Health Consultation

Vapor Intrusion Concerns

SPRINGFIELD STREET VOC PLUME
RIVERSIDE, MONTGOMERY COUNTY, OHIO

EPA FACILITY ID: OHN000510062

DECEMBER 18, 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.

You May Contact ATSDR TOLL FREE at
1-800-CDC-INFO
or
Visit our Home Page at: http://www.atsdr.cdc.gov

HEALTH CONSULTATION

Vapor Intrusion Concerns

SPRINGFIELD STREET VOC PLUME
RIVERSIDE, MONTGOMERY COUNTY, OHIO

EPA FACILITY ID: OHN000510062

Prepared by the Health Assessment Section
At the Ohio Department of Health
Under Cooperative Agreement with the
Agency for Toxic Substances and Disease Registry

PUBLIC HEALTH CONSULTATION

Vapor Intrusion Concerns

SPRINGFIELD STREET VOC PLUME

RIVERSIDE, MONTGOMERY COUNTY, OHIO

U.S. EPA CERCLIS ID: OHN000510062

Prepared by the Health Assessment Section
At the Ohio Department of Health
Under Cooperative Agreement with the
Agency for Toxic Substances and Disease Registry

STATEMENT OF ISSUES

The Health Assessment Section (HAS) at the Ohio Department of Health was contacted on November 14, 2005 by the Southwest District Office of the Ohio Environmental Protection Agency (Ohio EPA) regarding the results of environmental sampling at the Springfield Street VOC Plume site in a mixed residential and commercial portion of the city of Riverside, at the west edge of its boundary with the city of Dayton. Low levels of the volatile organic compound (VOC) perchloroethylene (PCE) had been detected in the city of Dayton's Mad River well field, just north of Springfield Street along the Mad River. Ohio EPA's investigation in 2004 traced the groundwater contamination plume to a trucking company parking lot. PCE was detected in the shallow groundwater in the area (up to 257 parts per billion [ppb]) and elevated levels (up to 7,700 parts per billion) were detected in the shallow soil gas. Shallow soils at the suspected source area had PCE concentrations as high as 478,000 ppb. Because of the nature of the contamination and the local geology, concerns were expressed by Ohio EPA staff regarding the potential public health threat posed by vapor-phase PCE migrating up into basements and crawl spaces of nearby homes where residents might come into contact with PCE in the indoor air in their homes.

As part of a United States Environmental Protection agency (U.S. EPA) Time-critical Removal Action, HAS was asked by the U.S. EPA Emergency Response Team On-Scene Coordinator (OSC) to establish both indoor air and subsurface soil gas screening levels for the chemicals of concern associated with the plume. The U.S. EPA OSC also asked HAS to review and evaluate groundwater, soil, subsurface gas, and indoor air sampling results in order to advise U.S. EPA regarding the need for further mitigation or remedial actions to eliminate the public health hazard posed to the nearby residents.

Discussions between HAS, the federal Agency for Toxic Substances and Disease Registry's Region V Office (ATSDR), and Ohio EPA staff led to the development of indoor air and sub-slab soil gas screening levels for PCE that were provided to the U.S. EPA OSC December 5, 2005. The U.S. EPA contractor mobilized at the site December 12, 2005, and began an investigation of sub-slab soil gas levels and indoor air levels of PCE in a number of down-gradient residences situated over the identified footprint of the underlying groundwater PCE plume. Initial sampling results for the two residences nearest to the identified source area were reviewed by HAS and ATSDR Region V staff early in January, 2006. An evaluation of these results and recommendations for future U.S. EPA actions at the site were provided to the U.S. EPA OSC in a written memo dated January 19, 2006 (Appendix A). This memo led to a U.S. EPA Time-critical Removal Action that included: 1) removal of the identified source area; 2) further sub-slab and indoor air sampling of area homes and businesses; and 3) the installation of subsurface gas mitigation systems in impacted residences. This Public Health Consultation documents the initial HAS/ATSDR evaluation of the Springfield Street VOC plume site and the results of the subsequent U.S. EPA Time-critical Removal Action.

BACKGROUND

Site Location and Description

The Springfield Street VOC Plume site (SSVP) consists of residences and commercial properties along Springfield Street in a mixed residential and industrial portion of the city of Riverside, just east of its boundary with the city of Dayton, in Montgomery County, Ohio (Figure 1). The area of concern is bounded by the Mad River to the north; North Garden Boulevard to the east; Byesville Boulevard to the south, and Kimbolton Avenue to the west (Figure 2). The identified source area consisted of a comparatively small area of contaminated soil at the west edge of a small trucking company's parking lot just west of Planters Avenue (Figure 2). The resulting groundwater PCE plume was traced from the city of Dayton well-field on the south bank of the Mad River north of Springfield Street and Eastwood Park, southeast to the source area on Planters Avenue (Figure 3). The plume underlies an urban-density residential neighborhood with single-family frame homes, some with poured concrete basements and some with dirt-floor crawl spaces. Commercial properties, including a large manufacturing company, are located primarily on the north side of Springfield Street, between the residences and the city well field (Figure 3).

Area Hydrogeology

The entire area of concern is on the level floodplain of the Mad River. The floodplain overlies a buried bedrock valley that has been back-filled with at least 160 ft of porous and permeable sand and gravel deposits that form the groundwater-bearing aquifer system that provides the city of Dayton and much of Montgomery County with drinking water. Homes in the area are underlain by 2-6 ft of soil followed by variable mixtures of sand and gravel down to depths of nearly 60 ft below the ground surface (Ohio Department of Natural Resources well logs). In the Byesville neighborhood, the water table is typically only 7-12 ft below the ground surface (Ohio EPA pers. comm. 2005). ODNR recorded a well log for only one private well in the area of concern – on Planters Street across the street from the identified source area. This residence was also one of the properties sampled by U.S. EPA. The owner indicated that he used the well water only for watering the yard and other outdoor activities like washing cars. All residents in the area use city of Dayton public water for their drinking water supply.

Ohio EPA Source Investigation

Starting in December, 2004, the Ohio EPA collected groundwater, soil, and soil gas samples from the area associated with the groundwater contaminant plume in an effort to find the source of the low levels of the volatile solvent PCE detected in the Dayton Mad River well field. Ohio EPA traced the plume back to a small (80 ft x 80 ft x 12 ft) area of PCE-contaminated soil on a property currently used by a small trucking company as a gravel-covered parking lot. PCE was detected in soil samples at levels as high as 478,000 parts per billion (ppb). The highest PCE concentrations were detected in shallow soil (2-4 ft below the ground surface) with detectable PCE levels also present at depths as great as 12 ft deep. The highest level detected in the groundwater was 257 ppb PCE immediately down-gradient (north-northwest) of the source area. On-site soil gas samples had PCE at levels as high as 7,700 ppb just north of the source area.

