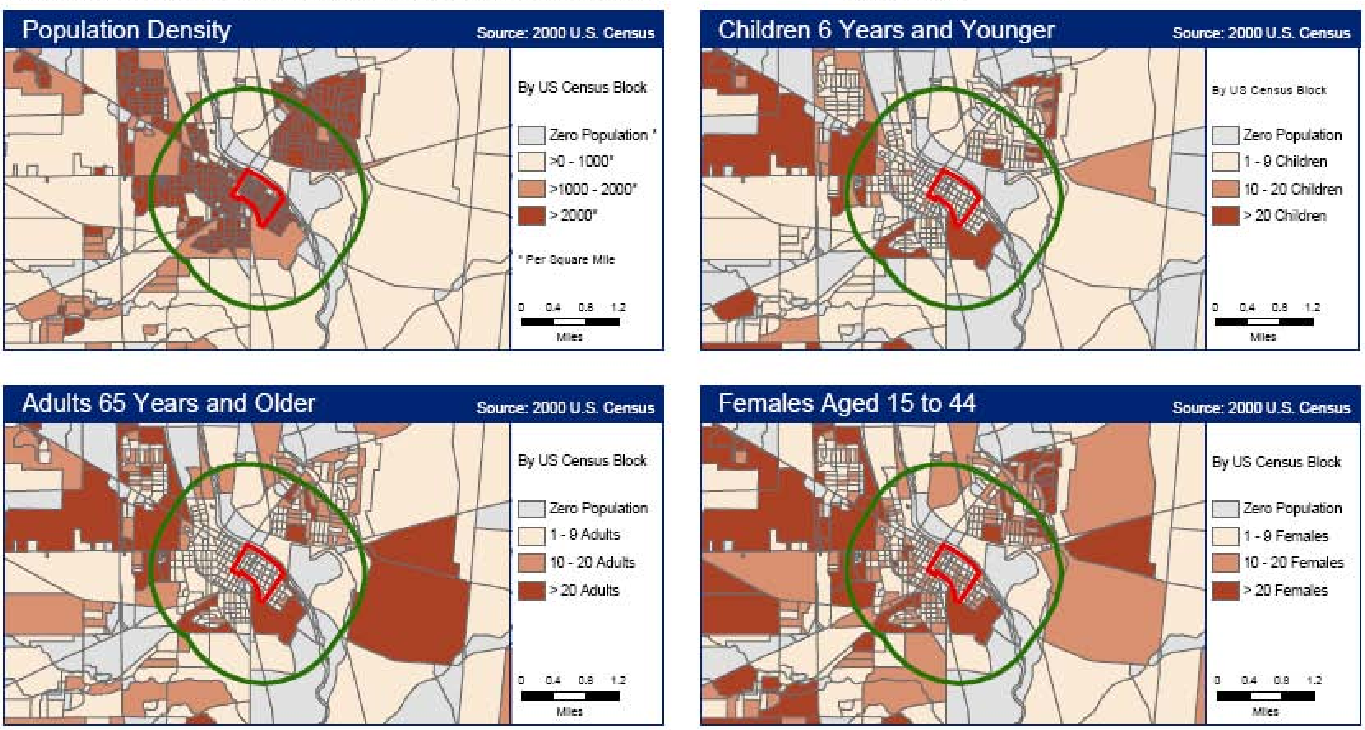


Base Map Source: Geographic Data Technology, May 2005.
Site Boundary Data Source: ATSDR Geospatial Research, Analysis, and Services Program, Current as of Generate Date (bottom left-hand corner).
Coordinate System (All Panels): NAD 1983 StatePlane Ohio South FIPS 3402 Feet

Site Location: Miami County, OH

Demographic Statistics Within Area of Concern*	Inside Site Boundary
Total Population	1,263
White Alone	1,194
Black Alone	48
Am. Indian & Alaska Native Alone	2
Asian Alone	5
Native Hawaiian & Other Pacific Islander Alone	0
Some Other Race Alone	2
Two or More Races	11
Hispanic or Latino**	16
Children Aged 6 and Younger	133
Adults Aged 65 and Older	129
Females Aged 15 to 44	311
Total Housing Units	548

Demographics Statistics Source: 2000 U.S. Census
* Calculated using an area-proportion spatial analysis technique
** People who identify their origin as Hispanic or Latino may be of any race.



<project=03019><userid=JXA0><geo=Miami County, OH><keywords=OHN000510096, Troy Voc>

