Health Consultation

DONNELSVILLE CONTAMINATED AQUIFER
(Residential Wells)

DONNELSVILLE, CLARK COUNTY, OHIO

EPA FACILITY ID: OHN000510459

Prepared by the
Ohio Department of Health

OCTOBER 31, 2011

Prepared under a Cooperative Agreement with the
U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Agency for Toxic Substances and Disease Registry
Division of Health Assessment and Consultation
Atlanta, Georgia 30333

Health Consultation: A Note of Explanation

A health consultation is a verbal or written response from ATSDR or ATSDR's Cooperative Agreement Partners 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 or ATSDR's Cooperative Agreement Partner 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

DONNELSVILLE CONTAMINATED AQUIFER
(Residential Wells)

DONNELSVILLE, CLARK COUNTY, OHIO

EPA FACILITY ID: OHN000510459

Prepared By:

The Health Assessment Section
of the Ohio Department of Health
Under a Cooperative Agreement with the
Agency for Toxic Substances and Disease Registry

SUMMARY

Introduction

The Health Assessment Section (HAS) of the Ohio Department of Health (ODH), in cooperation with the Agency for Toxic Substances and Disease Registry (ATSDR), seeks to assist the village of Donnelsville, Ohio by using the best environmental science, providing accurate health information, and taking public health actions to prevent harmful exposures and disease related to toxic substances.

In response to a request from the Ohio EPA, this public health consultation is HAS/ATSDR's evaluation of the environmental data regarding the Donnelsville Contaminated Aquifer in the village of Donnelsville, Clark County, Ohio. This report reviews the available environmental sampling data collected by the Ohio Environmental Protection Agency (Ohio EPA) and by the U.S. EPA regarding groundwater contamination in order to determine if the chlorinated solvents in well water pose a public health concern during indoor use, and whether or not the contaminants pose a public health hazard.

Overview

The HAS reached two conclusions about the Donnelsville Contaminated Aquifer.

Conclusion 1

HAS concludes that exposure to tetrachloroethylene (PCE) found in private well water over the course of a lifetime in the affected area in Donnelsville could harm people's health. This is a public health hazard.

Basis for decision

The data show that there is a potential health threat with an increased theoretical cancer risk for Donnelsville residents exposed to PCE over a lifetime (70 years). The levels of the chlorinated solvent PCE found in drinking water, along with predicted levels of PCE vapors during showering and bathroom use, were used to calculate theoretical cancer risks from exposure to PCE in Donnelsville and compared to the range of guidelines (10^{-6} to 10^{-4}) recommended by the U.S. EPA. To date, a total of 13 residential wells sampled by the U.S. EPA exceed the cancer risk guidelines for a population exposed to PCE over a lifetime.

Combining the Ohio EPA and U.S. EPA sampling events, a total of 17 wells, to date, have PCE levels that exceed the federal drinking water standard or maximum contaminant level (MCL) of 5 parts per billion (ppb). Although the U.S. EPA drinking water standards apply to public drinking water supplies, ODH uses these standards for making recommendations regarding the safety of private wells.

Next steps

More sampling is needed to determine the full extent of the contamination. Additional wells may be affected and need to be tested. The possibility of vapor intrusion into homes should also be investigated. The source(s) of the chlorinated solvent impacting the local aquifer needs to be identified, isolated and contained, or removed. The U.S. EPA is currently conducting a time-critical removal action for the Donnelsville Contaminated Aquifer site and has sampled additional residential locations as they are identified. The U.S. EPA has offered affected area residents whole-house water treatment systems, including a water softener and an air stripper, which remove volatile organic compounds (VOCs) from well water and safely vents them outside. As of October 2011, a total of 18 systems have been installed.

Conclusion 2

HAS concludes that the levels of PCE found in private wells in Donnelsville do not pose an immediate health hazard to the residents.

Basis for decision

Based on the doses estimated using the maximum levels of PCE found in area drinking water, PCE is not expected to cause any adverse, non-cancer health effects. The estimated exposure dose of PCE for either a child or an adult who is drinking water containing the maximum level of PCE detected is less than ATSDR's minimal risk level (MRL) for acute-duration oral exposure or the U.S. EPA's reference dose (RfD) for long-term (chronic) daily oral exposure. The estimated concentration of PCE in air when bathing or showering does not exceed ATSDR's health-based comparison values for non-cancer health effects over either short-term or long-term periods of exposure. The combined dose from drinking water intake and inhalation/dermal exposure is well below doses associated with non-cancer adverse health effects in animals and health-based comparison values. However, additional well sampling and seasonal variations could lead to the discovery of higher levels of PCE than those encountered thus far at the site.

Next steps

More sampling is needed to determine the full extent of the contamination. Additional homes may be affected and need to tested. The possibility of vapor intrusion into homes also should be investigated. The source(s) of the contaminated aquifer need to be identified, isolated and contained, or removed.

For more information

Citizens can contact Kristopher Weiss of Ohio EPA at (614) 644-2160 with general questions about this site. For more technical questions, you can contact Anthony Campbell, Site Coordinator, Ohio EPA, Southwest District Emergency and Remedial Response at (937) 285-6357.

If you have concerns about your health, you should contact your health care provider. You can also contact Bob Frey, Chief of the Health Assessment Section at the Ohio Department of Health at (614) 466-1390 and ask for information about this site.

If you have questions concerning an alternative water supply or residential water treatment system, please contact Dan Chatfield at Clark County Combined Health District at (937) 390-5600, ext. 239.

The U.S. EPA site information and On-Scene Coordinator contact information is available at: http://www.epaosc.org/site/site_profile.aspx?site_id=6536.

BACKGROUND AND STATEMENT OF ISSUES

This health consultation is in response to a request from Ohio EPA's Southwest District Office to evaluate the public health threat posed by exposures to volatile organic compounds (VOCs) from residential well water in the village of Donnelsville, Ohio. The Health Assessment Section (HAS) at the Ohio Department of Health (ODH) evaluated the Ohio EPA water sampling results for this site to determine if chlorinated solvents in well water pose a public health hazard from drinking and breathing during indoor (bathing) use and to make recommendations for further actions at this site to the U.S. EPA Emergency Response Branch On-Scene Coordinator.

Donnelsville is a village in Clark County, Ohio, located on U.S. Route 40 west of Springfield, Ohio (Figure 1). According to the U.S. Census, the population in 2000 was 293. Of the 98 occupied housing units, 79 are owner-occupied and 19 are renter-occupied housing units. There were 98 households and 81 families residing in the village with an average household size of about 3. There were 11 vacant housing units.

Village residents obtain their drinking water from private wells. Most of the wells in the western half of the village were drilled in the 1950's and are less than 100 feet in depth (Ohio Dept. of Natural Resources, Well Logs). These wells have yields of 3-10 gallons of water per minute and obtain their water from a limestone bedrock aquifer that is separated from the ground surface by 12 to 20 feet of mostly clay soils. This water-bearing limestone layer appears to be about 35-50 feet thick in the area with the underlying rock consisting of clay shale and thin crystalline limestone that is devoid of water. The soil cover in the area appears to thin from the east to west, toward Donnelsville Creek along the west edge of the village.