Soil gas samples collected from depths of 8 ft below the ground surface in the vicinity of the nearest down-gradient residence along Planters Avenue (70 ft to the north) had detections of PCE as high as 2,000 and 3,000 ppb immediately adjacent to the home's foundation (Figure 4).

In a letter dated November 16, 2005, the Ohio EPA requested U.S. EPA assistance in conducting a time-critical removal action at the Springfield Street VOC plume site. Ohio EPA noted elevated levels of PCE were present in surface soils and were migrating from the source area via the groundwater and soil gas. Nearby residents were thought to be at risk for exposure to site-related VOCs through vapor intrusion from the subsurface soil gas to the indoor air in nearby homes. As was indicated by the Ohio EPA investigation, the VOCs in the soil gas were determined to originate from contaminated soils in the source area and the resulting groundwater contaminant plume.

U.S. EPA Soil Gas/Indoor Air Investigation

At the request of Ohio EPA, U.S. EPA Emergency Response Team staff initiated a Removal Action assessment at the SSVP site in December 2005. U.S. EPA reviewed the available site data collected by Ohio EPA and, between December 2005 and February 2006, collected indoor air and sub-slab soil gas samples from seven residences and one commercial property in the largely residential neighborhood immediately down-gradient of the identified source area. These included residences along Planters Avenue, Somerset Avenue, Byesville Boulevard, and Springfield Street (Figure 2). As part of this Removal Action assessment, December 30, 2005, U.S. EPA requested ATSDR/HAS to prepare a health consultation reviewing and evaluating the results of this sampling. U.S. EPA also requested HAS and ATSDR to develop screening levels for the chemicals of concern for both the sub-slab soil gas and indoor air samples. Following consultations between HAS, the ATSDR Region V Office, and the Ohio EPA, both short-term (acute exposure scenario) and long-term (chronic exposure scenario) screening levels were agreed upon for PCE, TCE, and benzene (Table 1). These were forwarded to the U.S. EPA OSC on December 2, 2005.

At the request of the U.S. EPA OSC, HAS provided U.S. EPA with electronic versions of its fact sheets on Exposure to Toxic Chemicals and Vapor Intrusion and chemical fact sheets for Perchloroethylene, Trichloroethylene, and Benzene (Appendix B). These were placed on the U.S. EPA site webpage and copies were also included in the letters U.S. EPA sent to the residents with their sampling results.

HAS and the ATSDR Region V Office received sub-slab and indoor air results for the two residences closest to the source sampled by U.S. EPA December 30, 2005. HAS and ATSDR Region V submitted their evaluation of these results and their recommendations to the U.S. EPA OSC in a written Technical Memorandum dated January 19, 2006 (Appendix A). The agencies found that PCE levels in the indoor air sampled in one home exceeded the long-term indoor air guidelines and one sub-slab soil gas sampled exceeded the short-term ATSDR comparison values (Table 1). It was concluded that the PCE in and under the house posed a *Public Health Hazard* to the residents in this house. The agencies recommended that interim measures be taken to reduce exposure to these residents and suggested several possible actions. These included the installation of a sub-slab depressurization system to vent sub-slab soil gas vapors to the outside air; sealing cracks in walls and floors of the basement; and sealing or fixing drains that could be a pathway for soil gas vapors to enter the home. It was suggested that these interim measures should be implemented as soon as possible while the long-term solution, the removal of the contaminated soils in the source area, was being implemented (Appendix A).

U.S. EPA Time-critical Removal Action

Vapor-intrusion Investigation

Citing the results of the initial sampling of indoor air and sub-slab soil gas in area residences and the conclusions and recommendations of the joint ATSDR-HAS Technical Memorandum, the U.S. EPA On-Scene Coordinator was authorized to complete a Time-critical Removal Action at the SSVP site March 2, 2006. This Removal Action included funding for 1) a expanded investigation of soil gas and indoor air quality in additional homes and businesses in the area; 2) installation of Sub-slab Vapor Abatement systems to reduce or eliminate the migration of vapor-phase chemicals into the indoor air in individual site-impacted homes; and 3) a source area Soil Removal Action to address the long-term hazard posed by the site (U.S. EPA, 2006A).

HAS, U.S. EPA, Ohio EPA, and Public Health – Dayton & Montgomery County (PHDMC) staff conducted a site visit at the site January 17, 2006 and met one-on-one with the residents of the two homes nearest to the identified source area to give them their sample results and to answer any questions they might have, especially any health concerns.

Following receipt of the initial sample results for area homes and businesses, ATSDR and HAS worked with the U.S. EPA OSC in February, 2006 to craft letters to go to the residents with their sample results. The letters were an attempt to better explain what their results meant and the need (or not) for additional U.S. EPA actions to mitigate or eliminate exposure to PCE from the site.

March 22, 2006, HAS, U.S. EPA, and MCCHD staff met with the residents of seven of the homes sampled by U.S. EPA on a one-on-one basis in the on-site U.S. EPA Mobile Command Center. Agency staff and the residents discussed vapor intrusion and the nature of the contamination associated with the SSVP site; provided residents with copies of their results; answered questions about their results; answered health-related questions regarding exposure to PCE; and discussed the proposed installation of the sub-slab mitigation systems. Following these discussions, the U.S. EPA OSC offered free installation of the sub-slab mitigations systems to residents if their homes had detections of PCE, either in the indoor air and/or the sub-slab sample.

Public Meeting

HAS, U.S. EPA, Ohio EPA, and representatives of the City of Dayton and the City of Riverside participated in a public meeting held by U.S. EPA April 26, 2006 at the Old Harshman School in Riverside. Roughly 35 area residents attended the meeting. Agency staff presented information about the history of the site, the nature of the contamination and the chemicals of concern, the results of the U.S. EPA investigation, and U.S. EPA plans to address the contamination through the Time-critical Removal Action. HAS staff answered a number of health-related questions from community members.

From March to May, 2006, U.S. EPA and their contractor continued to sample additional homes for both indoor air and sub-slab soil gas, eventually sampling 30 residences and five businesses in the area for PCE (Figure 5). The full extent of the soil gas contamination was delineated by U.S. EPA sampling by May, 2006.

Exposure Mitigation

Upon completion of the sub-slab and indoor air sampling, 12 residences were found to have exceeded the established ATSDR/HAS screening levels for PCE in either the sub-slab or the indoor air, or both (Table 1). As of June 5, 2006, all 12 homes had sub-slab vapor abatement systems installed by the U.S. EPA contractor. Performance sampling was initiated May 8, 2006 and completed August 10, 2006. The performance sampling results indicated that the sub-slab mitigation systems at each location was operating effectively and had lowered PCE levels below the established screening levels.