FIGURE 2. OHIO EPA GROUND WATER SAMPLING RESULTS

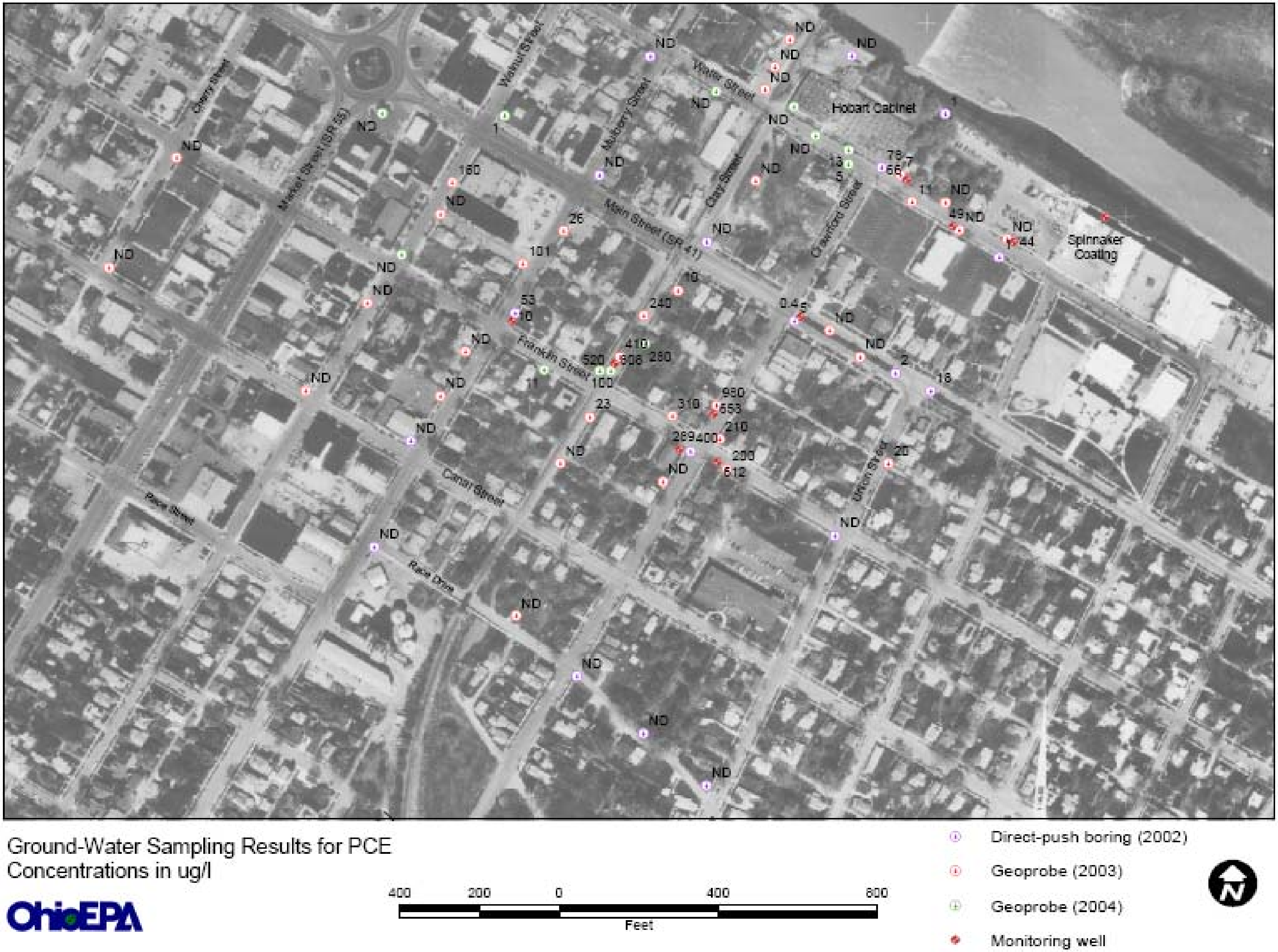


FIGURE 3. OHIO EPA SOIL-GAS, INDOOR