

Health Consultation

PHILADELPHIA GROUNDWATER
LOCUST LANE AND ILLINOIS ROUTE 125
PHILADELPHIA, CASS COUNTY, ILLINOIS

SEPTEMBER 7, 2007

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service
Agency for Toxic Substances and Disease Registry
Division of Health Assessment and Consultation
Atlanta, Georgia 30333

Health Consultation: A Note of Explanation

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

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

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HEALTH CONSULTATION

PHILADELPHIA GROUNDWATER
LOCUST LANE AND ILLINOIS ROUTE 125
PHILADELPHIA, CASS COUNTY, ILLINOIS

Prepared By:

Illinois Department of Public Health
Under a Cooperative Agreement with the
U.S. Department of Health and Human Services
Agency for Toxic Substances and Disease Registry

Purpose

In October 2004, the Illinois Environmental Protection Agency (Illinois EPA) requested the Illinois Department of Public Health (IDPH) assist with a groundwater contamination site in Philadelphia, Illinois. Volatile organic chemicals (VOCs) had been detected in a residential well. Illinois EPA asked IDPH to provide a health interpretation of the available data, offer recommendations for mitigation, and assist with further site characterization. A summary of site activities is provided in this health consultation.

Background and Statement of Issues

Site Location, Description and History

The Philadelphia groundwater site is in Philadelphia, Cass County, Illinois. Philadelphia is an unincorporated area of about 50 persons along Illinois Route 125. It is about 5 miles southeast of Virginia and about 7 miles northwest of Ashland (Attachment 1).

In July 2004, Illinois EPA began investigating reported groundwater and indoor air contamination of a home in Philadelphia. An elderly couple reported they had experienced a gasoline odor in their well water since moving into the home in August 2003. They reported that they obtained water from a church in Virginia for drinking and cooking, which they transported in one-gallon jugs. The use of their well water for other household purposes created a strong odor of gasoline in the home (Illinois EPA, 2004).

The affected home is west of another building that, based on the design and its location on the north side of Illinois Route 125, Illinois EPA staff suspected to be a former gas station. The source of contamination in the neighboring well was suspected to be a leaking underground fuel storage tank from the former gas station. The ground surface behind the former gasoline station property slopes gently to the northeast. Neighboring homes exist to the northeast, west, and south. East of this property is a farm field and farther east is the Philadelphia Township road commissioner property, which has several gravel piles and an aboveground fuel tank. About one block northeast of the affected home and south of Illinois Route 125 is another former gasoline station (Illinois EPA, 2004).

Illinois EPA staff sampled the well of the affected home on September 22, 2004 and results were made available to IDPH on October 25, 2004. VOCs including benzene, ethyl benzene, toluene, xylenes, acetone, isopropyl benzene, naphthalene, and 2-methylnaphthalene were detected in the sample. Of these, only benzene was detected at a level that exceeded the U.S. Environmental Protection Agency's (USEPA's) maximum contaminant level (MCL) for drinking water.

In a letter dated October 28, 2004, IDPH advised that the residents not use this water for drinking or cooking purposes and that other household uses of the water would release VOCs into the air. IDPH recommended the residents consider installation of a whole-house drinking water treatment unit certified by the National Sanitation Foundation (NSF) in accordance with NSF

standard number 53. The residents subsequently installed a water tank and they transport purchased water from the Virginia, Illinois public water system.

On October 28, 2004, Illinois EPA staff collected another well water sample at the home and additionally sampled two other wells in the area. In early November 2004, Illinois EPA sampled seven other nearby wells. The wells were sampled for both organic and inorganic chemicals.

The results of the follow-up sample of the affected home showed similar results. VOCs were not detected in any of the other wells. Results of the inorganic analysis identified elevated levels of sodium in many of the wells. IDPH sent letters to the residents, providing a health-based interpretation of the data.