Source Removal

U.S. EPA's Emergency Contingency Plan was presented to area fire, EMS, and police, as well as the City of Riverside Planning Department, April 4, 2006. The U.S. EPA contractor mobilized at the SSVP site April 5, 2006. Removal of PCE-contaminated soil commenced at the identified source area April 10, 2006. As of May 15, 2006, all of the contaminated soils identified at the source area had been delineated, excavated, and transported off-site for disposal in roll-off boxes (3,000 cubic yards of soil). Confirmation sampling established that all of the contaminated soils with PCE levels in excess of 10 parts per million (ppm) had been removed. Real-time work zone and residential air monitoring was carried out during the time soil was being excavated and removed from the source area. Levels of VOCs in the ambient air around the site remained in the normal range for the duration of the removal action.

Follow-up Groundwater, Soil Gas & Indoor Air Sampling

Ohio EPA sampled geoprobe wells in the yard of an impacted residence and next to the former source area in May, August, and December of 2006 and again in August 2007. The results demonstrated a general reduction in PCE concentrations (Table 3). Ohio EPA sampled sub-slab soil gas adjacent to the source in August 2007 and found only minor detections of PCE and a substantial reduction in PCE levels (Table 4). PHDMC follow-up sampling of the indoor air of two impacted properties adjacent to the source area in April 2007 did not detect PCE (Table 5). The city of Dayton tested nearby wells in November 2007 and did not detect PCE.

DISCUSSION OF THE ISSUES

Area residents must come into physical contact with the hazardous chemicals associated with the Springfield Street VOC Plume site in order to be at risk from the development of adverse health effects. In order for the residents to come into contact with the site-related chemical of concern – perchloroethylene – there must be a **completed exposure pathway** linking the chemical contaminants in the environment to area residents. A "completed exposure pathway" consists of **five main parts** that must be present for a chemical exposure to occur. These include:

- A **Source** of the hazardous chemicals (=*PCE-contaminated soils at the trucking company lot*).

- A method of **Environmental transport** which allows the chemical (PCE) to move from the source area and bring it into contact with people (=*area groundwater and soil gas*).

- A **Point of Exposure** where people come into direct contact with the chemical of concern (= *indoor air in impacted homes and businesses*).

- A **Route of Exposure** which is how people come into contact with the chemical of concern (=*inhaling vapor-phase PCE*)

- A **Population at Risk** which are the people who come into contact with the chemical of concern (=*residents and workers in down-gradient homes and businesses impacted by vapors coming off of the groundwater contaminant plume*).

Exposure pathways can also be characterized as to when the exposure occurred and might have occurred in the **Past, Present,** or **Future**.

Physical contact with the chemical contaminant in and by itself does not necessarily result in adverse health effects. A chemical's ability to affect the health of an exposed population is also controlled by a number of other factors that include:

- How much of a chemical a person is exposed to (*the Dose*).

- How long a person is exposed to the chemical (*Duration* of exposure).

- How often a person is exposed to the chemical (*Frequency* of exposure).

- The chemical of concern's toxicology (How it affects the body).

Other factors affecting a chemical's likelihood of causing adverse health effects upon exposure includes the individual's:

- History of past exposure to chemicals.

- Smoking, drinking, or taking of certain medicines or drugs.

- Current health status.

- Age and sex.

- Family medical history.

Vapor Intrusion Pathway

Review of the results of the environmental investigations carried out by Ohio EPA and U.S. EPA in the vicinity of the Springfield Street VOC Plume site in Riverside established that the primary potential health concern was the possibility that the perchloroethylene (PCE) detected in the underlying groundwater plume in the area may be vaporizing off of the plume and moving as a gas up through the intervening thickness of soils and into basements and crawls spaces of homes and commercial properties situated above the footprint of this plume. In these confined indoor air environments, residents and area workers could be exposed to PCE through the inhalation of this gas in the air within the home or business. This potential pathway is termed the *Vapor Intrusion Pathway* (see Appendix B, *Vapor Intrusion: Answers to Frequently Asked Health Questions* Fact Sheet).

PCE is a man-made industrial solvent. It belongs to a group of chemicals termed Volatile Organic Compounds (VOCs). Typically, at room temperature, PCE is a clear, colorless, non-flammable liquid. However, upon exposure to the air, it readily vaporizes to a gas. At levels in excess of one part PCE per million parts of air (1.0 ppm), people can detect it as a sharp, sweet-smelling odor. When it is spilled on the ground, most of the PCE will vaporize up into the air. In the air, PCE can be relatively persistent, with a half-life of 70 days. With continued exposure to the sunlight, oxygen, and other chemicals in the air, PCE will eventually breakdown to other, simpler compounds.

Some of the PCE may, however, soak into the underlying soils and attach to the soil particles. Rainwater infiltrating down through PCE-containing soils will wash the PCE down through permeable soils into the underlying groundwater. Upon coming into contact with the groundwater, PCE, due to its density (heavier than water) tends to sink down through the aquifer as time and distance from the source increases. PCE can persist in the groundwater for long periods of time. With time and increasing depth below the ground surface, PCE in the groundwater will eventually biodegrade to a series of "daughter chemicals" including 1,2 dichloroethene and vinyl chloride.

If the groundwater surface (i.e. water table) is close to the ground surface (depths of 30 ft or less), the intervening subsurface soils are porous and permeable (consisting of sands and gravels) and with air-filled pore spaces, and the concentrations of the PCE in the groundwater are high enough (greater than 200-300 ppb), the PCE in the groundwater can be released at the interface with the overlying soils as a gas. Upon being released as a gas to the soils, the vapor-phase PCE migrates up through these intervening soils from the areas of higher pressure deeper within the ground to areas of lower pressure on top of the ground surface. Vapor-phase VOCs like PCE will tend to follow the path of least resistance, seeking out soils that are porous and permeable, allowing for easy movement of the gases up through the soils to the surface. Upon reaching the surface, these gases discharge to the atmosphere, mixing with the air which effectively dilutes the concentrations of these chemicals and leads to their chemical breakdown to simpler compounds upon exposure to sunlight and oxygen.

However, if these vapor-phase VOCs migrate up to and into homes and businesses, they undergo less mixing and dilution. Concentrations in the indoor air in these structures may remain high enough to pose a health threat to residents and workers if the trapped gases are inhaled by these individuals. This is particularly true in the winter months when homes are typically closed up tight, trapping the air inside and allowing for little or no free exchange with the outside air. If indoor air concentrations of these chemicals are high enough and/or if people are exposed to these chemicals long enough, these vapor-phase solvents can pose a health threat to residents.

Complete Vapor Intrusion Pathway

The investigations carried out by Ohio EPA in the fall and winter of 2005 documented that a completed exposure pathway via the vapor intrusion route existed at the Springfield VOC Plume site. These investigations identified:

1) PCE-contaminated source area in the trucking company parking lot (PCE up to 478,000 ppb in soil);

2) PCE in area groundwater up to 257 ppb;

3) PCE in soil gas overlying the groundwater on the trucking company property (up to 7,700 ppb);

4) PCE in soil gas adjacent to nearest residence (up to 3,000 ppb).