AIR & MONITORING WELL RESULTS

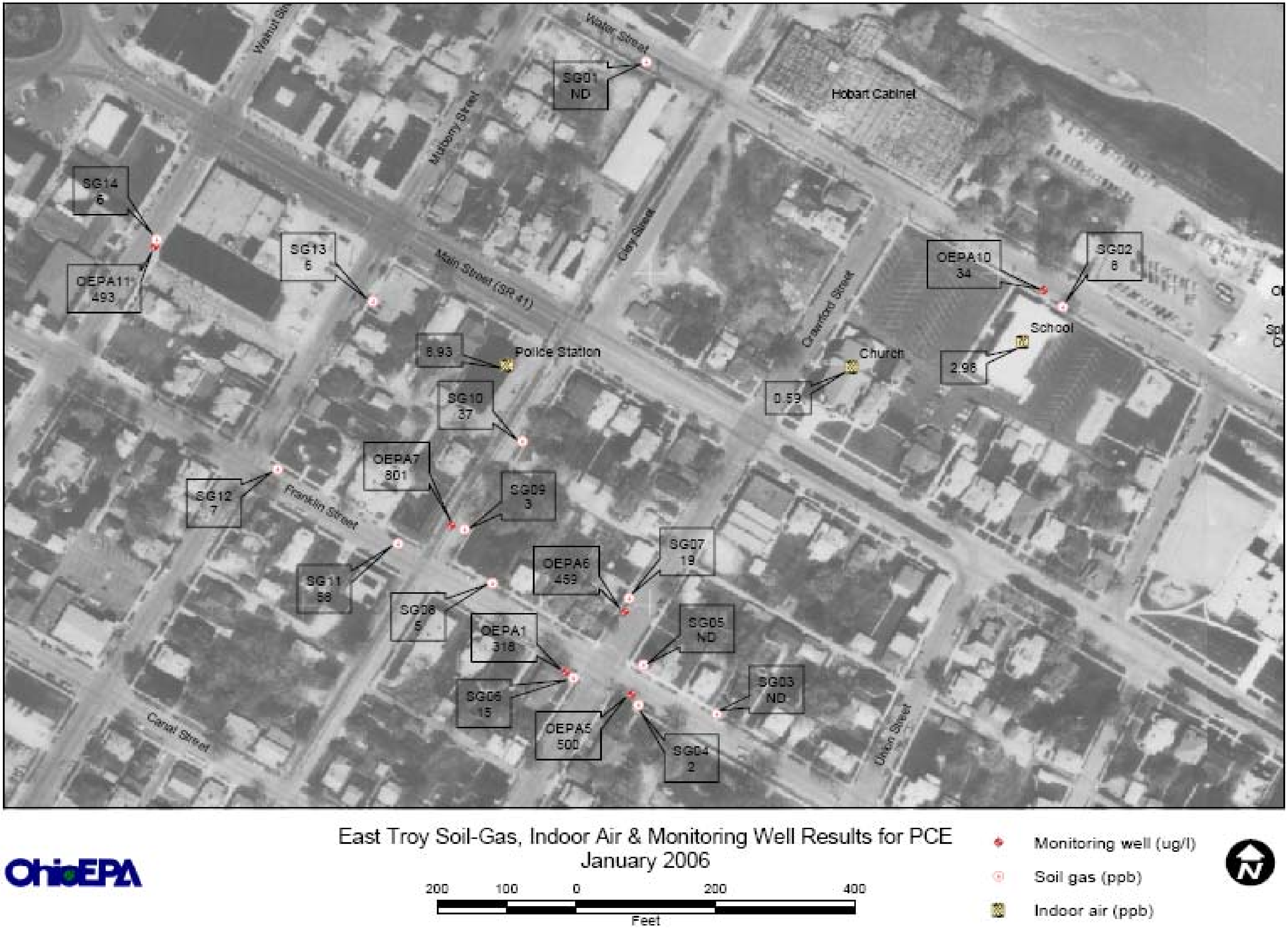
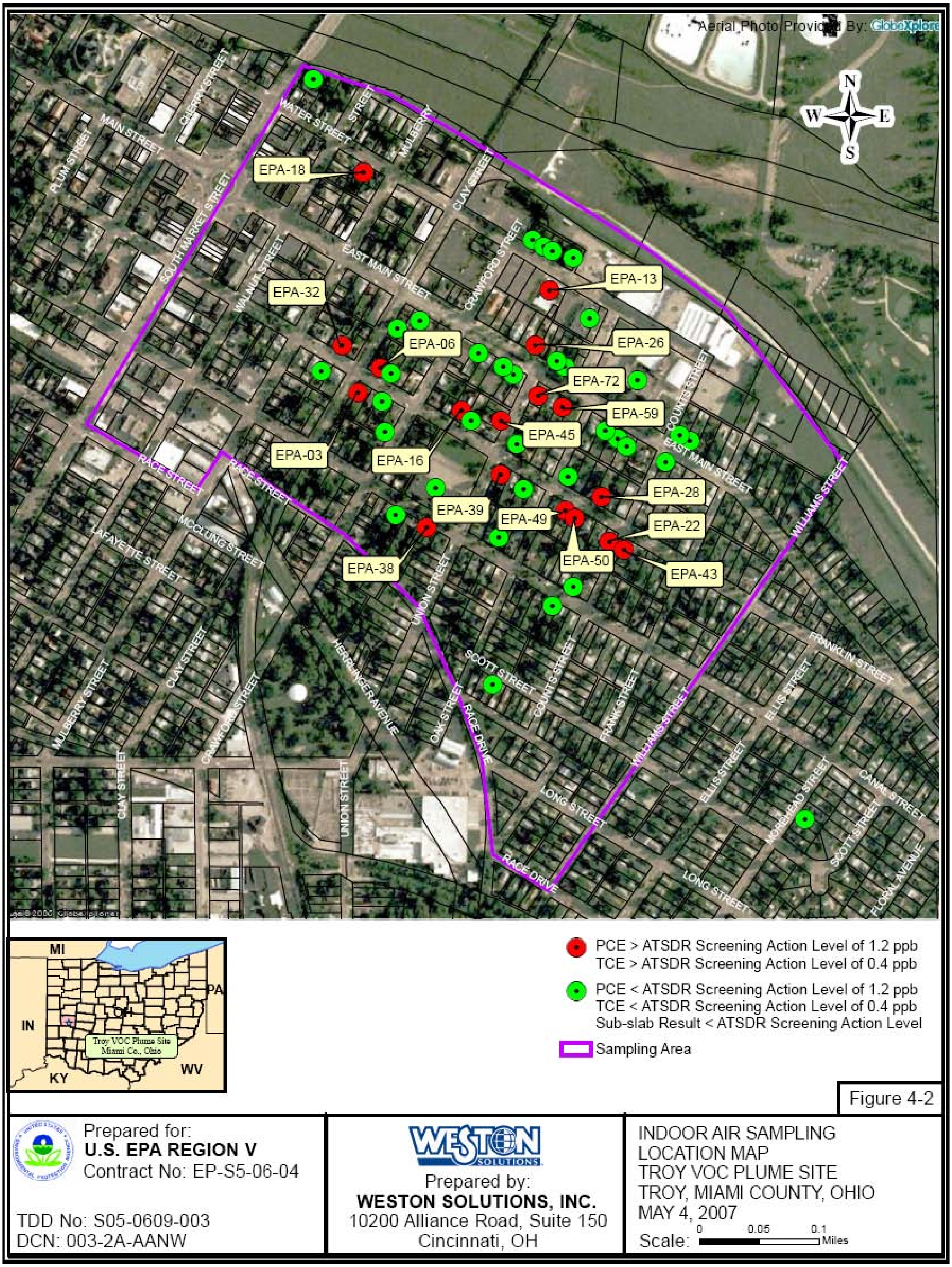