In November 2005, Illinois EPA conducted an investigation of the area. Illinois EPA staff used a Geoprobe at 12 locations to investigate potential subsoil contamination. In addition, Illinois EPA staff collected 5 soil samples and two groundwater samples. Seven of the subsurface soil samples showed gasoline contamination at depths from 15 to 30 feet below the ground surface. This investigation confirmed that the source of the groundwater contamination was a leaking underground storage tank associated with the former gasoline station east of the affected home.

In the July 2007, construction had begun on a public water system for Philadelphia. Well drilling began in early August on the northeast edge of town.

Site Visit

IDPH visited the site most recently on August 3, 2007. The conditions of the site were the same as described above. A well drilling rig was operating on the northeast edge of town and piping to be used as water main and residential plumbing connections were stacked throughout the community. No other excavations had yet begun.

Discussion

Chemicals of Interest

IDPH compared the results of each environmental sample with the appropriate comparison values used to select chemicals for further evaluation for carcinogenic and non-carcinogenic health effects. Chemicals found at levels greater than comparison values or those for which no comparison values exist were selected for further evaluation. Attachment 2 contains a description of each comparison value used in this health consultation.

Although eight VOCs were detected in the well water samples collected at the affected home, only benzene exceeded health based comparison values. The maximum level of benzene detected was 58 micrograms per liter compared with an MCL of 5 micrograms per liter. Sodium was found at a maximum level of 110 milligrams per liter. The USEPA Office of Water has a drinking water guidance level for sodium of 20 milligrams per liter for persons on a sodium-restricted diet (USEPA, 2005).

The levels of VOCs detected in the subsurface soil samples collected at depths of 15 to 30 feet below the ground surface did not exceed health based comparison values.

Exposure Evaluation

A chemical can cause an adverse effect only if people contact it at a sufficient level. That requires 1) a source of exposure, 2) an environmental transport medium, 3) a point of exposure, 4) a route of exposure, and 5) an exposed population. An exposure pathway is complete if all of the components are present, and people were exposed in the past, are currently exposed, or will be exposed in the future. If parts of a pathway are absent, data are insufficient to decide whether it is complete, or exposure may occur at some time (past, present, future), then a potential exposure pathway exists. If part of an exposure pathway is not present and will never exist, the pathway is incomplete and can be eliminated from further consideration.

Residents of one home with a private well had a completed exposure pathway and were exposed to elevated levels of site-related benzene in their well water and indoor air. IDPH advised these residents to reduce their exposure by not using their water for any indoor purposes. No other wells have been affected by VOCs to date, so there is an incomplete exposure pathway for everyone else in Philadelphia; however, the source of contamination remains, so future well contamination with VOCs is possible. The direction of groundwater flow in the area is not clear.

Benzene

IDPH assumed an adult would drink 2 liters and children would drink 1 liter of contaminated well water containing 58 micrograms of benzene per liter of water per day. The estimated dose for an adult exposed to benzene from drinking water would be 0.0017 milligrams per kilogram-day (mg/kg-day). This is less than the chronic minimal risk level (MRL) of 0.004 mg/kg-day established by the Agency for Toxic Substances and Disease Registry (ATSDR). The estimated increased cancer risk for exposure to this level of benzene over 30 years of a person's lifetime is 7 in 100,000.

Although no air data is available, IDPH assumed that residents would be exposed to benzene vapor released into indoor air during household water use, primarily during showering or bathing. To estimate an inhalation dose from showering, IDPH assumed that a resident would spend 15 minutes in the bathroom shower each day. The flow rate of water through the showerhead was estimated to be 8 liters per minute (L/min), and the volatilization rate of benzene from the water to the air was 90%. The estimated volume of the bathroom was 10 cubic meters (m³). The estimated breathing rate for adults was 20 cubic meters per day (m³/day) or 0.014 cubic meters per minute (m³/min). For children, the estimated breathing rate was 10 m³/day (0.007 m³/min). The estimated inhalation dose was calculated using the following formula:

$$\text{Estimated inhalation dose} = C \times 0.9 \times F \times T \times B \times T / V \times BW, \text{ where}$$

- C = benzene concentration in water (mg/L)
- 0.9 = volatilization rate of benzene from water to air (90%)
- F = flow rate of water through the showerhead (8 L/min.)