Sampling of soil gas under the basements of 30 adjacent residences and of indoor air inside these homes by U.S. EPA in the winter of 2005-2006 indicated PCE in sub-slab soil gas under 12 of these homes at levels from 0.72- 2,100 ppb and in the indoor air in five of these homes at levels from 0.14-30 ppb (Table 2). These data established that a completed exposure pathway via the vapor intrusion route linked residents of five of the 30 homes sampled with the PCE – contaminated soils in the identified source area. The chronic (long-term) screening level for PCE in indoor air in a residential home (= 1.2 ppb PCE) was exceeded in only two of the 30 homes tested (Table 2). None of the homes sampled came close to the 200 ppb acute (short-term) immediate action level for PCE in indoor air established by ATSDR Region V and HAS.

Toxicology of Perchloroethylene (PCE)

The chemical of concern identified at the Springfield Street VOC Plume site is the man-made chlorinated solvent Perchloroethylene (PCE). Other names for this chemical include Perc and Tetrachloroethylene. PCE is a widely-used industrial solvent. It was commonly used to degrease metal parts in a variety of industrial processes during the later half of the 20th century and it remains today the solvent of choice for many commercial dry-cleaning facilities. PCE also has been used in the past as a solvent in a variety of consumer products (water repellants, spot removers, fabric finishes, and adhesives) and was used in medical applications as a general anesthetic and as an anthelmintic in the treatment of parasitic worms in humans. Medical uses of the chemical and its use in consumer products were discontinued as it was replaced by less toxic chemicals in the 1960's and early 1970's. The main human exposure routes to PCE are via inhalation of PCE as a vapor or ingestion of PCE in contaminated drinking water. Absorption through the skin is not deemed to be a significant exposure route in people (ATSDR 1997a).

Until recently, U.S. EPA classified PCE as a B2 – “Probable” human cancer-causing agent based on animal studies and some limited evidence from occupational studies of workers in dry-cleaning establishments and epidemiological studies of people exposed to PCE through contaminated drinking water. The U.S. Department of Health and Human Services considers PCE to be “reasonably anticipated to be a human carcinogen” based on sufficient evidence from lab animal studies (NTP 2005). The U.S. EPA has pulled its cancer classification of PCE and is currently reviewing the information about PCE exposure and cancer in people.

Data with regard to adverse health effects in humans exposed to PCE in the environment comes primarily from occupational studies of dry-cleaner workers breathing elevated levels of PCE (greater than 50,000 ppb) in an enclosed air environment for long periods of time (years). These studies suggest associations between workers breathing in PCE at high levels for long periods of time and increased incidence of lymphomas, kidney, bladder, esophageal, intestinal, and cervical cancers in these workers (IARC 1995; ATSDR 1997a). These studies were confounded, however, by the presence of numerous other dry-cleaning chemicals in the indoor air in these facilities besides the PCE.

Health studies involving the ingestion of PCE in drinking water supplies are limited. PCE was identified as a chemical of concern in contaminated drinking water (along with the chlorinated solvent Trichloroethylene) in environmental exposure studies of populations in Woburn, Massachusetts, selected towns in New Jersey, and Camp Lejeune in North Carolina. Exposures to mixtures of these two solvents in drinking water supplies at comparatively high levels (300-2,000 ppb) were linked to excess levels of leukemia in all three populations (Lagako et al. 1984; Fagliano et al. 1990; ATSDR 2003).

Laboratory studies of mice and rats exposed to high levels of PCE via inhalation developed increased incidence of tumors in the liver. Similar studies indicated increased incidence of leukemia and rare kidney tumors in rats (ATSDR 1997a).

Non-cancer health effects from exposure to PCE target the central nervous system. Occupational studies of workers indicate that acute (short-term) exposure to high levels of PCE in the air (in excess of 500,000 ppb) can result in mood changes, headaches, short-term memory loss, faintness, dizziness, sleepiness, the loss of consciousness, plus a loss of muscle coordination (ATSDR 1997a). Some adverse reproductive effects have been reported in women workers at dry-cleaning facilities, including menstrual disorders and spontaneous abortion. The small size of these studies and the lack of accounting for other confounding factors limit the usefulness of these studies (ATSDR 1997a). There are no human health studies that have identified any adverse health effects associated with exposures to low-levels of PCE (single or double-digit part per billion levels) via either the inhalation or ingestion routes.

ATSDR has established 200 ppb PCE in air as a Minimal Risk Level (MRL), based on protection from neurological effects associated with acute (short-term) exposure to PCE (ATSDR 1997a). 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. HAS and ATSDR used this value as a short-term action level for PCE in indoor air in residential structures for this site (Table 1).

ATSDR has also established a MRL of 40 ppb based on non-cancer neurological effects in humans as a health-based comparison value for chronic-duration (longer term) inhalation exposure to PCE.

> None of the homes sampled as part of the U.S. EPA investigation at this site exceeded ATSDR's acute or chronic comparison values, and no non-cancer adverse health effects are expected. However, two of the 30 residences sampled were above the long-term screening level based on the acceptable cancer risk established for this site.

It is unknown how long the contamination has existed under the impacted neighborhood or whether or not residents were being exposed to these chemicals via the vapor intrusion route in the past.

Child Health Considerations

In communities faced with air, water, or food contamination, the many physical differences between children and adults demand special emphasis. Children could be at greater risk than are adults from certain kinds of exposure to hazardous substances. Children play outdoors and sometimes engage in hand-to-mouth behaviors that increase their exposure potential. Children are shorter than are adults; this means they breathe dust, soil, and vapors close to the ground. A child's lower body weight and higher intake rate results in a greater dose of hazardous substance per unit of body weight. If toxic exposure levels are high enough during critical growth stages, the developing body systems of children can sustain permanent damage. Finally, children are dependent on adults for access to housing, for access to medical care, and for risk identification. Thus adults need as much information as possible to make informed decisions regarding their children's health. The actions taken to eliminate and/or reduce exposure considered children's' health.

CONCLUSIONS

Based on environmental information of the Springfield Street VOC Plume site (SSVP) and the vapor intrusion into residences, ODH HAS concluded that the site posed a **public health hazard**. Conclusions for site conditions over time are as follows:

- The SSVP site posed an ***indeterminate public health hazard*** for exposure of nearby residents to contamination ***in the past*** prior to the initiation of the U.S. EPA investigation in December 2005. It is unknown how long the contamination has existed under the impacted neighborhood or whether or not residents were being exposed to these chemicals via the vapor intrusion route in the past.

- The SSVP site posed a ***public health hazard*** for exposure of nearby residents to contamination by vapor intrusion ***in 2005 and 2006***. A completed exposure pathway via the vapor intrusion route linked residents of five of the 30 homes sampled with the PCE – contaminated soils in the identified source area. Non-cancer health effects are not expected due to exposure; however, the concentrations of PCE in the indoor air in two homes were above guidelines based on acceptable cancer risks established at this site. On-going exposure of these residents ceased with installation of sub-slab vapor abatement systems in 12 of the 30 homes sampled.