FIGURE 4. U.S. EPA INDOOR AIR SAMPLING LOCATION MAP
TROY, OHIO



APPENDICES

DEPARTMENT OF HEALTH & HUMAN SERVICES

Public Health Service

Agency for Toxic Substances
and Disease Registry
Atlanta GA 30333

September 11, 2006

Steve Renninger
U.S. Environmental Protection Agency
Superfund Division, Emergency Response Branch
Cincinnati, OH

Dear Steve,

This letter is the response from the Ohio Department of Health (ODH) and the Agency for Toxic Substances and Disease Registry (ATSDR) to your request for health-based guidance to evaluate the results of air sampling of indoor air and subsurface for tetrachloroethylene (PERC) in the community of Troy (Miami County), Ohio.

The recommended screening levels presented in this letter are based on the understanding that exposures to PERC in this community has been on-going for some period of time, and that the removal of the source material will require an extensive effort that may not be accomplished in the near future. For those reasons, we have applied screening levels that are based more on chronic rather than acute exposures to this chemical. These are provided for residences, schools, commercial buildings, and public buildings. The application of these screening levels is considered by ODH and ATSDR to be protective of public health.

Residences/Schools:
The recommended health-based screening level for **residential indoor air** concentrations for PERC is **1.2 ppb**. This level is based on the EPA "Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils", at a 10^{-5} cancer risk. If the indoor PERC concentrations exceed 1.2 ppb, then an intervention strategy for reducing these levels should be initiated. Such a strategy should include the consideration of source control and installation of sub-slab depressurization systems to reduce the migration of vapors from the subsurface into indoor spaces. If the indoor PERC concentrations exceed **200 ppb**, then sub-slab depressurization systems should be installed as an immediate response action to reduce exposures. This level is the ATSDR Acute Minimal Risk Level, based on protection of neurological effects with short term exposure to PERC. We would recommend that this residential criterion also be applied to the evaluation of environments where children may occupy the space for a significant portion of the day, such as schools and daycare centers.

While data collected from sub-slab samples is an indication of contamination in subsurface soils levels that may migrate into indoor spaces, the determination of a public health hazard is generally based on more direct measures of inhalation exposure. A more definitive conclusion about the level of health hazard would require additional indoor air sampling. However, in cases where indoor air samples have not been collected and only **sub-slab** sampling data are available, then a health-based screening level of **12 ppb** is recommended as the initial comparison. Levels below this would not be considered to be of a health concern. If this level is exceeded, then indoor air sampling would be recommended. This sub-slab value is a conservative 10-fold adjustment of the indoor air screening concentration. Concentrations below this level would not be of a health concern. However, site-specific conditions indicate that periodic monitoring of contamination levels may be needed.

<u>Non-residential buildings:</u>

For building spaces that are not used for residences or where children are not continuously present, such as churches, **commercial** businesses and public buildings, then a recommended health-based screening level of PERC in **indoor air** is **5 ppb**. Concentrations below this level would not be considered to be a health concern. If the indoor air concentrations are greater than 5 ppb, then an intervention strategy for reducing these levels should be initiated. Such a strategy should include the consideration of source control and installation of sub-slab depressurization systems to reduce the migration of vapors from the subsurface into indoor spaces. If the indoor PERC concentrations exceed **840 ppb**, then sub-slab depressurization systems should be installed as an immediate response action to reduce exposures.

In cases where indoor air samples have not been collected and only **sub-slab** sampling data are available, then a health-based screening level for non-residential buildings of **50 ppb** is recommended as the initial comparison. Levels below this would not be considered to be of a health concern. If the levels exceed 50 ppb, then indoor air sampling would be recommended to verify the extent of vapor migration into indoor air and levels of exposure.

<u>Recommendations</u>

The indoor air and sub-slab sampling results for [redacted] Franklin St., [redacted] Franklin St., [redacted] Franklin St., [redacted] Clay St., the St. Patrick School, and the Forest Elementary School exceed these screening criteria. The contaminated groundwater in this area may have been impacting these properties for an extended period of time. The implementation of a long-term remedy to remove the source is unlikely to occur in the near future. Therefore, we recommend that interim measures be taken at these properties to disrupt the vapor intrusion pathway into homes may include installation of a sub-slab depressurization system, sealing cracks in walls and floors of the basement, and sealing or fixing drains that could be a pathway. These interim measures should be initiated while a long-term remedy such as source removal at the site is being planned.

The sub-slab sampling at the Troy Police Station and St. Patrick Church also exceed the non-residential screening levels. Interim measure should also be considered for these buildings to reduce vapor intrusion.

If you have questions, please contact Mark Johnson (312-353-3436) or Bob Frey (614-466-1069).