- T = a person's time in shower (15 min.)
B = breathing rate (0.014 m³/min for adults; 0.007 m³/min for children)
V = volume of bathroom (10 m³)
BW = body weight (70 kg for adults; 35 kg for children)

Using these assumptions, the estimated benzene concentration in bathroom air would be 625 micrograms per cubic meter (µg/m³). This results in an estimated daily inhalation dose of 0.0019 mg/kg-day for adults and 0.0066 mg/kg-day for children. Over a 30-year lifetime, inhalation would add an additional estimated increased cancer risk of 8 in 100,000.

Combining ingestion and inhalation exposures, benzene would pose an estimated increased risk of 1.5 in 10,000. This represents a low increased cancer risk. It is unlikely that persons have been exposed for 30 years; however, these dose estimates illustrate the prudent public health advice of using an alternate source of water for the affected home.

Sodium

Sodium was detected in several wells at levels greater than the USEPA advisory for persons on a sodium-restricted diet. This level of sodium in water is not likely to affect healthy persons, but may affect persons adhering to a sodium-restricted diet. The elevated levels of sodium detected in some wells are not related to the leaking underground storage tank. A possible source of the sodium is the use of salt to de-ice Illinois Highway 125. Sodium from past salt application may be affecting nearby shallow wells.

Toxicological Evaluation

Benzene

Benzene is found in gasoline and is a known human carcinogen. It has been associated with leukemia in humans exposed to benzene in the workplace (ATSDR, 1997). Based on the estimated lifetime dose described above, exposure to benzene in groundwater at the affected home on the east side of Philadelphia could pose a low increased cancer risk. No non-cancer adverse health effects would be expected.

Sodium

When sodium is greater than 20 milligrams per liter IDPH recommends that persons with high blood pressure, with a heart condition, or on a sodium-restricted diet consult their physician if they are drinking this water. Sodium has long been a major dietary factor affecting the risk of high blood pressure. Numerous studies have shown that reducing sodium intake can reduce blood pressure.

Community Health Concerns

Other than the residents of the affected home, the community has shown little interest in the site. They expressed gratitude for having their wells tested and for the health-based letters of interpretation provided by IDPH.

Child Health Considerations

The Illinois Department of Public Health recognizes that children are especially susceptible to some contaminants. Since no children live in the affected home, children are not being exposed to VOCs associated with the Philadelphia Groundwater site. In addition, elevated sodium levels are unlikely to affect the health of children.

Conclusions

Past exposure to benzene in groundwater may have posed an increased risk cancer for the residents of the affected home in Philadelphia, Illinois. Currently, these residents are not being exposed to benzene because the well has been disconnected for indoor use. As a result, IDPH concludes that exposure to contaminated groundwater poses no apparent public health hazard for the residents of the affected home. Because the leaking underground storage tank remains, future VOC contamination of nearby private wells is possible. The installation of a public water system in Philadelphia, which began in July 2007, will ensure no one is exposed to contaminated groundwater in the future.

Recommendations

IDPH recommends that the Illinois EPA Leaking Underground Storage Tank Program work with property owners in Philadelphia, Illinois to remove the leaking fuel tank, and any other tanks present to prevent future groundwater contamination. IDPH had previously encouraged the village to move forward with plans to install a public water system in the community and the system should be in place by early 2008.

Public Health Actions

IDPH has mailed letters to residents providing a health-based interpretation of their well water sample results. If elevated levels of chemicals were found, IDPH recommended appropriate exposure reduction methods.

The Cass County Health Department is aware of the location of the groundwater contamination in Philadelphia, Illinois, and will make decisions on a case-by-case basis regarding the permitting of wells in this area.