- The SSVP site should pose ***no public health hazard*** for residents living in the area ***in the future***. Follow-up confirmation sampling indicated that operation of the vapor abatement systems had reduced sub-slab and indoor air levels of PCE below the long-term screening levels established for this compound. These vapor abatement systems should continue to reduce the levels of the chemicals from under homes and the indoor air as long as they are properly operating and maintained. As of May 15, 2006, all of the contaminated soils identified at the source area had been delineated, excavated, and removed as part of the U.S. Time-critical Removal Action. Subsequent sampling by the Ohio EPA verified significant declines in levels of PCE in area groundwater and soil gas. This should further reduce potential vapor threats to area residents.

RECOMMENDATIONS

Long-term monitoring of the vapor abatement systems is recommended.

PUBLIC HEALTH ACTION PLAN

Ohio EPA sampled groundwater near the source area (5/06, 8/06, 12/06 and 8/07) and Public Health - Dayton & Montgomery County conducted follow-up air monitoring in April 2007. Sampling of groundwater and soil gas in down gradient portions of the site sampled by Ohio EPA in 2006 and 2007 indicated significant reductions in PCE levels in these media compared to the initial sampling conducted by Ohio EPA in 2004 (Tables 3 & 4).

Confirmation sampling of homes with installed sub-slab vapor abatement systems in 2005 & 2006 by U.S. EPA demonstrated reductions of levels of PCE in indoor air and sub-slab soil gas to concentrations below health-based screening levels. This was verified by additional indoor air sampling of area residences conducted by PHDMC staff in April 2007 which confirmed that indoor air levels of PCE remained at no-detect (Table 5).

Both of these sets of results indicate that the Springfield Street VOC Plume site does not pose a public health hazard to area residents at this time.

PREPARERS OF THE REPORT

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

REFERENCES

AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY (ATSDR) 1997. ToxFAQs for Tetrachloroethylene (PERC). September 1997.

ATSDR. 1997a. Toxicological Profile for Tetrachloroethylene. U.S. DHHS, Atlanta. 278 p + Appendices. September 1997.

ATSDR. 1997b. Toxicological Profile for Trichloroethylene (Update). U.S. DHHS, Atlanta. 298 p + Appendices. September, 1997.

ATSDR. 1997c. Toxicological Profile for Benzene. U.S. DHHS, Atlanta. 423 p + Appendices. September 1997.

ATSDR. 2003. ToxFAQs for Trichloroethylene. July 2003.

FAGLIANO, J. and M. BERRY, et al. 1990. Drinking Water Contamination and the Incidence of Leukemia: An Ecologic Study. American Journal of Public Health. v. 80, p. 1209-1212.

INTERNATIONAL AGENCY FOR RESEARCH ON CANCER (IARC). 1995. World Health Organization. IARC Monographs on the Evaluation of Carcinogenic Risks to Humans. Volume 63. Dry Cleaning, Some Chlorinated Solvents and Other Industrial Chemicals. 5. Summary of Data Reported and Evaluation

LAGAKO, S.W., B.J. WESSON and M. ZELEN. 1984. An Analysis of Contaminated Well Water and Health Effects in Woburn, Massachusetts. Technical Report No. 3, Department of Biostatistics, Harvard School of Public Health.

NATIONAL TOXICOLOGY PROGRAM (NTP) 2005. Official Citation: Report on Carcinogens, Eleventh Edition; U.S. DHHS, Public Health Service, NTP, January 31, 2005.

DEPARTMENT OF HEALTH AND HUMAN SERVICES. ATSDR. 2006. Letter from Mark Johnson, Michelle Watters, and Robert Frey to Steve Renninger of U.S. EPA. January 19, 2006.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY (U.S. EPA). 2002. OSWER Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils (Subsurface Vapor Intrusion Guidance) Tables. U.S. EPA. November, 2002. EPA 530-D-02-004.

U.S. EPA. 2006 Edition of the Drinking Water Standards and Health Advisories. EPA 822-R-06-013. Office of Water. Washington DC. Summer 2006.

CERTIFICATION

This Springfield Street VOC Plume Health Consultation was prepared by the Ohio Department of Health under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with approved methodology and procedures existing at the time the health consultation was begun. Editorial review was completed by the Cooperative Agreement Partner.

Technical Project Officer, CAT, CAPEB, DHAC, ATSDR

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

Team Lead, Cooperative Agreement Team, CAPEB, DHAC, ATSDR

TABLES

Table 1. Air Screening Levels

	Long-Term Screening Level (ppb)[1]			
Indoor Air				
Benzene	1	4.2	50	210
PCE	1.2	5	200	840
TCE	0.04	0.17	100	420
Sub-slab[4]				
Benzene	10	42	500	2,100
PCE	12	50	2,000	8,400
TCE	0.4	1.7	1,000	4,200

Source: ATSDR Region 5/ODH 2006

ppb - parts per billion (ppb) by volume
PCE - Perchloroethylene, also known as tetrachloroethylene
TCE - Trichloroethylene

[1]**Long-term screening levels** are based on U.S. EPA's guidelines using a 10^{-5} cancer risk and are found in U.S. EPA's "Draft Guidance for Evaluating Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils (Subsurface Vapor Intrusion Guidance), Appendix F (Table 2b)," November 2002.

[2]**Immediate action levels** provided are based on ATSDR's acute or intermediate air comparison values: PCE (Acute MRL); TCE (Intermediate MRL), Benzene (Acute MRL as of 1997).

[3]**Non-residential** values are derived by adjusting the exposure time from the residential values. Thus, a 4.2 factor is applied to adjust from a 168 hour week for residential exposure to a 40 hour per week non-residential exposure.

[4]In evaluating sub-slab air samples, a 10-fold attenuation factor is applied to these values, based on the U.S. EPA draft Subsurface Vapor Intrusion Guidance.