Sincerely,

Mark D. Johnson, PhD, DABT
Senior Environmental Health Scientist
Agency for Toxic Substances and Disease Registry
Region 5
Chicago, IL 60604

Robert Frey, PhD
Chief, Health Assessment Section
Bureau of Environmental Health
Ohio Dept. of Health
Columbus, OH 43216

cc: Bill Bolen, USEPA-R5, Chief, Emergency Response Branch #1
Linda Nachowicz, USEPA-R5, Chief, Emergency Response Branch #2
Wendy Carney, USEPA-R5, Chief, Remedial Response Branch #1
Tina Forrester, ATSDR Division Director, Regional Operations
Clem Welsh, ATSDR Deputy Division Director, Regional Operations

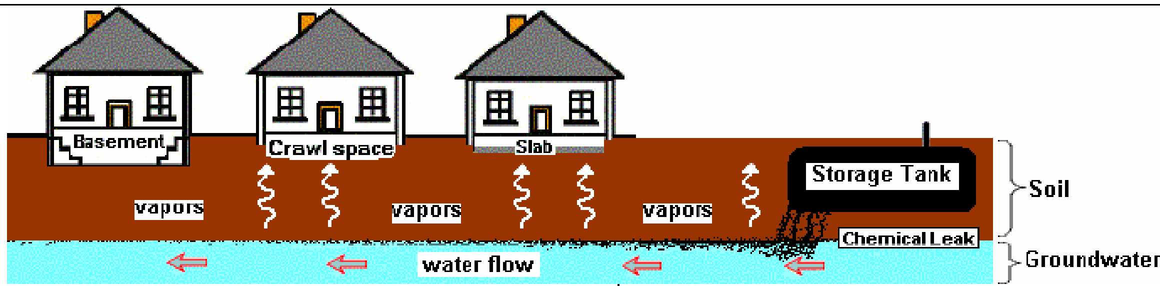
Appendix B. Fact Sheets

Bureau of Environmental Health
Health Assessment Section

"To protect and improve the health of all Ohioans"

Vapor Intrusion

Answers to Frequently Asked Health Questions



What is vapor intrusion?

Vapor intrusion refers to the vapors produced by a chemical spill/leak that make their way into indoor air. When chemicals are spilled on the ground or leak from an underground storage tank, they will seep into the soils and will sometimes make their way into the groundwater (underground drinking water). There are a group of chemicals called volatile organic compounds (VOCs) that easily produce vapors. These vapors can travel through soils, especially if the soils are sandy and loose or have a lot of cracks (fissures). These vapors can then enter a home through cracks in the foundation or into a basement with a dirt floor or concrete slab.

VOCs and vapors:

VOCs can be found in petroleum products such as gasoline or diesel fuels, in solvents used for industrial cleaning and are also used in dry cleaning. If there is a large spill or leak resulting in soil or groundwater contamination, vapor intrusion may be possible and should be considered a potential public health concern that may require further investigation.

Although large spills or leaks are a public health concern, other sources of VOCs are found in everyday household products and are a more common source of poor indoor air quality. Common products such as paint, paint strippers and thinners, hobby supplies (glues), solvents, stored fuels (gasoline or home heating fuel), aerosol sprays, new carpeting or furniture, cigarette smoke, moth balls, air fresheners and dry-cleaned clothing all contain VOCs.

Can you get sick from vapor intrusion?

You can get sick from breathing harmful chemical vapors. But getting sick will depend on:
<u>How much</u> you were exposed to (dose).
<u>How long</u> you were exposed (duration).
<u>How often</u> you were exposed (frequency).
<u>How toxic</u> the spill/leak chemicals are.
<u>General Health, age, lifestyle:</u> Young children, the elderly and people with chronic (on-going) health problems are more at risk to chemical exposures.

VOC vapors at high levels can cause a strong petroleum or solvent odor and some persons may experience eye and respiratory irritation, headache and/or nausea (upset stomach). These symptoms are usually temporary and go away when the person is moved to fresh air.

Lower levels of vapors may go unnoticed and a person may feel no health effects. A few individual VOCs are known carcinogens (cause cancer). Health officials are concerned with low-level chemical exposures that happen over many years and may raise a person's lifetime risk for developing cancer.

How is vapor intrusion investigated?

In most cases, collecting soil gas or groundwater samples near the spill site is done <u>first</u> to see if there is on-site contamination. If soil vapors or groundwater contamination are detected at a spill site, environmental protection and public health officials may then ask that soil vapor samples be taken from areas outside the immediate spill site and near any potential affected business or home. The Ohio Department of Health (ODH) does not usually recommend indoor air sampling for vapor intrusion before the on-site contamination is determined.