Preparers of Report

Kathy Marshall and Ken Runkle
Environmental Health Specialists
Illinois Department of Public Health

References

1. Agency for Toxic Substances and Disease Registry. Toxicological Profile for Benzene. Atlanta: US Department of Health and Human Services; 2005 Sept.
2. Illinois EPA. Investigation Memorandum for Philadelphia Groundwater Site. Springfield, Illinois. October 2004.
3. U.S. Environmental Protection Agency. Sodium in Drinking Water. Available from: URL: <http://www.epa.gov/safewater/ccl/sodium.html>. Accessed July 2005.

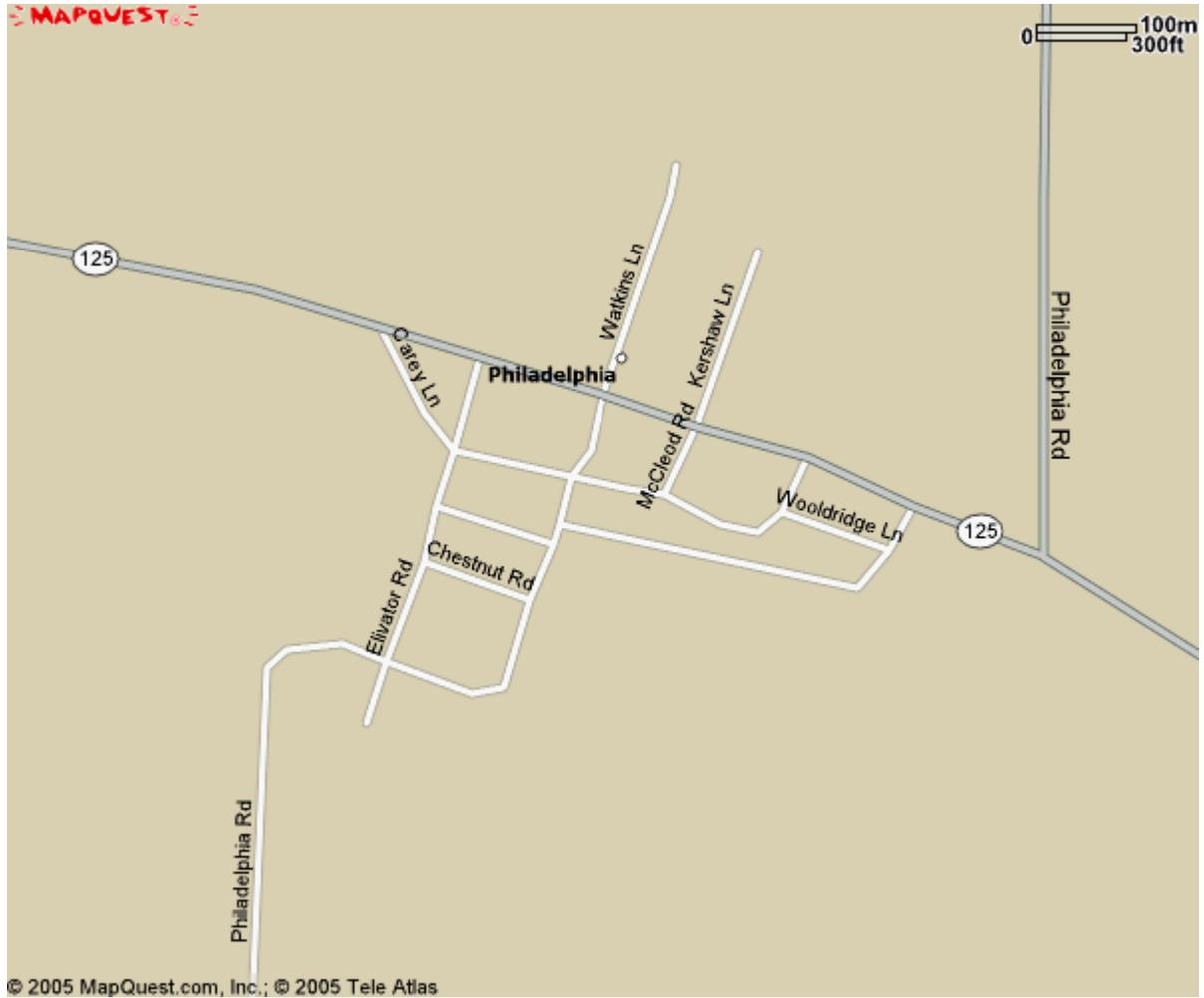
Table 1. Maximum Levels of VOCs Detected in Philadelphia Groundwater Investigation.

