Evaluation of Volatile Organic Compounds in Private Well Samples Collected at a Private Residence in Chamblissburg, VA

Chamblissburg, VA

Letter Health Consultation

September 2017

Virginia Department of Health
Division of Environmental Epidemiology
Richmond, Virginia 23219

Ellick, Rachel (VDH)

From: Ellick, Rachel (VDH)
Sent: Thursday, September 21, 2017 9:12 AM
To: 'HouckFamily@outlook.com'
Cc: Flammia, Dwight (VDH)
Subject: water sampling results
Attachments: LHC Chamblissburg groundwater 09 21 2017.docx

Dear Mrs. Houck,

Thank you for the opportunity to review your well sampling data. Our analysis is attached.

Sincerely,

Rachel Ellick
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September 21, 2017

Mrs. Tami Houck
10625 Stewartsville Rd.
Vinton, Virginia

Dear Mrs. Houck,

Thank you for the opportunity to review the well water sample results collected on June 16, 2017 at your residence that were tested for the presence of volatile organic compounds. After reviewing the analysis results, VDH concludes that there is a very low health risk from exposure to reported concentrations of benzene and 1,2-dichloroethane in your drinking water. However, we recommend that you use an alternative water source or filter your well water, in case of changes in contamination levels in groundwater.

BACKGROUND

The Houck family has owned the property at 10555 Stewartsville Road since 1965, which has been occupied by three generations of the family in that time.

VDH was contacted by Mrs. Tami Houck on July 5, 2017 by telephone to request a review of the water sample results. In a follow-up email, Mrs. Houck provided further information about the family. The Houck household currently includes a 52 year old male, 50 year old female, 19 year old female, and 17 year old female. Of particular concern is that one of the teenage residents "has been diagnosed with methylation and metabolic disturbances which interferes with the normal detoxification process," according to Mrs. Houck. Furthermore, Mrs. Houck reported that her mother died of leukemia in 1979 and her father died of end-stage renal disease in 2007. Mrs. Houck's parents had lived at the residence on Stewartsville Road since 1965.

Samples of the groundwater were collected on June 16, 2017 at the Houck residence by Greene Environmental Services, LLC (contracted by the Department of Environmental Quality), and were sent to REI Consultants, Inc. for analysis of volatile organic compounds (VOCs) using method SW8260B. An investigation into an historic gasoline release from a local gas station is ongoing by DEQ.

DISCUSSION

A completed exposure pathway is determined in this case by five key elements: a source of contamination (petroleum products leaked into the groundwater); an environmental transport medium (groundwater); a point of exposure (well water); route of exposure (drinking); and exposed population (residents and their guests). These elements determine to what extent exposures may have occurred, may be occurring, or may occur in the future. At present, a *complete* pathway occurs, which means that there is a current exposure of chemicals to the family. This however, does not indicate that there will be health effects due to the present exposure (see health effects evaluation). Furthermore, we cannot speculate about past or future exposure due to the lack of data about the groundwater at any other point in time.

To determine potential health effects, the concentrations of chemicals in the drinking water are compared to comparison values (CVs), which are set by regulatory agencies to help discern a level at which further calculations should be done. Any concentration below the CV is not considered to be a threat to human health. Chemicals found above the CV are investigated further to determine whether or not there is a concern for human health.

Health Effects Evaluation

Analysis of the groundwater samples showed that of the 68 VOCs tested, 3 were detected in the water samples. These include, benzene (3.56 ppb), 1,2-dichloroethane (2.85 ppb), and methyl-t-butyl ether (MTBE) (10.8 ppb). Both benzene and 1,2-dichloroethane were found at concentrations exceeding ATSDR cancer risk evaluation guide (CREGs) for drinking water (0.44 ppb and 0.27 ppb, respectively), and are therefore considered for further evaluation. The MTBE concentration of 10.8 ppb was below the non-cancer risk CV of 2,100 ppb (MTBE is not considered to be carcinogenic), and so it was not considered further as a risk to health.