(continued on next page)

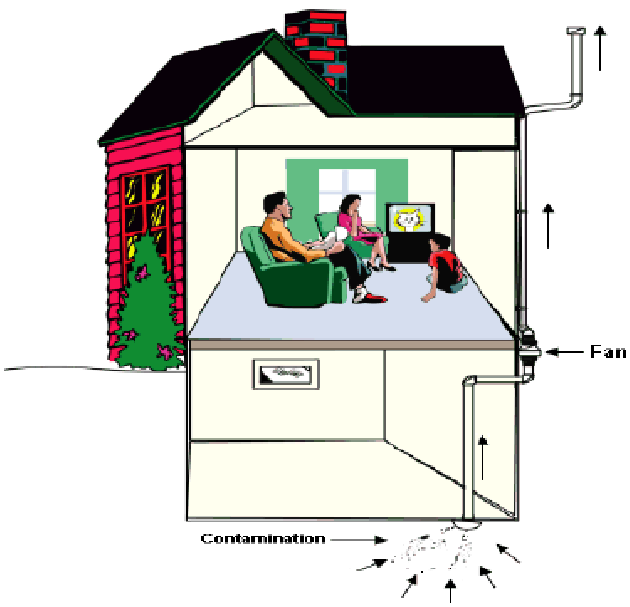
How is vapor intrusion investigated? (continued)

Because a variety of VOC sources are present in most homes, testing will not necessarily confirm VOCs in the indoor air are from VOC contamination in soils at nearby spill site. But if additional sampling is recommended, samples may be taken from beneath the home's foundation (called sub-slab samples), to see if vapors have reached the home. Sub-slab samples are more reliable than indoor air samples and are not as affected by other indoor chemical sources. If there was a need for additional sampling on a private property, homeowners would be contacted by the cleanup contractor or others working on the cleanup site and their cooperation and consent would be requested before any testing/sampling would be done.

What happens if a vapor intrusion problem is found?

If vapor intrusion is having an effect on the air in your home, the most common solution is to install a *radon mitigation system*. A radon mitigation system will prevent gases in the soil from entering the home. A low amount of suction is applied below the foundation and the vapors are vented to the outside. The system uses minimal electricity and should not noticeably affect heating and cooling efficiency. This mitigation system also prevents radon from entering the home, an added health benefit. Usually, the party responsible for cleaning up the contamination is also responsible for paying for the installation of this system. Once the contamination is cleaned up, the system should no longer be needed. In homes with on going radon problems, ODH suggests these systems remain in place permanently.

Radon Mitigation System



What can you do to improve your indoor air quality?

As stated before, the most likely source of VOCs in indoor air comes from the common items that are found in most homes. The following helpful hints will help improve air quality inside your home:

- Do not buy more chemicals than you need and know what products contain VOCs.
- If you have a garage or an out building such as a shed, place the properly stored VOC-containing chemicals outside and away from your family living areas.
- Immediately clean and ventilate any VOC spill area.
- If you smoke, go outside and/or open the windows to ventilate the second-hand, VOC-containing smoke outdoors.
- Make sure all your major appliances and fireplace(s) are in good condition and not leaking harmful VOC vapors. Fix all appliance and fireplace leaks promptly, as well as other leaks that cause moisture problems that encourage mold growth.
- Most VOCs are a fire hazard. Make sure these chemicals are stored in appropriate containers and in a well-ventilated location and away from an open pilot light (flame) of a gas water heater or furnace.
- Fresh air will help prevent both build up of chemical vapors in the air and mold growth. Occasionally open the windows and doors and ventilate.
- Test your home for radon and install a radon detector.

References:

Wisconsin Department of Health and Family Services, Environmental Health Resources, Vapor Intrusion, electronic, 2004.

New York State Department of Health, Center for Environmental Health, April 2003.

Ohio Department of Health, Bureau of Environmental Health, Indoor Environment Program, 2004.

For more information contact:

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Bureau of Environmental Health
Health Assessment Section
246 N. High Street
Columbus, Ohio 43215
Phone: (614) 466-1390
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Created September 2004

Bureau of Environmental Health
Health Assessment Section

"To protect and improve the health of all Ohioans"

Tetrachloroethylene (PERC)

Other names for tetrachloroethylene include perchloroethylene, PCE, and tetrachloroethene.

What is tetrachloroethylene (PERC)?

Tetrachloroethylene (PERC) is a man-made chemical that is widely used for dry cleaning clothes and for metal degreasing. It is also used to make other chemicals and can be found in some household products such as water repellents, silicone lubricants, fabric finishers, spot removers, adhesives and wood cleaners. It evaporates easily into the air and has a sharp, sweet odor. PERC is a nonflammable (does not burn) liquid at room temperature.

How does tetrachloroethylene (PERC) get into the environment?

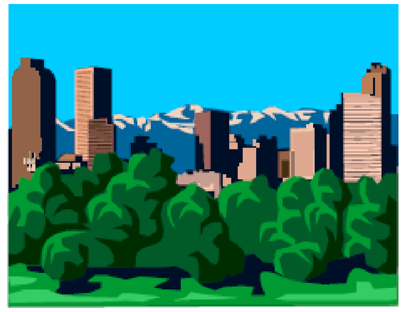
Tetrachloroethylene (PERC) can evaporate into the air during dry cleaning operations and during industrial use. It can also be released in air if it is not properly stored or was spilled. If it was spilled or leaked into the soil, it may be found in groundwater (or underground drinking water).

People can be exposed to tetrachloroethylene (PERC) from the environment, from household products, from dry cleaning products and from their occupation (work). Common environmental levels of tetrachloroethylene (called background levels) can be found in the air we breathe, in the water we drink and in the food we eat. In general, levels in the air are higher in the cities or around industrial areas where it is used more than rural or remote areas.

The people with the greatest chance of exposure to tetrachloroethylene are those who work with it. According to estimates from a survey conducted by the National Institute for Occupational Safety and Health (NIOSH), more than 650,000 U.S. workers may be exposed. However, the air close to dry cleaning business and industrial sites may have levels of tetrachloroethylene higher than background levels. If the dry cleaning business or industry has spilled or leaked PERC on the ground, there may also be contaminated groundwater as well.