The Ohio EPA sampled drinking water from 31 residential wells, 4 non-residential wells, and a school in the village of Donnelsville in September 2010. The results of the environmental sampling indicated that the water from nine homes contained tetrachloroethylene (PCE) above the federal maximum contaminant level (MCL) of 5 parts per billion (ppb). The highest concentration was 21 ppb (Personal Communication: Ohio EPA Nov. 22, 2010). The wells with the highest concentration of PCE occur along Hampton Road at the western edge of the village (Figure 1). The highest levels detected are north of U.S. Route 40.

On December 17, 2010, the Ohio Department of Health (ODH) officially requested assistance from the U.S. EPA in addressing drinking water contamination impacting drinking water wells in Donnelsville, Ohio (see Appendix A). From January 11 to 14, 2011, the U.S. EPA collected 17 samples from 16 well locations in a targeted area in the northwest area of town along North Hampton Road. Six of these wells were sampled by Ohio EPA in 2010. The U.S. EPA On-Scene Coordinator requested that the HAS review and evaluate the results of this sampling in a public health consultation. Results indicate that 8 not previously tested wells had PCE levels greater than the MCL. Combining the Ohio EPA and U.S. EPA sampling events brought the total number of wells above the MCL to 17.

DISCUSSION

Exposure Pathways

In order for the public to be exposed to elevated levels of chemical contaminants in Donnelsville, Ohio, they must come into direct contact with the contaminated groundwater. To come into direct contact with the contaminated groundwater, 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 the hazardous chemicals (=*PCE-contaminated groundwater: however, a specific source of this contamination has not been located)*.
2. 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*).
3. A **Point of Exposure** where people come into direct contact with the chemical of concern (= *residential wells of impacted homes*).
4. A **Route of Exposure** which is how people come into contact with the chemical of concern (=*drinking contaminated well water and breathing vapor-phase PCE during showering*).
5. A **Population at Risk**, which are the people who come into contact with the chemical of concern (=*residents with contaminated well water*).

Physical contact with the chemical contaminant does not necessarily result in adverse health effects. A chemical's ability to affect the health of an individual 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 include the individual's:

- History of past exposure to chemicals.
- Smoking, drinking, or taking of certain medicines or drugs.
- Current health status.
- Age and gender.
- Family medical history.

Groundwater Pathway

Currently, there is a completed exposure pathway from an unknown source that has impacted the residential drinking water wells in Donnelsville, Ohio. There is an indication that people may have been drinking contaminated water for a long period of time, at least since 1995. An earlier investigation conducted by the Ohio EPA in 1995 found PCE below the MCL in a well used by Donnelsville Elementary School. In addition, three nearby private wells had detections of PCE, all below the MCL. At that time, an attempt was made to locate the source of contamination without success. In 2006, as part of the local school district facilities' modernization, Donnelsville Elementary School was razed and a new school built on the same property. A new drinking water well was also drilled to replace the contaminated one. To date, PCE has not been detected in the school's new well (Personal Communication: Ohio EPA Nov. 19, 2010).

In September 2010, the Ohio EPA sampled drinking water from 36 wells in the village of Donnelsville, Ohio. This was a follow-up to the more limited investigation in 1995. The results of the site inspection (SI) indicated that the water from nine homes contained tetrachloroethylene (PCE) above the maximum contaminant level (MCL) of 5 parts per billion (ppb). The maximum concentration of PCE found was 21 ppb. The results are summarized in the tables below (Table 1). Degradation products of PCE, including trichloroethylene (TCE), cis-1,2-dichloroethylene (cis-1,2-DCE), and vinyl chloride (VC) were analyzed for but not detected above the method detection limit of 0.5 ppb for these compounds.

Table 1: PCE Detected in Private Wells in 2010

Range of Detections (ppb)	*Average of Detections (ppb)*	*Frequency of Detections*	*Frequency Above Comparison Value*	*Comparison Value (ppb)*	*Type*
ND − 21	5.4	23/36	9/36	5	MCL

Source: Ohio EPA 2010

ppb – parts per billion
ND – Not Detected
MCL – Maximum Contaminant Level (U.S. EPA)

Vapor Intrusion Pathway

Vapor intrusion is the movement of volatile chemicals and gases from soil and groundwater up through the soil and into the indoor air of homes and commercial buildings. PCE is a volatile organic compound that can vaporize off of contaminated groundwater or soil and migrate as a gas to the indoor environment of nearby homes and buildings. Vapor intrusion into indoor air from the subsurface may be a possibility at this site depending on the geology of the area. Although the aquifer is separated from the ground surface by 12 to 20 feet of clay soils, making vapor intrusion less likely, the soil cover appears to diminish toward the west edge of the village where the affected area is located. Therefore, the possibility of vapor intrusion into homes should be evaluated further.

Health Evaluation of Ohio EPA Sampling Data

Discussion

Tetrachloroethylene (also known as perchloroethylene, PCE or PERC) is a nonflammable liquid at room temperature and is widely used for dry cleaning of fabrics and for metal degreasing. Other major uses of PCE are 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 1,000 ppb), PCE's distinctive odor can be smelled 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 move downward through soils to underground water where it may remain for a long time. Under oxygen-poor conditions and with time, bacteria will degrade some of the PCE that is in groundwater, leading to the formation of breakdown products, including 1,2-dichloroethylene and vinyl chloride (Vogel and McCarty 1985). PCE is most frequently detected in the air and less often in drinking water. It does not appear to bioaccumulate in fish or other animals that live in water. People are typically exposed to PCE from occupational sources, consumer products, and environmental sources.

Sampling by the Ohio EPA indicates that PCE has been detected in a number of residential wells in the village of Donnelsville and a completed exposure pathway exists.

Health Effects Evaluation

<u>Oral Dose Estimate</u>
Assuming that a child weighing 16 kilograms (about 35 lbs.) drinks 1 liter of water a day containing a maximum of 21 parts per billion (ppb) of tetrachloroethylene (PCE), the estimated exposure dose for PCE is 0.0013 mg/kg/day. If an adult weighing 70 kilograms (about 154 lbs.) drinks 2 liters of water a day containing 21 ppb PCE, the estimated exposure dose for PCE would be 0.0006 mg/kg/day.

EPA's Chronic Reference Dose (RfD) is an estimate, with uncertainty or safety factors built in, of the daily dose of a substance that is unlikely to cause adverse health effects (excluding cancer) in humans during a lifetime. The estimated exposure dose of PCE for a child drinking water containing 21 ppb PCE is about 8 times less than EPA's chronic oral RfD of 0.01 mg/kg/day. The estimated exposure dose of PCE for an adult drinking the water is 17 times less than the RfD for 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.

