

Health Consultation

CLIMBING HILL GROUNDWATER CONTAMINATION SITE

CLIMBING HILL, WOODBURY COUNTY, IOWA

OCTOBER 18, 2004

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES

Public Health Service

Agency for Toxic Substances and Disease Registry

Division of Health Assessment and Consultation

Atlanta, Georgia 30333

Health Consultation: A Note of Explanation

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

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

You May Contact ATSDR TOLL FREE at
1-888-42ATSDR

or

Visit our Home Page at: <http://www.atsdr.cdc.gov>

HEALTH CONSULTATION

CLIMBING HILL GROUNDWATER CONTAMINATION SITE

CLIMBING HILL, WOODBURY COUNTY, IOWA

Prepared by:

Iowa State Department of Public Health
Under a Cooperative Agreement with the
Agency for Toxic Substances and Disease Registry

Table of Contents

I. Purpose	1
II. Background	1
Contaminants of Concern	2
Community Health Concerns.....	3
III. Discussion.....	3
Exposure to Benzene	3
Toxicological Evaluation.....	4
IV. Children’s Health.....	6
V. Conclusions.....	6
VI. Recommendations.....	7
VII. Public Health Action Plan	7
Table 1	8
Figure 1	9
VIII. References.....	10
IX. Preparers of the Report	11
CERTIFICATION	12
Appendix A	

I. Purpose

The Iowa Department of Natural Resources (IDNR) asked the Iowa Department of Public Health (IDPH) Hazardous Waste Site Health Assessment Program to perform a health consultation for the Climbing Hill, Iowa, groundwater contamination site. IDNR wants to know if the site poses a public health hazard. The information in this health consultation was current at the time of writing. Data that emerges later could alter this document's conclusions and recommendations.

II. Background

Climbing Hill is an unincorporated town in Woodbury County, Iowa, approximately 15 miles southeast of Sioux City. The town has approximately 120 residents. All of the residents and most businesses within the town use private wells to supply their drinking water. The local restaurant has an individual well that is classified as a public water supply system because it has the potential to serve more than 25 people in a day. Several wells in the town have become contaminated with gasoline and diesel fuel leaking from two underground storage tanks. All of the wells are roughly 75–80 feet deep (R. Cardinale, IDNR, Underground Storage Tank Section, personal communication, January 30, 2004).

IDNR has identified two underground storage tanks in Climbing Hill that have leaked gasoline and diesel fuel into the groundwater and soil beneath a section of the town. The contamination was initially discovered in 1990. The two sites are the Woodbury Central Community School Maintenance facility and a former automotive service station. Contamination has spread several hundred feet from the original sites and currently affects wells that serve four residences and one business (1). The two underground storage tanks referred to above have been removed. At the present time the contamination plume appears to be stable and not moving (R. Cardinale, personal communication May 20, 2004).

After the initial site assessment in 1991, groundwater contamination was noted in one private well. At that time, this residence was provided bottled water for consumptive use. Sampling of private wells continued, and in 1996 two additional private wells were identified as being contaminated. These two residences were also provided with bottled water for consumptive use. The duration of exposure to these residents to gasoline and diesel in private wells is uncertain. All residents were provided with bottled water shortly after contamination in their private wells was discovered.

The contaminated private well water now filters through point-of-use treatment systems, which use carbon filters to remove contamination and ultraviolet light to disinfect the water before it reaches the tap. These point-of-use treatment systems were installed in 1999. Designed for short-term use, these systems require periodic inspections and filter changes to work properly. IDNR maintains the carbon filters, including periodic inspection and replacement. These filters have been effective in reducing the amount of contaminants in the drinking water (1) as can be seen from the data included in Table 1.

IDNR and Climbing Hill residents, seeking a permanent solution, have resolved to replace the impacted wells and wells at risk of petroleum contamination with two association wells and a public water well (R. Cardinale, personal communication, January 30, 2004). At the present

time, the two new community wells have been installed by the IDNR, and some residents have been connected to one of these wells (R. Cardinale, personal communication May 20, 2004).

Contaminants of Concern

Contaminants of concern at the site are the petroleum components found in gasoline and diesel fuels that have leaked from underground tanks. The contamination has affected several private wells, primarily in the shallow groundwater (75–80 ft below ground surface) that supplies a number of these wells. The petroleum products have contaminated four private wells. These wells supply water for four homes and one business. IDNR has provided a point-of-use treatment system for each user.