What happens to tetrachloroethylene (PERC) in the environment?

Much of the tetrachloroethylene (PERC) that gets into surface waters or soil evaporates into the air.



However, some of the PERC may make its way to the groundwater. Microorganisms can break down some of the PERC in soil or underground water. In the air, it is broken down by sunlight into other chemicals or brought back to the soil and water by rain. PERC does not appear to collect in fish or other animals that live in water.

How can tetrachloroethylene (PERC) enter and leave my body?

Tetrachloroethylene (PERC) can enter your body when you breathe contaminated air or when you drink water or eat food containing the chemical. If PERC is trapped against your skin, a small amount of it can pass through into your body. Very little PERC in the air can pass through your skin into your body. Breathing contaminated air and drinking water are the two most likely ways people will take in PERC. How much enters your body in this way depends on how much of the chemical is in the air, how fast and deeply you are breathing, how long you are exposed to it or how much of the chemical you eat or drink.

Most PERC leaves your body from your lungs when you breathe out. This is true whether you take in the chemical by breathing, drinking, eating, or touching it. A small amount is changed by your body (in your liver) into other chemicals that are removed from your body in urine. Most of the changed (PERC) leaves your body in a few days. Some of it that you take in is found in your blood and other tissues, especially body fat. Part of the tetrachloroethylene that is stored in fat may stay in your body for several days or weeks before it is eliminated.

Can tetrachloroethylene (PERC) make you sick?

Yes, you can get sick from contact with PERC. But getting sick will depend upon:

- How much you were exposed to (dose).
- How long you were exposed (duration).
- How often you were exposed (frequency).
- General Health, Age, Lifestyle Young children, the elderly and people with chronic (on-going) health problems are more at risk to chemical exposures.

How can tetrachloroethylene (PERC) affect my health?

Exposure to very high concentrations of tetrachloroethylene (particularly in closed, poorly ventilated areas) can cause dizziness, headache, sleepiness, confusion, nausea, difficulty in speaking and walking, unconsciousness, and death. Skin irritation may result from repeated or extended contact with it as well. These symptoms occur almost entirely in work (or hobby) environments when people have been accidentally exposed to high concentrations or have intentionally used tetrachloroethylene to get a "high." Normal background levels (or common environmental levels) will not cause these health affects.

Is tetrachloroethylene (PERC) a carcinogen (cause cancer)?

In the United States, the National Toxicology Program (NTP) releases the *Report on Carcinogens* (RoC) every two years. The NTP is formed from parts of several different government agencies, including the National Institutes of Health (NIH), the Centers for Disease Control and Prevention (CDC), and the Food and Drug Administration (FDA). The *Report on Carcinogens* (RoC) identifies two groups of agents: "Known to be human carcinogens" & "Reasonably anticipated to be human carcinogens." Tetrachloroethylene (PERC) has been shown to cause liver tumors in mice and kidney tumors in male rats. The RoC has determined that PERC may reasonably be anticipated to be a carcinogen.

Reference:

Agency for Toxic Substances and Disease Registry (ATSDR). 1997. Toxicological Profile for tetrachloroethylene. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service

Is there a medical test to show whether you have been exposed to tetrachloroethylene (PERC)?

One way of testing for tetrachloroethylene (PERC) exposure is to measure the amount of the chemical in the breath, much the same way breath-alcohol measurements are used to determine the amount of alcohol in the blood. Because PERC it is stored in the body's fat and slowly released into the bloodstream, it can be detected in the breath for weeks following a heavy exposure. Also, PERC and trichloroacetic acid (TCA), a breakdown product of tetrachloroethylene, can be detected in the blood. These tests are relatively simple to perform but are not available at most doctors' offices and must be done at special laboratories that have the right equipment. Because exposure to other chemicals can produce the same breakdown products in the urine and blood, the tests for breakdown products cannot determine if you have been exposed to PERC or the other chemicals that produce the same breakdown chemicals.

What has the federal government made recommendations to protect human health?

The EPA maximum contaminant level for the amount of tetrachloroethylene that can be in drinking water is 0.005 milligrams tetrachloroethylene per liter of water (0.005 mg/L).

The Occupational Safety and Health Administration (OSHA) has set a limit of 100 ppm for an 8-hour workday over a 40-hour workweek.

The National Institute for Occupational Safety and Health (NIOSH) recommends that tetrachloroethylene be handled as a potential carcinogen and recommends that levels in workplace air should be as low as possible.

The Ohio Department of Health is in cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR), Public Health Service, U.S. Department of Health and Human Services.

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Created 10-15-04

Bureau of
Environmental Health
Health Assessment Section

"To protect and improve the health of all Ohioans

Trichloroethylene (TCE)

(try- klor'oh eth'uh- leen)

Answers to Frequently Asked Health Questions

What is TCE?

TCE is man-made chemical that is not found naturally in the environment. TCE is a non-flammable (does not burn), colorless liquid with a somewhat sweet odor and has a sweet, "burning" taste. It is mainly used as a cleaner to remove grease from metal parts. TCE can also be found in glues, paint removers, typewriter correction fluids and spot removers.