The estimated exposure dose is also much lower than ATSDR's minimal risk level (MRL) of 0.05 mg/kg/day for acute-duration oral exposure. Based on the exposure doses calculated using the maximum levels found in drinking water, short-term exposure to PCE is not expected to cause any adverse, non-cancer health effects. PCE levels detected in some of the Donnelsville wells exceed the U.S. EPA's federal drinking water standard or

Maximum Contaminant Level (MCL) of 5 ppb. According to the U.S. EPA, some people who drink water containing tetrachloroethylene in excess of the MCL over many years could have problems with their liver and may have an increased risk of getting cancer. The MCL has been set at 5 ppb because EPA believes, given present technology and resources, this is the lowest level to which water systems can reasonably be required to remove this contaminant should it occur in drinking water (U.S. EPA 2009a).

The maximum PCE level found (21 ppb) in drinking water exceeds ATSDR's interim guidance of a Cancer Risk Evaluation Guide (or CREG) for PCE (0.06 ppb). ATSDR's CREG is based on California's EPA's oral cancer slope factor and represents the concentration of a chemical in drinking water that is unlikely to result in an increase of cancer rates in an exposed population. In developing the CREG, a theoretical cancer risk of 1 in 1,000,000 (10^{-6}) and a lifetime exposure is assumed. An adult is assumed to weigh 70 kg and drink 2 liters of water per day for a lifetime (70 years). A PCE level of 6 ppb represents an estimated theoretical lifetime excess cancer risk of 10^{-4} or 1 person out of 10,000 getting cancer. This estimate is the high end of the range of cancer guidelines suggested by the U.S. EPA.

Inhalation Dose Estimate

The HAS estimated exposures to PCE for adults and children when they shower in PCE-contaminated water. For a full discussion of the inhalation determination, see the attached Appendix B. The exposure dose from shower/bath use for a 70 kg adult would be 0.0013 mg/kg/day. The exposure dose for a 16 kg child with an inhalation rate of about 0.5 cubic meters of air per hour, calculated using the same bathing scenario above, would be 0.0027 mg/kg/day.

The U.S. EPA has not established a Reference Concentration (RfC) for inhalation exposure to tetrachloroethylene. ATSDR has established an acute (short-term) inhalation minimal risk level (MRL) of 200 ppb and a chronic (long-term) inhalation MRL of 40 ppb for PCE. The U.S. EPA Regional Screening Level (RSL) for Resident Air is 0.06 ppb, which is based on a 1 x 10^{-6} cancer risk (U.S. EPA 2011). A concentration of 0.6 ppb in air can be derived for a 1 x 10^{-5} cancer risk, along with a concentration of 6 ppb, based on a 1 x 10^{-4} cancer risk. The maximum concentration of PCE in the bathroom air is estimated to be 22 ppb (Appendix B). The estimated concentration of PCE in air generated from water use does not exceed ATSDR's acute inhalation MRL of 200 ppb or the chronic inhalation MRL of 40 ppb for PCE in air.

Combined Dose

The total exposure dose for an adult can be estimated as the sum of the drinking water intake and inhalation/dermal exposure due to shower/bath use (0.0006 mg/kg/day + 0.0013 mg/kg/day) or 0.0019 mg/kg/day. The total exposure dose for a child can be estimated as: 0.0013 mg/kg/day + 0.0027 mg/kg/day, or 0.004 mg/kg/day. Figure 2 shows the combined dose from groundwater exposure at the maximum level detected (21 ppb) relative to doses associated with adverse health effects in animals and health-based comparison values. Figure 3 shows how PCE concentrations (Ohio EPA data), detected in wells in Donnelsville compare to drinking water standards and guidelines. The maximum estimated exposure dose was about 5 times lower than oral RfD. Based on the dose estimated using the maximum levels found in well water, short-term exposure to PCE is not expected to cause non-cancer health effects.

Cancer Risk

Data shows that long term exposure to PCE causes liver cancer in mice and monocellular leukemia and kidney cancers in rats. However, humans respond to PCE differently than mice and rats do. PCE is suspected, but not proven, to cause cancer in humans. 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 (NTP 2011). 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).

Human 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 and selected towns in New Jersey. The Woburn, Massachusetts study (Lagakos et al. 1986) and the New Jersey study (Fagliano et al. 1990) associated exposure to these chemicals through ingestion of contaminated water with increased levels of leukemia in specific populations within these communities. ATSDR is launching a study regarding diseases that may be associated with past exposures to TCE, along with PCE and benzene, related to drinking water at Marine Corps Base Camp Lejeune in North Carolina.

Site-Specific Cancer Risk from Oral Exposure:

Using the California EPA cancer slope factor for PCE (0.54 $[mg/kg/day]^{-1}$) and the estimated exposure dose for an adult (0.0006 mg/kg/day), the estimated theoretical cancer risk from oral exposure to drinking water is 3.2×10^{-4} (3 additional cancer cases per 10,000 people). The estimated risk is considered unacceptable, because it exceeds the targeted cancer risk range of 1×10^{-4} to 1×10^{-6} as defined by the U.S. EPA. Seven of the sampled wells in the Donnelsville area sampled by the Ohio EPA had a PCE level associated with an estimated theoretical cancer risk greater than 1×10^{-4}.

> 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}.

Site-Specific Cancer Risk for Inhalation Exposure:

The California EPA inhalation unit risk (IUR) for PCE is 5.9×10^{-6} per $\mu g/m^3$, or $(\mu g/m^3)^{-1}$. If we assume defaults of a 70-kg adult breathing 20 m^3/day, the inhalation unit risk can be converted to a cancer slope factor of 0.02 $(mg/kg/day)^{-1}$. The theoretical cancer risk can be estimated for the inhalation route by multiplying the dose by the cancer slope factor: 0.0013 mg/kg/day x 0.02 $(mg/kg/day)^{-1} = 2.6 \times 10^{-5}$.

Total Cancer Risk:

The total cancer risk from oral and inhalation exposure to the maximum level of PCE found in well water is $3.2 \times 10^{-4} + 2.6 \times 10^{-5} = 3.5 \times 10^{-4}$, which exceeds U.S. EPA's acceptable risk of 1×10^{-4}. Using this approach, most of the risk can be attributed to oral exposure (drinking the water).

Health Evaluation of U.S. EPA Sampling Data

U.S. EPA Sampling Summary

In January 2011, the U.S. EPA collected 17 samples from 16 well locations in a targeted area in the northwest area of Donnelsville. Testing included 6 wells sampled by Ohio EPA in 2010. Results indicated that 13 out of 16 wells tested had PCE levels greater than the MCL of 5 ppb. Sampling included two commercial wells located at the Beach Manufacturing Company in Donnelsville which tested above the MCL. (Since these two wells are part of a business operation, no further action will be taken by the U.S EPA.) As of August 2011, 15 out of 30 residential wells tested have PCE levels greater than the MCL. The results are summarized below (Table 2).