The primary constituents of concern in gasoline and diesel, from a toxicological perspective, are benzene, toluene, ethylbenzene, and xylene. The International Agency for Research on Cancer has concluded that benzene is carcinogenic. Although the other three are not classified as carcinogens, long term exposure to high concentrations of any can lead to adverse health effects other than cancer (2,3).

All the affected wells have been monitored since 1999. Before installation of the treatment systems, concentrations of benzene ranged from less than 0.5 µg/L (micrograms of contaminant per liter of water) to 32.4 µg/L. Toluene and ethylbenzene generally measured at less than 0.5 µg/L before filtration, but toluene once reached a level of 12.6 µg/L. Xylene was measured at 1 – 4 µg/L.

Groundwater monitoring wells now monitor water at the water table elevation, approximately 39 ft below ground surface. The affected wells impacted are near monitoring wells MW-9, MW-10R, MW-12, and MW-111 (see Figure 1).

The U.S. Environmental Protection Agency's Maximum Contaminant Level (MCL) serves as the water quality standard for protecting human health. Although an MCL serves as a regulatory requirement for large water supply systems, it can be used as a comparison value for smaller or individual systems. A substance's MCL is the concentration determined to be safe for even the most sensitive populations. The standard assumes that a person consumes up to two liters a day, every day, over a lifetime. A contaminant's presence in concentrations above its MCL does not mean that health problems will result. It does mean, however, that action to reduce levels is necessary. The MCLs for benzene, toluene, ethylbenzene, and xylene are 5 µg/L, 1000 µg/L, 700 µg/L, and 10,000 µg/L, respectively. Thus, only benzene was ever found at concentrations above its MCL (Table 1).

Tap water (after filtration) showed a marked reduction in contaminant concentrations. This sampling started in 1999, and is continuing until everyone is connected to a permanent water supply. The range of these contaminants decreased to essentially non-detectable levels (4). Benzene concentrations fell below its MCL (Table 1).

Community Health Concerns

On April 1, 2003, IDNR sponsored a public meeting in Climbing Hill to address citizen concerns about the contamination and to discuss a possible long-term solution. Staff from the IDPH Hazardous Waste Site Health Assessment Program also attended. For the Climbing Hill residents, the major concern was the cost of either replacing the wells or constructing a new water supply source. The residents did not express any concerns about possible human health effects. They indicated that the carbon filters were working as planned and that a long-term permanent solution was needed.

III. Discussion

Exposure to Benzene

Exposure to benzene is determined by examining human exposure pathways. An exposure pathway has five parts:

1. a source of contamination,
2. an environmental medium such as air, water, or soil that can hold or move the contamination,
3. a point at which people come in contact with a contaminated medium, such as, in drinking water, or in surface soil,
4. an exposure route such as, drinking water from a well, or eating contaminated soil on homegrown vegetables, and
5. a population who could come in contact with the contaminants.

An exposure pathway is eliminated if at least one of the five parts is missing and will not occur in the future. For a completed pathway, all five pathway parts must exist and exposure to a contaminant must have occurred, be occurring, or will occur. A potential pathway is an exposure to a contaminant that could have occurred in the past, could be occurring now, or could occur in the future.

Exposure Through Ingestion of Contaminated Drinking Water

In Climbing Hill, an exposure pathway to benzene has been completed via residents of Climbing Hill ingesting contaminated drinking water prior to being provided bottled water or point-of-use treatment systems. It is uncertain as to the length of time residents of Lowell may have ingested drinking water contaminated with benzene. Most likely the exposure time was short-term (less than one year). The maximum concentration of benzene documented in private wells in Climbing Hill has been 32.4 µg/L. Since homes in Climbing Hill have been provided bottled water or point-of-use treatment systems, this previous pathway of exposure has been eliminated.

Exposure through Vapor Inhalation and Dermal Exposure

Since benzene is a volatile organic chemical, there is a potential exposure pathway for this chemical due to inhalation of the vapors during bathing and showering with contaminated water. In addition to inhalation of vapors, a person bathing and showering in contaminated water will be exposed to benzene through adsorption of this chemical through the skin.