The biggest source of TCE in the environment comes from evaporation (changing from a liquid into a vapor/gas) when industries use TCE to remove grease from metals. But TCE also enters the air when we use common household products that contain TCE. It can also enter the soil and water as the result of spills or improper disposal.

What happens to TCE in the environment?

- TCE will quickly evaporate from the surface waters of rivers, lakes, streams, creeks and puddles.
- If TCE is spilled on the ground, some of it will evaporate and some of it may leak down into the ground. When it rains, TCE can sink through the soils and into the ground (underground drinking) water.
- When TCE is in an oxygen-poor environment and with time, it will break down into different chemicals such as 1,2 Dichloroethene and Vinyl Chloride.
- TCE does not build up in plants and animals.
- The TCE found in foods is believed to come from TCE contaminated water used in food processing or from food processing equipment cleaned with TCE.

How does TCE get into your body?

- TCE can get into your body by breathing (inhalation) air that is polluted with TCE vapors. The vapors can be produced from the manufacturing of TCE, from TCE polluted water evaporating in the shower or by using household products such as spot removers and typewriter correction fluid.
- TCE can get into your body by drinking (ingestion) TCE polluted water.
- Small amounts of TCE can get into your body through skin (dermal) contact. This can take place when using TCE as a cleaner to remove grease from metal parts or by contact with TCE polluted soils.

Can TCE make you sick?

Yes, you can get sick from TCE. But getting sick will depend on the following:

- How much you were exposed to (dose).
- How long you were exposed (duration).
- How often you were exposed (frequency).
- General Health, Age, Lifestyle Young children, the elderly and people with chronic (on-going) health problems are more at risk to chemical exposures.

How does TCE affect your health?

Breathing (Inhalation):

- Breathing high levels of TCE may cause headaches, lung irritation, dizziness, poor coordination (clumsy) and difficulty concentrating.
- Breathing very high levels of TCE for long periods may cause nerve, kidney and liver damage.

Drinking (Ingestion):

- Drinking high concentrations of TCE in the water for long periods may cause liver and kidney damage, harm immune system functions and damage fetal development in pregnant women (although the extent of some of these effects is not yet clear).
- It is uncertain whether drinking low levels of TCE will lead to adverse health effects.

Skin (Dermal) Contact:

- Short periods of skin contact with high levels of TCE may cause skin rashes.

Does TCE cause cancer?

The National Toxicology Program's 11th Report on Carcinogens places chemicals into one of two cancer-causing categories: *Known to be Human Carcinogens* and *Reasonably Anticipated to be Human Carcinogens*.

The11th Report on Carcinogens states TCE is *"Reasonably Anticipated to be Human Carcinogen."*

The category *"Reasonably Anticipated to be Human Carcinogen"* gathers evidence mainly from animal studies. There may be limited human studies or there may be no human or animal study evidence to support carcinogenicity; but the agent, substance or mixture belongs to a well-defined class of substances that are known to be carcinogenic.

There are human studies of communities that were exposed to high levels of TCE in drinking water and they have found evidence of increased leukemia's. But the residents of these communities were also exposed to other solvents and may have had other risk factors associated with this type of cancer.

Animal lab studies in mice and rats have suggested that high levels of TCE may cause liver, lung, kidney and blood (lymphoma) cancers.

As part of the National Exposure Subregistry, the Agency for Toxic Substances and Disease Registry (ATSDR) compiled data on 4,280 residents of three states (Michigan, Illinois, and Indiana) who had environmental exposure to TCE. ATSDR found no definitive evidence for an excess of cancers from these TCE exposures.

The U.S. EPA is currently reviewing the carcinogenicity of TCE.

Is there a medical test to show whether you have been exposed to TCE?

If you have recently been exposed to TCE, it can be detected in your breath, blood, or urine. The breath test, if done soon after exposure, can tell if you have been exposed to even a small amount of TCE.

Exposure to larger amounts is measured in blood and urine tests. These tests detect TCE and many of its breakdown products for up to a week after exposure. However, exposure to other similar chemicals can produce the same breakdown products in the blood and urine so the detection of the breakdown products is not absolute proof of exposure to TCE.

These tests aren't available at most doctors' offices, but can be done at special laboratories that have the right equipment. **Note:** Tests can determine if you have been exposed to TCE but cannot predict if you will experience adverse health effects from the exposure.

Has the federal government made recommendations to protect human health?

The federal government develops regulations and recommendations to protect public health and these regulations can be enforced by law.

Recommendations and regulations are periodically updated as more information becomes available. Some regulations and recommendations for TCE follow:

- The Environmental Protection Agency (EPA) has set a maximum contaminant level for TCE in drinking water at 0.005 milligrams per liter (0.005 mg/L) or 5 parts of TCE per billion parts water (5 ppb).
- The Occupational Safety and Health Administration (OSHA) have set an exposure limit of 100 ppm (or 100 parts of TCE per million parts of air) for an 8-hour workday, 40-hour workweek.
- The EPA has developed regulations for the handling and disposal of TCE.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 1997. Toxicological profile for TCE (electronic at http://www.atsdr.cdc.gov/tfacts19.html)

Report on Carcinogens, Eleventh Edition; U.S. Department of Health and Human Services, Public Health Service, National Toxicology Program, 2005 (2005 electronic at http://ntp.niehs.nih.gov/ntp/roc/toc11.html)

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AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

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