Table 2. PCE Detected in Private Wells in 2011

Range of Detections (ppb)	*Average of Detections (ppb)*	*Frequency of Detections*	*Frequency Above Comparison Value*	*Comparison Value (ppb)*	*Type*
ND – 23.7	8.9	22/30	15/30	5	MCL

Source: U.S. EPA August 2011

ppb – parts per billion
ND – Not Detected
MCL – Maximum Contaminant Level (U.S. EPA 2009)

Health Effects Evaluation

Non-cancer Risk

Using the U.S. EPA sampling data, HAS evaluated acute (short-term) exposure to the highest detected concentration (23.7 ppb) in the most contaminated well. Based on a 70 kg adult drinking 2 liters of water a day, the estimated dose would be 0.0007 mg/kg/day. For a child weighing 16 kilograms drinking 1 liter of water a day containing the maximum detected concentration of PCE, the estimated exposure dose for PCE is 0.0015 mg/kg/day. Both fall below ATSDR's minimal risk level (MRL) of 0.05 mg/kg/day for acute-duration oral exposure. An MRL is an estimate of daily human exposure to a substance that is unlikely to pose noncancerous health effects. The estimated exposure doses of PCE are also below than EPA's chronic oral Reference Dose (RfD) of 0.01 mg/kg/day. Based on the doses arrived at using the maximum levels found in drinking water, exposure to PCE is not expected to cause any adverse, non-cancer health effects.

Cancer Risk

HAS calculated the estimated increase in theoretical cancer risk from drinking PCE-contaminated well water, assuming a 70-year (lifetime) exposure. As described above, an adult scenario was assumed, which corresponds to an exposure dose of 0.0007 mg/kg/day. Using the California EPA's cancer slope factor for PCE of 0.54 $(mg/kg/day)^{-1}$, the resulting estimate of increased risk was 3.7×10^{-4}. This estimate is greater than 1×10^{-4} or one excess cancer case per 10,000 exposed individuals − the high end of the range of public health guidelines (10^{-6} to 10^{-4})

suggested by the U.S. EPA. The 10^{-4} theoretical risk level corresponds to approximately 6 ppb PCE. To date, a total of 13 residential wells exceed the cancer risk guidelines for a population exposed to PCE over a lifetime (70 years).

Additional Public Health Concerns

The HAS Program had concerns about these 2010 results as: 1) they represent limited sampling events and may not be representative of a "worse-case scenario" with regard to seasonal levels of PCE in drinking water supplies; 2) only a limited number of the total number of water supply wells were sampled, so it is possible that wells with higher concentrations of PCE in their water were not sampled; 3) the full extent of the groundwater contamination has not been determined with elevated levels of PCE being detected in the southernmost wells sampled along Hampton Road; 4) it is not known how long the groundwater in the village has been contaminated with PCE – the 1995 sampling results indicate the presence of the chemical in the local aquifer for at least the past 15 years; 5) the groundwater flow characteristics of the impacted aquifer are largely unknown; 6) no known source of the contamination has yet been identified; and 7) the contaminated limestone bedrock aquifer is essentially a "sole-source aquifer" as drilling deeper will tap older clay shale bedrock that is a very poor source of groundwater. Because of the reasons and uncertainties listed above, the HAS, to be protective of the public health of the residents using well water as their drinking water supply in Donnelsville, recommends that this groundwater contamination be more fully investigated and remediated as soon as possible (see Appendix A).

This assessment focused on the health risk due to drinking the PCE-contaminated water. Additional exposure can occur through inhalation of PCE vapors during shower and bath use. However, most of the theoretical excess cancer risk can be attributed to drinking the water alone. It is important to note that these risks are only estimates and that the true risk is unknown.

Child Health Issues

Both the HAS and the ATSDR recognize that children are inherently at a greater risk of developing illness due to exposure to hazardous chemicals given 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.

CONCLUSIONS

Conclusions regarding exposure to PCE in the Donnelsville community are based on environmental data and the extent of the well water contamination and are described below:

1. HAS concludes that exposure to PCE-contaminated well water over the course of a lifetime in the impacted area in Donnelsville could harm people's health. This is a public health hazard. The theoretical cancer risks associated with exposure to PCE from the contaminated

aquifer exceed guidelines for estimating cancer risk. In addition, PCE levels detected in Donnelsville wells exceed the federal drinking water standard of 5 ppb.

The data show that there is a potential health threat with an increased theoretical cancer risk for Donnelsville residents affected by PCE during a lifetime (70 years) of exposure. The levels of the chlorinated solvent PCE found in drinking water, along with predicted levels of PCE vapors during showering and bathroom use, were used to calculate theoretical cancer risks from exposure to PCE compared to the range of guidelines (10^{-6} to 10^{-4}) recommended by the U.S. EPA. Seven of the sampled wells in the Donnelsville area sampled by the Ohio EPA had a PCE level associated with an estimated theoretical cancer risk greater than one excess cancer case per 10,000 exposed individuals (1×10^{-4}), the high end of the range. Additional sampling by U.S. EPA showed that, overall, the North Hampton Road area in Donnelsville had PCE levels associated with an estimated lifetime excess cancer risk greater than 1×10^{-4}. Thirteen residential wells sampled by U.S. EPA exceed the cancer risk guidelines for a population exposed to PCE over a lifetime.

Combining the Ohio EPA and U.S. EPA sampling events brings the total number of private (residential) wells above the 5 ppb MCL to 17. Although the U.S. EPA drinking water standards apply to public drinking water supplies, ODH uses these standards for making recommendations to ensure the safety of private wells.

2. For the wells sampled in 2010 by the Ohio EPA and in 2011 by the U.S. EPA, HAS concludes that the levels of PCE found in private wells in Donnelsville do not pose an immediate health hazard to the residents. Based on the doses estimated using the maximum levels of PCE found in area drinking water, PCE is not expected to cause any adverse, non-cancer health effects. The estimated exposure dose of PCE for either a child or an adult who is drinking water containing the maximum level of PCE detected is less than ATSDR’s minimal risk level (MRL) for acute-duration (up to 14 days) oral exposure or the U.S. EPA’s reference dose (RfD) for chronic (long-term) daily oral exposure. The estimated concentration of PCE in air when bathing or showering does not exceed ATSDR’s health-based comparison values for non-cancer health effects over either short-term or long-term periods of exposure. However, additional well sampling and seasonal variations could lead to the discovery of higher levels of PCE than those encountered thus far at the site. Additional public health concerns include the need for further investigation and remediation of the source of the groundwater contamination.

RECOMMENDATIONS

1. HAS recommends that homeowners with PCE levels above 5 ppb consider another source of drinking water or the installation and operation of whole-house water treatment systems to reduce or eliminate exposure to PCE in the water supply.

2. HAS recommends additional sampling to determine the full extent of the contamination and periodic monitoring of the private wells previously sampled.

3. The possibility of vapor intrusion into homes also should be investigated.

4. The source(s) of the chlorinated solvent impacting the local aquifer needs to be identified, isolated and contained, or removed.