For chemicals that exceed CREGs, VDH calculates the estimated additional cancer risk. **Figure 1** (below) shows an example of the calculation of the estimated additional cancer risk. Cancer risk was calculated for benzene and 1,2-dichloroethane separately for each adults and teenagers 16-21 years old. This is due to differences in body mass and rates of daily water intake for these different age groups. Results shown in **Table 1** indicate that there is a lower risk of cancer for the teenage residents of the house compared to the adults for both chemicals. However, any estimated additional cancer risk that is less than 1.0×10^{-6} is considered extremely low. The background risk of developing cancer in the United States is about 1 in 3 for women and 1 in 2 for men[1], so this is an additional risk of 1 additional cancer incidence in a population 1 million, above the expected background rate of cancer.

[1] American Cancer Society: Lifetime Risk of Developing or Dying from Cancer. 2016. https://www.cancer.org/cancer/cancer-basics/lifetime-probability-of-developing-or-dying-from-cancer.html Accessed 08.31.17.

Figure 1: Calculated Risk and Exposure Dose Equations

Estimated additional cancer risk (ER) is calculated by**: ER = CSF x dose**
Where:
ER = estimated risk (unitless)
CSF = cancer slope factor $(mg/kg/day)^{-1}$
Dose = estimated exposure dose (mg/kg/day)

Dose is calculated by **D = (C x IR x EF) / BW**
Where:
C = contaminant concentration (mg/L)
IR = intake rate of contaminated water (L/day)—1.23 L/day is assumed for adults
EF = exposure factor (unitless)
BW = body weight (kg)—80 kg is assumed for adults

Calculations:
$D_{benzene}$= (0.00356 mg/L x 1.23 L/day x 1)/80 kg = 0.0000547 mg/kg/day
$ER_{benzene}$= $0.055(mg/kg/day)^{-1}$ x 0.0000547 mg/kg/day = 2.74×10^{-6}

1.0×10^{-6} means that in a population of 1,000,000, there is one possible excess cancer case.

Table 1: Results from calculated dose and cancer risk for each carcinogenic compound and exposure group.

Analyte (exposure group)	Water Concentration (ppb)	Cancer Slope Factor $(mg/kg/day)^{-1}$	Additional Calculated Cancer Risk	Qualitative Risk of Cancer
Benzene (adult)	3.56	0.055	2.7×10^{-6}	Extremely Low
Benzene (teenager)	3.56	0.055	1.3×10^{-7}	Extremely low
1,2-Dichloroethane (adult)	2.85	0.091	3.6×10^{-6}	Extremely Low
1,2-Dichloroethane (teenager)	2.85	0.091	1.8×10^{-7}	Extremely Low

Chemical-specific information:

Benzene:

Benzene is commonly found in the environment and comes from a variety of sources, mostly associated with burning oil and manufacturing industries, including: rubbers, lubricants, dyes, detergents, drugs, and pesticides. People are most often exposed to benzene in the air they breathe from sources including vehicle exhaust, evaporation from gasoline, and cigarette smoke. Exposure to benzene through drinking water is much less common, with typical drinking water in the U.S. containing less than 0.1 ppb benzene. Benzene can be found in drinking water due to leaks of gasoline from underground storage tanks and from accidental spills. It can pass through soil

and into groundwater, where it is may be a route of exposure for human consumption. Benzene does not accumulate in plants or animals, so that is not a concern for human exposure.