Table 2. Air Sampling Results
Locations Exceeding Screening Levels

Location ID				
RES-1	Sub-slab	ND	1,700	39
	Sub-slab	1.5	2,100	ND
	Indoor Air	2.7	30	0.36 (J)
RES-3	Sub-slab	ND	400	13.0
	Indoor Air	0.47	4.0	ND
RES-4	Sub-slab	ND	0.61	ND
	Sub-slab	0.13	14	ND
	Indoor Air	0.37	0.14	ND
RES-10	Sub-slab	0.20 (J)	22	ND
	Indoor Air	0.64	0.6	ND
RES-12	Sub-slab	0.17 (J)	410	7.2
	Indoor Air	0.18 (J)	ND	ND
RES-28	Sub-slab only	20.4	63.2	24.9
RES-29	Sub-slab only	ND	81.6	1.0
COM-1	Sub-slab	0.15 (J)	1,100	140
	Sub-slab	0.102 (J)	1,400	76
	Indoor Air	1.6	6.8	ND
COM-2	Sub-slab	ND	170	3.3
	Sub-slab	1.6	ND	ND

Source: U.S. EPA June 2006

ppb – parts per billion
PCE – Perchloroethylene, also known as tetrachloroethylene
TCE – Trichloroethylene
ND – Not detected
(J) – Analytical result is between the method detection limit (MDL) and the practical quantitation limit (PQL)

Table 3. Ground Water Sampling Results for Geoprobe Wells Down-gradient of Source Removal Area

Sample ID	***Location***	***Date***	***Analytical Results (µg/L)***	
			PCE	***TCE***
Geoprobe Well -1	RES-1	2/9/06	65.2	3.61
		4/14/06	44.3	1.51
		5/19/06	32.3	0.67
		8/18/06	7.49	ND
		12/20/06	18.5	0.5
		8/27/07	2.26	ND
Geoprobe Well - 2	RES-1	2/9/06	10.6	ND
		4/14/06	6.74	ND
		5/19/06	5.02	ND
		8/18/06	2.91	ND
		12/20/06	3.55	ND
		8/27/07	3.47	ND

Source: U.S. EPA September 2008

Table 4. Sub-slab Soil Sampling Results for House Adjacent to Source

Sample ID	***Location***	***Date***	***PCE (ppb)***
SS-1	RES-1	12/7/05	1,700
		8/27/07	46
SS-2	RES-1	12/7/05	2,100
		8/27/07	2

Source: U.S. EPA September 2008

Table 5. Indoor Air Sampling Results for House Adjacent to Source

Sample ID			
Before	RES-1	12/15/05	30
After		4/19/07	ND
Before	RES-20	4/14/06	ND
After		4/19/07	ND

Source: PHDMC June 2007

ppb – parts per billion
PCE – Perchloroethylene, also known as tetrachloroethylene
ND – Not detected

FIGURES

Figure 1. Springfield Street VOC Plume Site
Riverside (Montgomery County), Ohio

Source: Ohio EPA 2005

Figure 2. Area of Concern and Identified Source Area

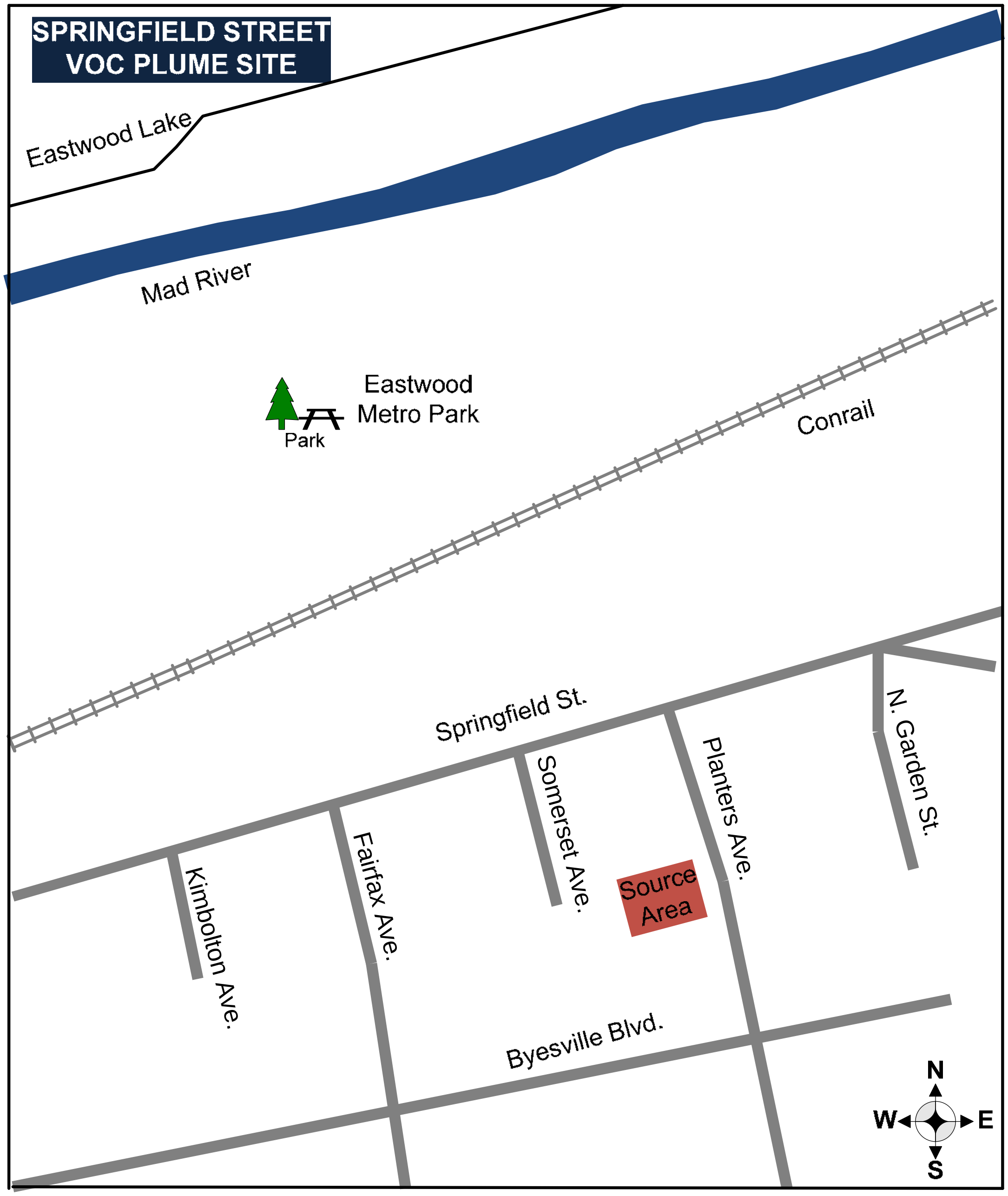


Figure 3. PCE Plume
Ohio EPA Springfield Street Plume Investigation

Source: Ohio EPA

Figure 4. Soil Gas Sample Locations

Source: Ohio EPA

Figure 5. Residential Sample Location Map

Source: U.S. EPA 2006

APPENDICES

DEPARTMENT OF HEALTH & HUMAN SERVICES

Public Health Service

Agency for Toxic Substances
and Disease Registry
Atlanta GA 30333

January 19, 2006

Steven Renninger, On-Scene Coordinator
U.S. EPA Region V
Emergency Response Branch
26 West Martin Luther King Drive (B-4)
Cincinnati, OH 45268

Re: Sampling results for two residential properties at the Springfield Street VOC Plume Site, Riverside, Ohio.