PUBLIC HEALTH ACTIONS

The public health actions that have been planned and completed by Ohio EPA, U.S. EPA, ODH, and the Clark County Combined Health District (CCCHD) are listed below.

1. On January 13, 2011, the Ohio EPA, ODH and CCCHD met with about 75 residents of Donnelsville at a public meeting to discuss Ohio EPA's findings and provide recommendations regarding PCE found in private wells in 2010. Bob Frey, Geologist and Principle Investigator for ODH's Health Assessment Section answered health-related questions, along with questions regarding the contaminated aquifer.

2. From January 11 to 14, 2011, the U.S. EPA collected 17 samples from 16 well locations, including 6 wells that were sampled by Ohio EPA in 2010 in a targeted area in the northwest area of town along North Hampton Road.

3. On January 25, 2011, ODH's Residential Water and Sewage Program, with the assistance of CCCHD, collected four additional samples from private wells at other locations in the Donnelsville area located south of U.S. Route 40 on South Hampton Road. One well exceeded the MCL for PCE at 8.23 ppb and another was below the MCL at 4.11 ppb. Two wells located at the southern end of the area of concern did not have detectable levels of PCE.

4. The U.S. EPA is in the process of completing a time-critical removal action for the Donnelsville Contaminated Aquifer site.
    a. Affected area residents were offered whole-house drinking water treatment systems which include a water softener and an air stripper.
    b. A total of 18 water treatment systems have been installed by a registered private water contractor as of October 20, 2011. One property owner declined the system.
    c. Confirmation sampling is being conducted to test the effectiveness of the systems. All 18 systems have passed the 7 day post mitigation sampling, and 16 out of 18 locations now have 21-day proficiency results less than the MCL. The remaining two locations have results pending.

PREPARERS OF THE REPORT

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

REFERENCES

Andelman JB. 1990. Total Exposure to Volatile Organic Compounds in Potable Water. In: Significance and Treatment of Volatile Organic Compounds in Water Supplies; Chapter 20. Lewis Publishers. Chelsea, MI. 485-504. 1990.

ATSDR (Agency for Toxic Substances and Disease Registry). 1997. Toxicological Profile for Tetrachloroethylene (Update). Atlanta: U.S. Department of Health and Human Services (DHHS); September 1997.

ATSDR. 2005. Public Health Assessment Guidance Manual (Update). U.S. DHHS. January 2005.

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

IARC (International Agency for Research on Cancer). 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.

Jo et al. (Jo WK, Weisel CP, Lioy PJ). 1990a. Chloroform exposure and the health risk associated with multiple uses of chlorinated tap water. Risk Analysis 1990 Dec;10(4):581-5.

Jo et al. 1990b. Routes of chloroform exposure and body burden from showering with chlorinated tap water. Risk Analysis 1990 Dec;10(4):575-80.

Lagakos, S.W., B.J. Wesson and M. Zelen. 1986. An Analysis of Contaminated Well Water and Health Effects in Woburn, Massachusetts. Journal of the American Statistical Association. V. 81, p. 583-596.

McKone TE. 1989. Household exposure models. Toxicol Lett 1989 Dec;49(2-3):321-39.

NTP (National Toxicology Program). 2011. Report on Carcinogens, Twelfth Edition; U.S. DHHS, Public Health Service, NTP, June 10, 2011.

Rao HV and DR Brown. A physiologically based pharmacokinetic assessment of tetrachloroethylene in groundwater for a bathing and showering determination. Risk Anal 13(1):37-49.

U.S. Census Bureau. 2000. Profile of General Demographic Characteristics: 2000. American FactFinder. Washington, DC: U.S. Department of Commerce. Available at: http://factfinder.census.gov/.

U.S. EPA (U.S. Environmental Protection Agency). 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. 2003. Appendix C: Inhalation Exposure to Tap Water Through Showering Literature and Model Review - Supplemental Background Document for the Non-groundwater Risk Assessment for the Petroleum Waste Listing Interim Notice of Data Availability 03-12-2003.

U.S. EPA. 2009a. Consumer Factsheet on: Tetrachloroethylene. Available at: http://www.epa.gov/safewater/pdfs/factsheets/voc/tetrachl.pdf.

U.S. EPA. 2009b. 2009 Edition of the Drinking Water Standards and Health Advisories. EPA 822-R-09-011. Office of Water. Washington, DC. October 2009.

U.S. EPA. 2011. Regional Screening Level Table (RSL). Regional Screening Levels of Chemical Contaminants at Superfund Sites. June 2011. Available at: http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/index.htm.

Vogel TM and PL McCarty. 1985. Biotransformation of Tetrachloroethylene to Trichloroethylene, Dichloroethylene, Vinyl Chloride, and Carbon Dioxide under Methanogenic Conditions. Applied and Environmental Microbiology 49:1080-1083.

Weisel CP and WK Jo. 1996. Ingestion, Inhalation, and Dermal Exposure to Chloroform and Trichloroethene from Tap Water. Environmental Health Perspectives. Vol. 104. No. 1. pp. 48-51. Jan. 1996.

REPORT PREPARATION

The Ohio Department of Health prepared this Public Health Assessment, for the Donnelsville Contaminated Aquifer site, 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. ATSDR has reviewed this document and concurs with its findings based on the information presented. ATSDR's approval of this document has been captured in an electronic database, and the approving agency reviewers are listed below.

Author

John Kollman
Health Assessor / Environmental Specialist
Health Assessment Section
Ohio Department of Health

Robert C. Frey, Ph. D.
Principal Investigator
Health Assessment Section
Ohio Department of Health

ATSDR Reviewers

Trent LeCoultre
Technical Project Officer
ATSDR/DHAC/CAPEB

Alan Yarbrough
Cooperative Agreement Team Lead
ATSDR/DHAC/CAPEB

Rick Gillig
Cooperative Agreement and Program Evaluation Branch Chief
ATSDR/DHAC/CAPEB