Estimations of the amount of benzene a person could potentially be exposed to during showering and bathing can be determined by utilizing several mathematical equations that calculate an equivalent exposure to benzene through inhalation. Details of these calculations are explained in Appendix A to this report. The table below is a summary of these calculations using the highest concentration of benzene reported in drinking water wells.

Estimated Exposure Levels of Benzene

Chemical	Estimated Acute Vapor Exposure Level μg/L	Estimated Intermediate and Chronic Vapor Exposure Level μg/L
Benzene	48.4	3

Source: Sample calculations are included in Appendix A

If the concentration of benzene in drinking water is 32.4 μg/L, then the acute and intermediate and/or chronic inhalation exposure levels can be estimated and are represented by the numbers in the above table. Keep in mind that these numbers in the table above are not actually measured levels, and are only estimated levels. Levels of benzene within indoor air in any residences of Climbing Hill have not been measured since indoor air has not been monitored. In order to more accurately determine inhalation exposures to benzene, indoor air monitoring would need to be completed.

The table above includes an estimated acute exposure level and an estimated intermediate and chronic exposure level to benzene. What is the difference between and acute, intermediate, and chronic exposure levels as applied to the inhalation exposures in Climbing Hill? An estimated acute exposure level is an estimation of the exposure level during a shower or bath. An estimated intermediate and chronic exposure level is an estimation of the exposure level throughout the day for an extended period of time, greater than several weeks.

Toxicological Evaluation

The following information has been prepared as a toxicological evaluation for exposure to benzene from private wells in Lowell. This evaluation will include ingestion of drinking water containing benzene, and inhalation of benzene vapors during showering and bathing using the highest documented levels of these chemicals found in private wells in Climbing Hill. This toxicological evaluation will compare exposures levels to the following comparison values: minimum risk levels, the cancer risk evaluation guide, and the chronic oral reference dose.

Minimum Risk Levels

This toxicological evaluation will compare the levels of exposure in Climbing Hill to minimum risk levels (MRL) established by the Agency for Toxic Substances and Disease Registry. A MRL is defined as, “an estimate of daily exposure of a human being to a chemical that is likely to be without an appreciable risk of deleterious effects (non-carcinogenic) over a specified

period of time.” MRLs are based upon human and animal studies and are reported for acute exposure (less than 14 days), intermediate exposure (15 – 364 days), and chronic exposure (greater than 365 days).

Cancer Risk Evaluation Guide

This toxicological evaluation will also compare the levels of exposure in Climbing Hill to the cancer risk evaluation guide (CREG). The CREG is an estimated level of exposure over a 70-year period to a chemical at which there is a risk of an additional one-in-one million cancer incidences. That is, if a group of one million people were exposed to the chemical above the CREG, it is estimated that one extra person within the group of one million people would get cancer.

Chronic Oral Reference Dose

This toxicological evaluation will also compare the levels of oral exposure in Climbing Hill to the EPA chronic oral reference dose (RfD) for benzene, since there are no oral MRLs established for benzene. The chronic RfD is defined as “an estimate of a daily exposure to the general public (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects (non-carcinogenic) during a lifetime exposure.” The chronic RfD for benzene is 4.0×10^{-3} mg/kg/day.

In order to compare the concentrations of benzene in drinking water to the chronic RfD it is necessary to estimate the daily consumption of water by adults and children. Using standard assumptions of water consumption of 2 L/day and weight of 70 kg for adults, and standard assumptions of water consumption of 1 L/day and weight of 10 kg for children, corresponding concentrations in water can be calculated. The benzene comparison concentrations calculated from the RfD are 0.14 mg/L (140 µg/L) for adults and 0.04 mg/L (40 µg/L) for children.

Evaluation for Benzene

The following tables include the highest level of benzene documented in private well water in Climbing Hill, the estimated inhalation exposures resulting from showering or bathing in this water, and comparison values for RfD, MRLs, and the CREG. In the case of oral exposure to benzene, the highest level in private wells was compared to the RfD, a chronic oral exposure level, since only the oral RfD is available for comparison.