Steve:

As requested, the Agency for Toxic Substances and Disease Registry (ATSDR) and the Ohio Department of Health (ODH) has reviewed the sampling results taken from two residences within the vicinity of the Springfield Street VOC Plume Site, Riverside, Ohio. On December 14, 2005, indoor air and sub-slab air samples were taken at these two locations using 24-hour Summa canisters and sent for analysis of volatile organic compounds (VOCs).

<u>1009 Planters Avenue</u>
At the 1009 Planters Avenue residence, tetrachloroethylene (PCE) was measured at concentrations that are of concern. PCE was found at 30 ppb in the basement. Exposure to this concentration over long periods of time would exceed Ohio EPA's guidelines based on an increased risk of cancer of 10^{-5}. This PCE concentration falls below ATSDR's acute and chronic comparison values for non-cancer health effects (200 ppb and 40 ppb, respectively). The two sub-slab air monitoring values at this location measured 2100 and 1700 ppb. Assuming a ten-fold attenuation factor, PCE concentrations in the sub-slab air exceed the acute ATSDR comparison value of 2000 ppb (200 ppb x 10). Therefore, based on the long-term indoor air guidelines, the levels of PCE at this location present a public health hazard. Based on the acute sub-slab comparison values, the levels of PCE pose a continued potential source as a public health hazard.

We recommend that interim measures be taken to reduce exposure to PCE at 1009 Planters Avenue. Interim measures to disrupt the vapor intrusion pathway into these 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. We recommend a phased approach to reduce the potential for any health impacts. Thus, interim measures should be implemented as soon as feasible, while the long-term solution, such as source removal at the site, is being executed.

Benzene concentrations in indoor air at 1009 Planters Avenue were also slightly above the Ohio EPA's guidance for long-term exposures. However, sub-slab air concentrations were less than indoor air concentrations, suggesting that there may be an indoor source for this compound. Although we do not have specific information about the residence, benzene is known to be released from smoking tobacco and is found in some consumer products that may have been present in the home during sampling. At this point, we cannot conclusively attribute the source of the benzene as being site-related.

1004 Planters Avenue

The results of the crawl space air sampling performed at 1004 Planters Avenue indicated that all VOCs were detected at concentrations below Ohio EPA's guidelines and ATSDR's air comparison values. As described to us, the crawl space was vented and more closely approximated ambient air rather than indoor air. Review of background samples of ambient air suggests that this assumption is correct. Under these conditions, there is currently no public health hazard at this residence. However, given the proximity to the site and also the indoor air results from the neighboring home at 1009 Planters, it is reasonable to assume that without ventilation concentrations of PCE would be higher. Therefore we recommend continued ventilation at this site or other interim measures be taken to disrupt the vapor intrusion pathway until a long-term solution is in place.

Based on these results, we strongly encourage you to sample additional homes in the vicinity of the plume to determine if they have been impacted by vapor intrusion. The sampling results for these residences will be the subject of an additional evaluation, to be documented in a Health Consultation for the site.

Thank-you for the opportunity to review the sampling results. Should you need additional information, please contact Bob Frey (ODH: 614-466-1069) or Mark Johnson and Michelle Watters (ATSDR: 312-886-0840).

Sincerely,

Mark Johnson, PhD
Senior Regional Representative
ATSDR-Region 5

Robert C. Frey, PhD
Chief, Health Assessment Section
Ohio Department of Health

Michelle Watters, MD, PhD, MPH
Medical Officer
ATSDR-Region 5

cc: Jason El-Zein, USEPA
Randy Watterworth, OEPA
Robert Knowles, ATSDR, DHAC
Tina Forrester, ATSDR, DRO

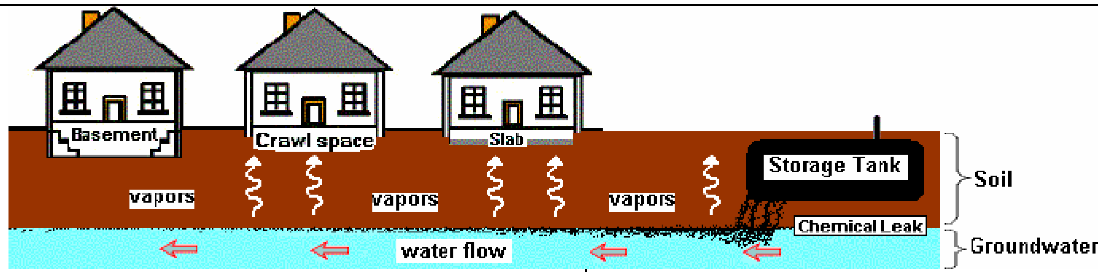
Appendix B. Fact Sheets

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:
How much you were exposed to (dose).
How long you were exposed (duration).
How often you were exposed (frequency).
How toxic the spill/leak chemicals are.
General Health, age, lifestyle: 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 first 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)

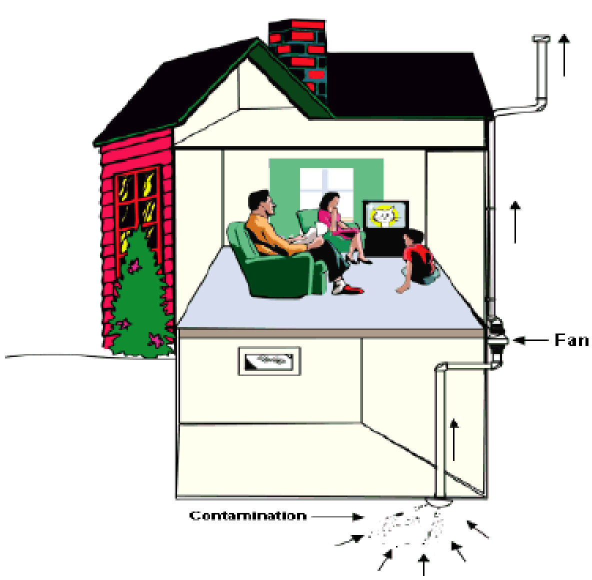
How is vapor intrusion investigated? (continued)

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:

Ohio Department of Health
Bureau of Environmental Health
Health Assessment Section
246 N. High Street
Columbus, Ohio 43215
Phone: (614) 466-1390
Fax: (614) 466-4556

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?

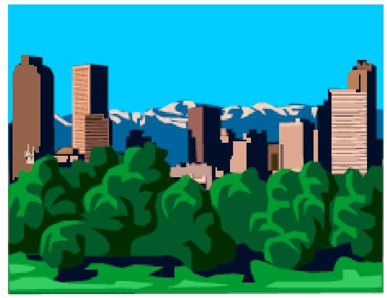
Tetrachloroethylene (PERC) can evaporate into the air during dry cleaning operations and during industrial use. It can also be released in air if it is not properly stored or was spilled. If it was spilled or leaked into the soil, it may be found in groundwater (or underground drinking water).

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.