Lynn Wilder
Assistant Director for Science
ATSDR/DHAC

William Cibulas
Division Director
ATSDR/DHAC

Olivia Harris
NCEH/ATSDR Office of Science

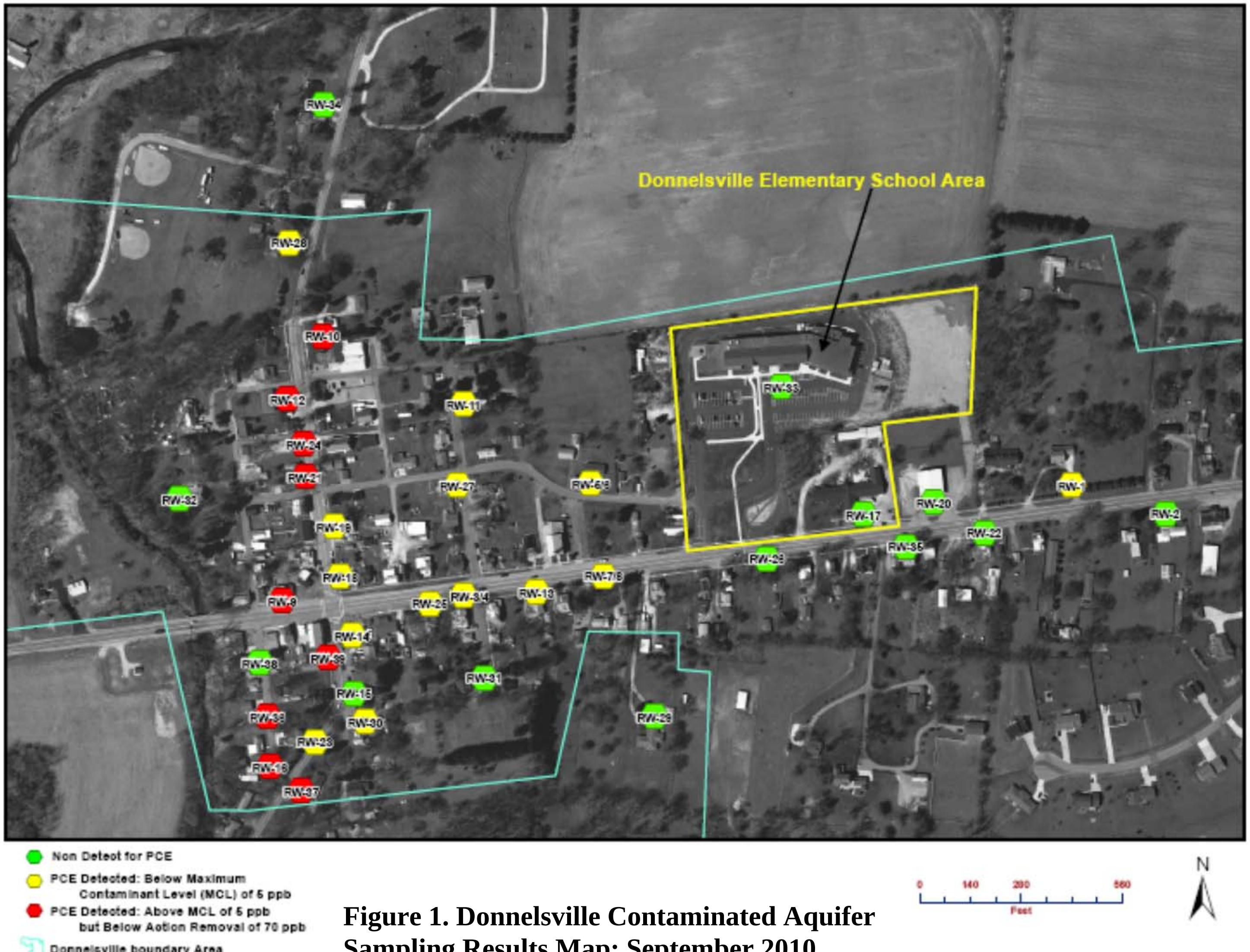
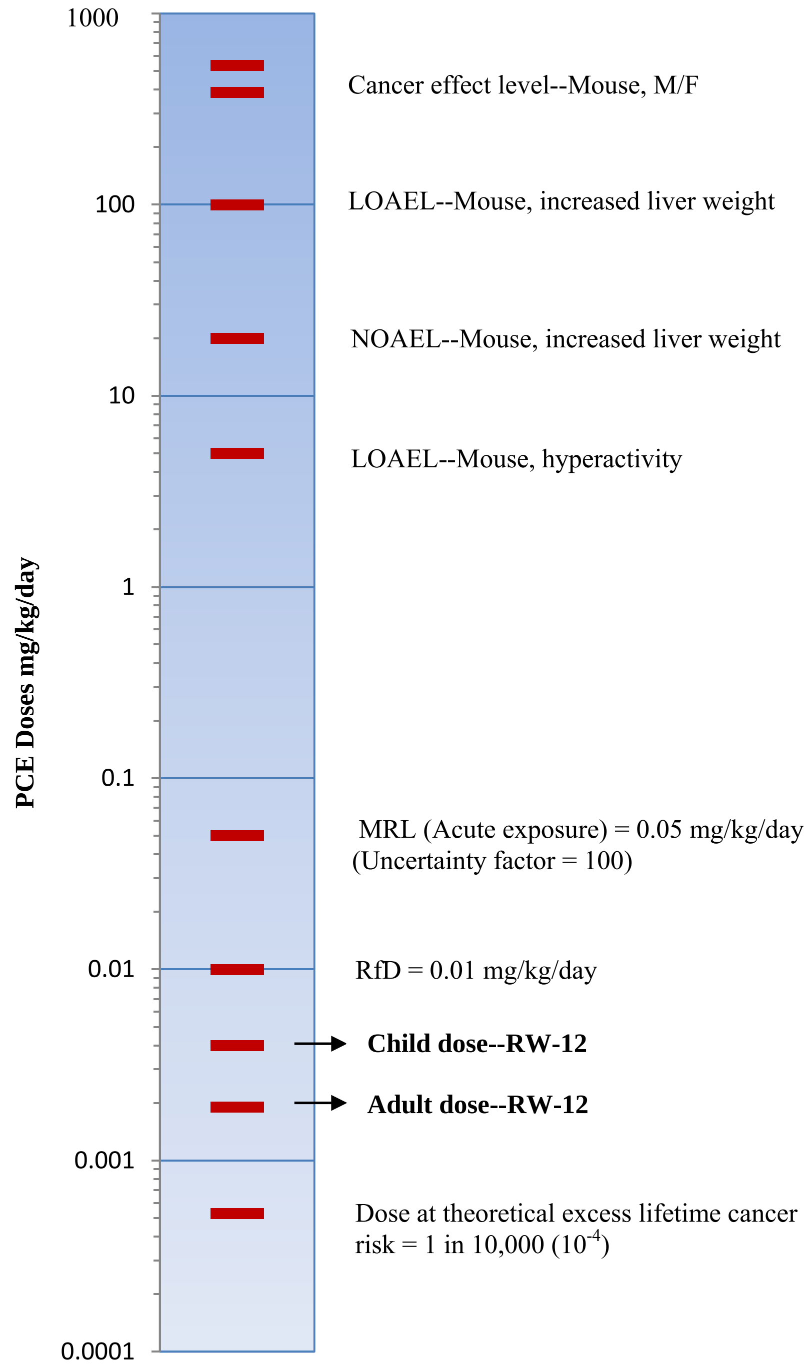