| Chemical | Maximum Level Detected (in micrograms per liter) | Comparison Value (in micrograms per liter) |
|---------------------|---|---|
| Benzene | 58 | 5 (MCL) |
| Ethyl benzene | 500 | 700 (MCL) |
| Toluene | 140 | 1,000 (MCL) |
| Xylenes | 680 | 10,000 (MCL) |
| Acetone | 99 | 20,000 (IEMEG Child) |
| Isopropyl benzene | 120 | NA |
| Naphthalene | 19 | 100 (LTHA) |
| 2-methylnaphthalene | 3 | 500 (CEMEG Child) |
| Sodium | 110,000 | 20,000 (USEPA) |

MCL – maximum contaminant level
 IEMEG – intermediate environmental media evaluation guide
 NA – no comparison value available
 LTHA – lifetime health advisory
 CEMEG – chronic environmental media evaluation guide
 USEPA – USEPA Office of Water Guidance

Attachment 1

Map of Philadelphia, Illinois



Comparison Values Used In Screening Contaminants For Further Evaluation

Environmental media evaluation guides (EMEGs) are developed for chemicals on the basis of their toxicity, frequency of occurrence at National Priorities List (NPL) sites, and potential for human exposure. They are derived to protect the most sensitive populations and are not action levels, but rather comparison values. They do not consider carcinogenic effects, chemical interactions, multiple route exposure, or other media-specific routes of exposure, and are very conservative concentration values designed to protect sensitive members of the population.

Reference dose media evaluation guides (RMEGs) are another type of comparison value derived to protect the most sensitive populations. They do not consider carcinogenic effects, chemical interactions, multiple route exposure, or other media-specific routes of exposure, and are very conservative concentration values designed to protect sensitive members of the population.

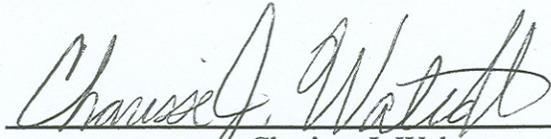
Cancer risk evaluation guides (CREGs) are estimated contaminant concentrations that are based on a probability of 1 excess cancer in 1 million persons exposed to a chemical over a lifetime. These are also very conservative values designed to protect sensitive members of the population.

Maximum contaminant levels (MCLs) have been established by USEPA for public water supplies to reduce the chances of adverse health effects from contaminated drinking water. These standards are well below levels for which health effects have been observed and take into account the financial feasibility of achieving specific contaminant levels. These are enforceable limits that public water supplies must meet.

Lifetime health advisories for drinking water (LTHAs) have been established by USEPA for drinking water and are the concentration of a chemical in drinking water that is not expected to cause any adverse noncarcinogenic effects over a lifetime of exposure. These are conservative values that incorporate a margin of safety.

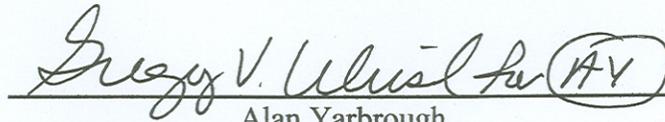
Certification

This Philadelphia Groundwater public health consultation was prepared by the Illinois Department of Public Health under a cooperative agreement with the federal Agency for Toxic Substances and Disease Registry (ATSDR). It was completed in accordance with approved methodologies and procedures existing at the time the health consultation was initiated. Editorial review was completed by the Cooperative Agreement partner.



Charisse J. Walcott
Technical Project Officer, CAT, CAPEB, DHAC

The Division of Health Assessment and Consultation (DHAC), ATSDR, has reviewed this health consultation and concurs with its findings.



Alan Yarbrough
Team Lead, CAT, CAPEB, DHAC, ATSDR