This pamphlet was created by the Ohio Department of Health, Bureau of Environmental Health, Health Assessment Section and supported in whole by funds from the Comprehensive Environmental Response, Compensation and Liability Act trust fund.

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):

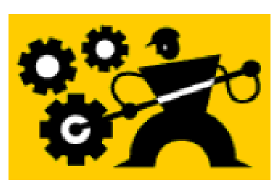
- Breathing high levels of TCE may cause headaches, lung irritation, dizziness, poor coordination (clumsy) and difficulty concentrating.
- Breathing very high levels of TCE for long periods may cause nerve, kidney and liver damage.

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)

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.

This pamphlet was created by the Ohio Department of Health, Bureau of Environmental Health, Health Assessment Section and supported in whole by funds from the Cooperative Agreement Program grant from the ATSDR.

ATSDR AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

Updated 10/12/06

Bureau of
Environmental Health
Health Assessment Section

"To protect and improve the health of all Ohioans"

Benzene (ben' zeen)

Answers to Frequently Asked Health Questions

What is benzene?

Benzene, also known as benzol, is a colorless liquid with a sweet odor. It is highly flammable and evaporates in the air quickly.

Where do you find benzene?

Most people are exposed to small amounts of benzene in the air outside, at work, and in the home. Most everyone is exposed to low levels of benzene in their every day activities.

Benzene is a natural part of crude oil, gas, and cigarette smoke. Auto exhaust and industrial emissions account for about 20% of the total nationwide exposure to benzene. About 50% of the entire nationwide exposure to benzene results from smoking tobacco or from exposure to tobacco smoke. Other natural sources of benzene include volcanoes and forest fires.

The outdoor air has low levels of benzene that come from the car exhaust, gas fumes and cigarette smoke. Indoor air usually contains higher levels of benzene that can be found in cigarette smoke, glues, paints, furniture wax, and detergents.

Benzene is widely used in U.S. industry. Some industries use benzene to make other chemicals which are used to make plastics, resins, and nylon and synthetic fibers. Benzene is also used to make some types of rubbers, lubricants, dyes, detergents, drugs and pesticides.

How do you come in contact with unhealthy levels of benzene?

In the air:

- Higher levels of benzene can be released in the air around industries that make or use benzene.

In the underground drinking water:

- If underground storage tanks containing benzene leak, benzene could get into the underground well water and pollute it.

Occupation (job):

- Working in an industry that makes or uses benzene.

Can benzene make you sick?

Yes, you can get sick from benzene. Getting sick will depend on:

- 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 benzene affect health?

Breathing benzene:

Breathing high levels of benzene can cause rapid heart rate, dizziness, headaches, tremors (shaking), confusion, drowsiness (sleepy), and unconsciousness (passing out). Breathing very high levels of benzene can result in death.

Eating or drinking benzene:

Eating foods or drinking water containing high levels of benzene can cause an irritated (upset) stomach, vomiting, rapid heart rate, dizziness, convulsions (severe shaking), sleepiness, and death.

Long-term exposure to benzene:

Long-term exposure (365 days or longer) to high levels of benzene causes serious problems with the production of blood. Benzene harms the bone marrow which produces the body's red and white blood cells. Red blood cells carry oxygen and white blood cells fight infection. A decrease in red blood cells leads to anemia. A decrease in white blood cells affects the immune system and increases the chance for infection.

Women exposed to benzene:

Some women who breathed high levels of benzene for many months had irregular menstrual periods and a decrease in the size of their ovaries. It is not known whether benzene exposure affects the developing fetus in pregnant women or fertility in men.

Does benzene cause cancer?

The Department of Health and Human Services (HHS) has determined that benzene is a known human carcinogen (causes cancer).

Long-term exposure to high levels of benzene in the air can lead to leukemia and cancers of the blood-forming organs.

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

Several tests can show if you have been exposed to benzene. However, all these tests must be done shortly after exposure because benzene leaves the body quickly. These tests include testing the breath, blood and urine. However, the urine test may not be as effective to measures benzene levels.

Note that all these tests will show the amount of benzene in your body but cannot tell you whether you will have any harmful health problems. They also do not tell you where the benzene came from.

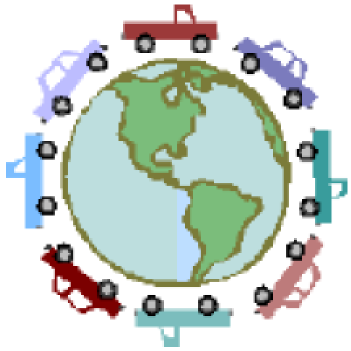
What has been done to protect human health?

Most people can begin to smell benzene in air at 1.5 - 4.7 parts of benzene parts per million (ppm) and smell benzene in water at 2 ppm. Most people can begin to taste benzene in water at 0.5 - 4.5 ppm.

The Occupational Safety and Health Administration (OSHA) has set a permissible 1 ppm exposure limit of air in the workplace during an 8-hour workday, 40-hour week.

The Environmental Protection Agency (EPA) has set the maximum permissible level of benzene in drinking water at 0.005 parts per million (ppm).

The EPA requires benzene spills or accidental releases into the environment of 10 pounds or more of be reported to the EPA.



For more information contact:

Ohio Department of Health
Bureau of Environmental Health
Health Assessment Section
246 N. High Street
Columbus, Ohio 43215
Phone: (614) 466-1390
Fax: (614) 466-4556

Reference:

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

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.

This pamphlet was created by the Ohio Department of Health, Bureau of Environmental Health, Health Assessment Section and supported in whole by funds from the Comprehensive Environmental Response, Compensation and Liability Act trust fund.

Revised 10/28/03

DEPARTMENT OF HEALTH & HUMAN SERVICES

Public Health Service

Agency for Toxic Substances and Disease Registry
Mailstop E-60
1600 Clifton Road, NE
Atlanta, GA 30333

Date December 18, 2008

From Division of Health Assessment and Consultation, ATSDR

Subject Health Consultation
Springfield Street VOC Plume

To Mark Johnson
Senior Regional Representative, ATSDR, Region V

Enclosed please find a copy of the December 18, 2008 Health Consultation on the following site prepared by the Ohio Department of Health under cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR).

Vapor Intrusion Concerns

SPRINGFIELD STREET VOC PLUME
RIVERSIDE, MONTGOMERY COUNTY, OHIO

The Division of Health Assessment and Consultation requires copies of all letters used to transmit this document to the agencies, departments, or individuals on your distribution list. The copy letters will be placed into the administrative record for the site and serve as the official record of distribution for this health consultation.

Please address correspondence to the Agency for Toxic Substances and Disease Registry (ATSDR) Records Center, 1600 Clifton Road, NE (F09), Atlanta, Georgia 30333.

Freda Dumas
Manager, ATSDR Records Center

Enclosures
cc: W. Cibulas, Jr. R. Gillig T. LeCoultre L. Luker L. Daniel