Figure 1. Donnelsville Contaminated Aquifer Sampling Results Map: September 2010

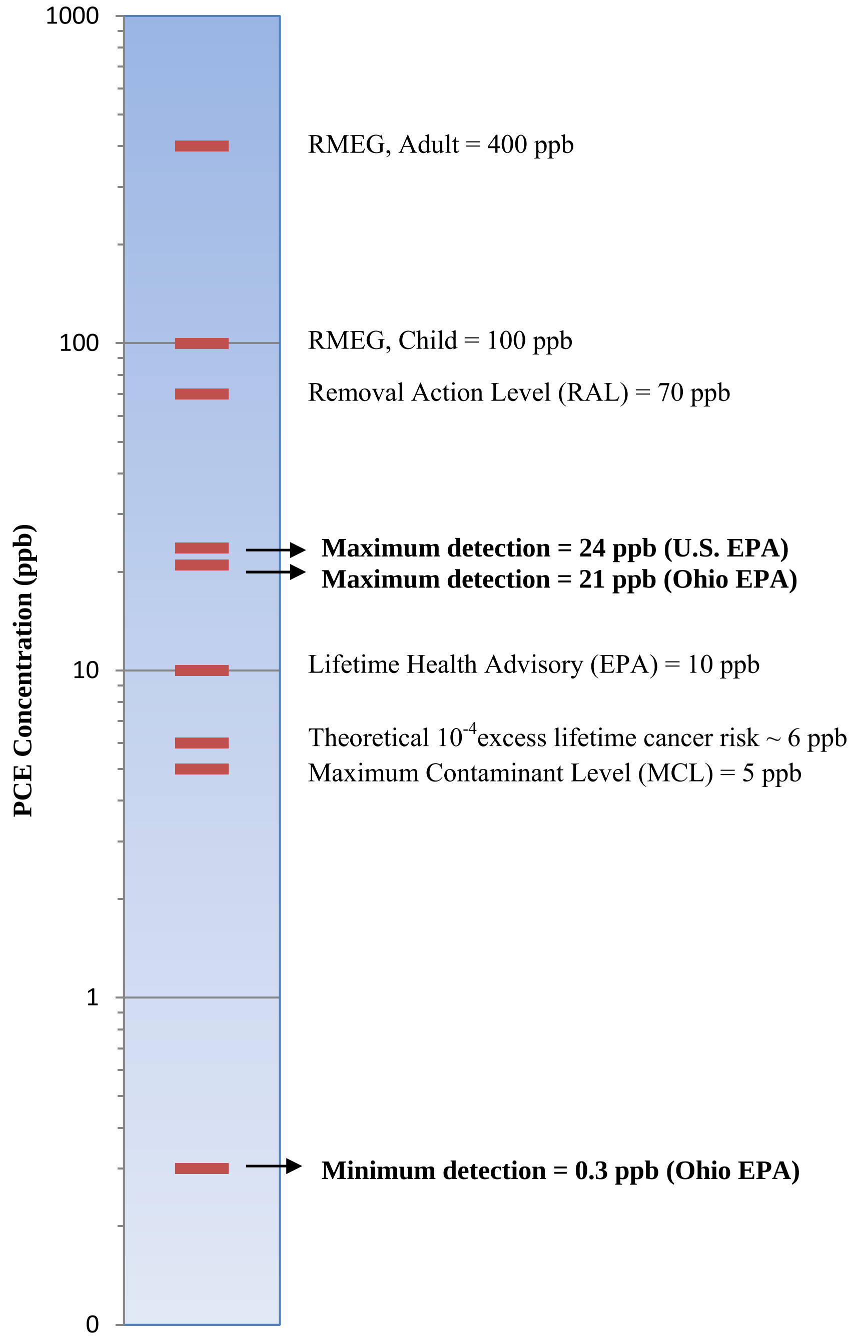
Source: Ohio EPA 2010

Figure 2. Estimated PCE Doses from Well Water Relative to Health Comparison Values



mg/kg/day = milligrams of chemical per kilogram of body weight per day (exposure dose).
MRL = Minimal risk level (ATSDR)
NOAEL = No observed adverse effect level.
LOAEL = Lowest observed adverse effect level.
RfD = Reference Dose (EPA)

Figure 3. Tetrachloroethylene (PCE) Concentrations in Well Water (ppb) Relative to Drinking Water Standards and Guidelines



ppb = parts per billion
RMEG = Reference Dose Media Evaluation Guide (ATSDR)

Appendix A. HAS Letter Requesting Assistance from U.S. EPA

OHIO DEPARTMENT OF HEALTH

246 North High Street
Columbus, Ohio 43215

614/466-3543
www.odh.ohio.gov

Ted Strickland/Governor

Alvin D. Jackson, M.D./Director of Health

December 17, 2010

Steven L. Renninger
On-Scene Coordinator,
U.S. EPA Region V Emergency Response Section
Office B-2, 26 W. Martin Luther King Drive
Cincinnati, OH 45268

Dear Steve,

As the Chief of the Health Assessment Section at the Ohio Department of Health and ATSDR's program representative for Ohio, I am officially requesting your assistance in addressing drinking water contamination impacting drinking water wells in the city of Donnelsville, in Clark County, Ohio.

A US EPA-funded groundwater investigation in the city of Donnelsville conducted by Ohio EPA in September, 2010, detected the chlorinated solvent Perchloroethylene (PCE) in 23 of 36 well samples taken. This sampling was conducted as a follow-up to previous sampling of a public water supply at the Donnelsville Elementary School plus several additional private and commercial water supply wells in 1995. At that time, low levels of PCE were detected in the school well and the two private water supply wells but at levels below the federal drinking water standard for PCE (=Maximum Contaminant Level = 5 ppb). The 2010 sample results indicated PCE in 23 wells, mostly along a north-south trend paralleling Hampton Street on the west edge of the city. Nine of these wells had PCE detections in excess of the MCL with the highest levels detected being 21 ppb in well RW-12 at the north end of Hampton Street. PCE is a chlorinated, man-made chemical that is considered to be a "Probable human cancer-causing chemical" by US EPA and is "reasonably anticipated to be a human carcinogen" by the National Toxicology Program at the US Department of Health & Human Services.

While the results of this latest one-time sampling event do not indicate PCE levels at concentrations that would likely cause short-term health effects, seven of the nine wells with PCE levels above the MCL exceeded US EPA lifetime cancer risk guidelines and drinking the water from these wells poses a long-term chronic public health hazard to residents due to an increased risk of developing cancer.

Health Assessment Section staff are concerned about these 2010 results as: 1) they represent a one-time sampling event and may not be representative of a "worse case scenario" with regard to seasonal PCE levels in drinking water supplies; 2) only a limited number of the total number of water supply wells the city were sampled such that it is possible that wells with higher concentrations of PCE in their water were not sampled; 3) the full extent of the groundwater contamination has not been determined with elevated levels of PCE being detected in the southernmost wells sampled along Hampton Street; 4) it is not known how long the groundwater in the city has been contaminated with PCE – the 1995 sampling results indicate the presence of the chemical in the local aquifer at least for the past 15 years; 5) the groundwater flow characteristics of the impacted aquifer are largely unknown; 6) no known source of the contamination has been identified; and 7) the contaminated carbonate bedrock aquifer is essentially a "sole-source aquifer" as drilling deeper will tap Upper Ordovician clay shales that are very poor sources of groundwater and function hydrogeologically as aquitards not aquifers.