Chronic Oral Exposure

Level In Private Wells µg/L	RfD Concentration µg/L	
	Child	Adult
32.4	40	140

Inhalation Exposure

Estimated Inhalation Acute Exposure Level µg/L	Acute MRL µg/L	Estimated Inhalation Intermediate and Chronic Exposure Level µg/L	Intermediate MRL µg/L	CREG µg/L
48.4	50	3	4	0.031

The highest levels of benzene documented in private wells in Climbing Hill and the corresponding estimated inhalation exposures are below the comparison values for chronic oral exposure and for both acute and intermediate inhalation exposures. The estimated inhalation chronic exposure level is above the CREG.

As previously stated in this consultation, all residents were provided with bottled water shortly after contamination in their private wells was discovered. It is suspected that oral exposure to elevated levels of benzene in private wells was for a short period of time – less than a few years. Since the CREG is based upon chronic exposures over many years to benzene, the residents of Climbing Hill would most likely not have any carcinogenic impacts from being exposed to benzene within private well water.

IV. Children’s Health

Children have unique vulnerabilities to some environmental chemicals, and IDPH’s Hazardous Waste Site Health Assessment Program evaluated the potential impact of Climbing Hill’s groundwater contamination on children’s health. The program has not identified any existing exposure scenarios that might lead to adverse health effects among children. Concentrations of all contaminants in the treated tap water are lower than those reported to cause adverse health effects, even among children.

V. Conclusions

The Climbing Hill site poses no apparent public health hazards in the past and currently poses no apparent public health hazard. This designation means that contamination is present, but not in amounts likely to cause adverse health effects. The water treatment filters must be maintained properly and changed regularly for the site to remain classified as posing no apparent health hazard.

VI. Recommendations

IDPH has no recommendations at this time

VI. Public Health Action Plan

- IDPH will follow up with Climbing Hill residents to address any health concerns.
- IDPH will provide assistance with community health education as needed and requested.
- IDNR plans to continue to monitor the water at Climbing Hill regularly to ensure no additional wells become contaminated.
- IDNR plans to continue to inspect and maintain the carbon filtration systems.
- All concerned parties plan to continue to work with local residents, county officials, and other water resource agencies to resolve the water quality issue.

Table 1. Comparison of measured concentrations in drinking water with MCLs

Contaminant	Highest measured value at Climbing Hill, µg/L (Before / After filtration)	Maximum Contaminant Level (MCL), µg/L for lifetime of exposure
Benzene	32.4/1.5	5
Toluene	12.6/<1	1000
Ethylbenzene	<2/<0.5	700
Xylene	4.3/<1	10,000

VIII. References

1. Cardinale, R. Addressing petroleum contamination in a small Iowa town. *Iowa Groundwater Q.* 2002/2003; 13(4)
2. Agency for Toxic Substances and Disease Registry. *ToxFAQs for automotive gasoline.* Atlanta: US Department of Health and Human Services; 1996 Sept. CAS No.: 8006-61-9.
3. Agency for Toxic Substances and Disease Registry. *Toxicological profile for total petroleum hydrocarbons.* Atlanta: US Department of Health and Human Services. 1999 Sept. Report No.: PB-99-163370
4. Iowa Department of Natural Resources, Underground Storage Tank Section. Data provided. Des Moines, Iowa. 2003 March 18.

IX. Preparers of the Report

Author

Stuart Schmitz, P.E., and Charles Barton, Ph.D., DABT
Hazardous Waste Site Health Assessment Program
Iowa Department of Public Health

Reviewers

Alan Parham, LCDR
ATSDR Technical Project Officer
Division of Health Assessment and Consultation
Superfund Site Assessment Branch

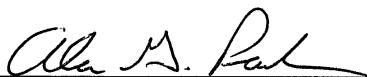
LTJG Shawn Blackshear
ATSDR Regional Representative
Office of Regional Operations, Region VII

Editor

Joseph Sigalas
Writer-Editor
NCEH / ATSDR
Office of Communication

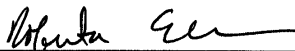
CERTIFICATION

The Iowa Department of Public Health, Hazardous Waste Site Health Assessment Program, has prepared this health consultation for the Climbing Hill, Iowa, groundwater contamination site under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). The document is in accordance with approved methodology and procedures existing when the health consultation was being prepared.



Technical Project Officer, SPS, SPAB, DHAC, ATSDR

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



Team Lead, SPS, SPAB, DHAC, ATSDR