Some health effects associated with exposure to high levels (>25 mg/kg/day) of benzene in food or water include: dizziness, irritation of the stomach, rapid heart-rate, convulsions, and even death. Health effects of low-level exposure to ingested benzene are unknown, although animal studies have shown that benzene can damage the blood and immune system, and can cause cancer. Benzene is categorized as a Group 1 carcinogen (carcinogenic to humans) by the International Agency for Research on Cancer due to evidence of a causal relationship between benzene and benzene-containing solvents and the occurrence of acute non-lymphocytic leukemia (ANLL).[2]

1,2-Dichloroethane:

1,2-Dichloroethane is currently used to make PVC pipes and other construction materials, and as a solvent in leaded gasoline, used to remove lead. Other sources of 1,2-dichloroethane for human exposure include the glues used for carpet and wallpaper, older cleaning products, cigarette smoke. When released into the environment, 1,2-dichloroethane can travel through soil into groundwater. Concentrations from 0.05 to 64 ppb 1,2-dichloroethane have been found in drinking water in the U.S. Although small amounts of 1,2-dichloroethane has been measured in food, very little accumulates in fish and animals so that is not a significant concern for human exposure.

Chronic exposure to high doses of 1,2-dichloroethane (>42 mg/kg/day) can result in damage to the kidney, liver, and lungs, can damage the immune system, and can result in nervous system disorders. Effects related to low-level exposures are not known. 1,2-Dichloroethane is categorized as a Group 2B carcinogen (possibly carcinogenic to humans) by the International Agency for Research on Cancer due to evidence of cancer in animals exposed to 1,2-dichloroethane experimentally.[3]

Medical Testing

As far as medical tests are concerned, while there are medical tests available for these substances, testing is not recommended because it does not provide information that will help to determine potential health outcomes. Blood and urine tests that are available to analyze benzene exposure are not useful for low-level exposures, such as the concentrations seen in these groundwater samples. 1,2-dichloroethane can be measured in the blood, breath, breast-milk, and urine. However, these tests are not very useful because they must be done quickly after an exposure takes place, and cannot make predictions about toxic effects. We recommend that you work with your primary care physician about specific health concerns. If your doctor is not familiar with these chemicals, then an occupational health specialist may be able to provide more insight into the testing and other chemical-specific health effects.

LIMITATIONS

[2] Toxicological Profile for Benzene. U.S. Department of Health and Human Services, Agency for Toxic Substances and Disease Registry. August 2007.

[3] Toxicological Profile for 1,2-Dichloroethane. U.S. Department of Health and Human Services, Agency for Toxic Substances and Disease Registry. September 2001.

Several limitations apply to this assessment. First, the data that was provided is for only one point in time. Chemical concentrations can fluctuate depending on time of year and environmental conditions, so we can only comment on the conditions of the time in which the sample was collected. Second, we cannot speculate on past or future exposures to residents in this home, as conditions are likely to change as contaminants move through the groundwater and the environment. Finally, we do not know the details of the resident with metabolic abnormalities and do not have medical expertise. We therefore cannot specifically comment on the extent to which this resident might be at a greater risk to health effects from benzene and 1,2-dichloroethane compared to the other residents.

CONCLUSION

Based on the data provided, there is no apparent public health hazard due to present exposure to petroleum chemicals in residential drinking water. The measurable levels of benzene, 1,2-dichloroethane, and methyl-*t*-butyl ether (MTBE) in the samples collected from drinking water are not at concentrations that are expected to cause human health effects based on the exposure analysis.

RECOMMENDATIONS

It is recommended that to reduce future exposure to VOCs in their drinking water, the family accept the filtration system that DEQ is offering to install. We recommend this cautious approach based on the lack of more comprehensive sampling data and because possible future exposures are unknown. After a filter has been installed, we recommend that you have your water re-tested to ensure that the filter is working properly. If you choose not to install the recommended water filter you should have your water re-tested to ensure that the chemical concentrations do not increase. We also recommend that you contact the Pediatric Environmental Health Specialty Units regarding concerns about the resident with medical abnormalities. The contact number for the regional location at Georgetown University Medical Center is 202-687-2330, and their website is http://kidsandenvironment.georgetown.edu

Should you have any additional questions please contact Rachel Ellick, at (804) 864-8194 or at rachel.ellick@vdh.virginia.gov or Dwight Flammia, Ph.D., at (804)-864-8127 or at dwight.flammia@vdh.virginia.gov.

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