Public health officials are recommending that homes with wells whose PCE levels exceed the federal drinking water standard not use their well water for drinking unless they install and operate a water treatment system to remove the PCE prior to the tap. This is problematic in that area residents are generally blue-collar, lower income folks that likely could not easily afford to regularly sample their own wells to insure their safety or to pay to install whole-house water treatment systems on their wells if PCE is detected above levels of health concern.

Because of the reasons and uncertainties stated above, the Health Assessment Section, to be protective of the public health of the residents using well water as their drinking water in the city of Donnelsville, requests that this groundwater contamination be investigated and remediated sooner rather than later. Therefore we are requesting the assistance of your program to accomplish these objectives in a more timely fashion. If you have any questions regarding this site, don't hesitate to contact me by phone at (614) 466-1069 or email me at bob.frey@odh.ohio.gov. Thank you for your consideration.

Sincerely,

Robert C. Frey, Ph.D.
Chief, Health Assessment Section
Bureau of Environmental Health

Appendix B. Estimation of Inhalation Exposure Doses

The Health Assessment Section (HAS) of the Ohio Department of Health (ODH) evaluated exposures to groundwater in Donnelsville that included an estimate of exposure to PCE from breathing PCE released into the air and skin contact when showering. It is possible that a resident could inhale PCE vapor in the bathroom while showering and immediately after showering.

PCE is a volatile chemical and vaporizes into the air when water is released under pressure from the tap. People who shower could inhale the vapor-phase PCE. There is also a potential for dermal exposure during showers and other activities where water is in contact with the skin. Although there is variation in their findings, most researchers indicate that inhalation to volatile chemicals can be an important exposure route. McKone (1989) applied a three-compartment model to estimate concentrations of VOCs in a shower, bathroom, and remainder of a house. Applying modeling results, household-inhalation uptake were shown to be 1 to 6 times higher than ingestion uptake for VOCs (ATSDR 2005).

In addition to using modeling as a method to determine indoor air concentrations of chemicals, researchers have also conducted field studies measuring tap water concentrations and resulting airborne concentrations. For example, Jo et al. (1990a and b) provide measured shower air data associated with water contaminated with chloroform—their measurements showing an equal risk associated with ingestion and inhalation exposures. It should be noted, however, that applying models using water concentrations may predict air concentrations more than10 times greater than those measured in field studies (ATSDR 2005).

Showering or bathing with contaminated water can also result in tetrachloroethylene (PCE) exposure. Rao and Brown (1993) describe a combined physiologically based pharmacokinetic (PBPK) exposure model that estimates brain and blood levels of PCE following a 15-minute shower or 30-minute bath with water containing 1 mg PCE/L. The PBPK model is described further in Section 2.3.5. The exposure model assumed that the shower or bath would use 100 L of water, the air volume in the shower stall or above the bath tub was 3 m^3, and the shower flow rate was 6.667 L/minute. The exposure model was validated with data for chloroform and trichloroethylene, but not PCE. Using this model, Rao and Brown (1993) estimated that shower air would contain an average of 1 ppm and that the air above the bathtub would contain an average of 0.725 ppm if the water contained 1 mg PCE/L (ATSDR 1997).

When showering in chlorinated hydrocarbon-contaminated water, a resident may be exposed from (1) breathing the portion of the contaminant that is released into the air and (2) absorbing the contaminant through the skin. A resident could inhale the vapor while showering and while standing in the bathroom immediately after showering. Studies in humans have demonstrated that approximately equivalent amounts of VOCs from water can enter the body by ingestion, inhalation, and dermal absorption (Weisel and Jo 1996).

The following assumptions were made to estimate PCE exposure to adults who are showering with PCE-contaminated water:

(1) A resident would take a 10 minute shower once per day, and
(2) A resident spends an additional 15 minutes in the bathroom after showering.
(3) The rate of skin absorption of PCE is similar to rate for chloroform absorption.

The maximum concentrations of PCE released from water in a bathroom can be estimated with the following formula (Andelman 1990):

$$C_a = \frac{C_w \text{ x k x F x t}}{V}$$

where:

C_a = air concentration in milligrams per liter (mg/L)
C_w= PCE concentration in tap water in milligrams per liter (0.021 mg/L)
k = volatile mass transfer coefficient in liter per minute (conservatively assumed to be 0.9)
F= flow rate in liters per minute (L/min) (assumed to be 8 liters per minute)
t = shower time in minutes (10 minute shower)
V = bathroom volume in liters (assumed to be 10,000 liters) (This is approximately the size of a small bathroom.)

If the concentration of PCE in the shower water is 0.021 mg/liter, the maximum concentration of PCE in the bathroom air is estimated to be 0.15 milligrams per cubic meter (mg/m^3) or 150 $\mu g/m^3$ or 22 parts per billion (ppb). Assuming an adult breathes 1.0 cubic meter of air per hour and the water concentration is 0.021 mg/liter, the estimated daily exposures during showering and subsequent bathroom use are as follows:

Shower inhalation dose = (0.15 mg/m^3) x (1.0 m^3/hr) x (10/60 hr) = 0.025 mg
Sink inhalation dose = (0.15 mg/m^3) x (1.0 m^3/hr) x (15/60 hr) = 0.038 mg
Shower dermal dose = shower inhalation dose = 0.025 mg
Total dose = $shower_{inh}$ + $sink_{inh}$ + $shower_{der}$ = 0.088 mg/day
Exposure dose for a 70 kg adult = 0.0013 mg/kg/day

Assuming a child breathes 0.5 cubic meters of air per hour, the estimated daily exposures during shower/bath use can be calculated using the same showering scenario:

Shower inhalation dose = (0.15 mg/m^3) x (0.5 m^3/hr) x (10/60 hr) = 0.0125 mg
Sink inhalation dose = (0.15 mg/m^3) x (0.5 m^3/hr) x (15/60 hr) = 0.0188 mg
Shower dermal dose = shower inhalation dose = 0.0125 mg
Total dose = $shower_{inh}$ + $sink_{inh}$ + $shower_{der}$ = 0.044 mg/day
Exposure dose for a 16 kg child = 0.0027 mg/kg/day

Appendix C. Fact Sheet

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.

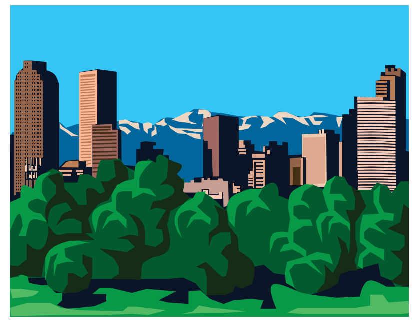
How does tetrachloroethylene (PERC) get into the environment?

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 exposur

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