

Health Consultation

Vapor Intrusion at a School

PRIMARY SCHOOL CAMPUS OF ST. KATHARINE DREXEL SCHOOL

CITY OF BEAVER DAM, DODGE COUNTY, WISCONSIN

JUNE 20, 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.

You May Contact ATSDR TOLL FREE at
1-800-CDC-INFO

or

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

HEALTH CONSULTATION

Vapor Intrusion at a School

PRIMARY SCHOOL CAMPUS OF ST. KATHARINE DREXEL SCHOOL

CITY OF BEAVER DAM, DODGE COUNTY, WISCONSIN

Prepared By:

Wisconsin Department of Health and Family Services
Under a Cooperative Agreement with the
Agency for Toxic Substances and Disease Registry

Summary

In February 2007, staff with the Wisconsin Department of Health and Family Services (DHFS) sampled groundwater infiltrating into the basement of a primary school and found very low levels of several chlorinated volatile organic compounds (CVOCs). Since no one is drinking or having occasional contact with the groundwater, the levels of CVOCs in groundwater do not pose a public health hazard. DHFS also collected air samples with dosimeter badges, which did not detect CVOCs in indoor air.

In April 2007, DHFS resampled indoor air at the school with a more sensitive method and found slightly elevated levels of four CVOCs that were also in groundwater infiltrating into the basement. These levels of CVOCs in indoor air were very low and pose No Apparent Public Health Hazard to students and staff of the school. Halting groundwater from infiltrating into the basement could decrease both moisture and very low levels of CVOCs in indoor air. Should school officials decide to halt infiltrating groundwater, DHFS recommends obtaining advice from a qualified building inspector or engineer.

Background

In January 2007, the Wisconsin Department of Natural Resources (DNR) requested assistance from DHFS to determine whether groundwater flowing into a private school next to a dry cleaner was contaminated and, if so, whether it posed a health concern for students and staff of a nearby school.

Contamination was found on the property of Beaver Cleaners, located at 111 West Maple Avenue, in the City of Beaver Dam, Dodge, County, Wisconsin. The past use of certain dry cleaning solvents at Beaver Cleaners resulted in soils and groundwater contaminated by a number of CVOCs. A recent investigation (MSA 2006) found that dry cleaning-related chemicals have migrated to the southwest and away from the Beaver Cleaner property. CVOCs are present in a shallow groundwater monitoring well on the southeast corner of the adjacent property, the Primary School Campus of St. Katharine Drexel School, which is located at 117 West Maple Avenue. School officials report that on any given school day there are approximately 100 students present.

While CVOCs in groundwater on the school property were at relatively low levels (Table 1), several compounds exceeded their respective Wisconsin Public Health Groundwater Quality Enforcement Standard (Wisc Admin Code, 2004). The school and surrounding properties are in downtown Beaver Dam and obtain drinking water from the City's municipal drinking water system.

On February 14th, 2007, DHFS and DNR staff met with officials of the St. Drexel Katharine School and discussed soil and groundwater contamination at the next door dry cleaners, as well as groundwater contamination found on the Primary School Campus. Discussions with school

officials addressed an observation in the 2006 MSA investigative report that groundwater is flowing into the southeast corner of the school's basement. The investigative report stated that neither the consultant nor school staff noticed CVOC odors in the basement, and a photo-ionization detector (PID) did not report the presence of any solvents. However, the human sense of smell starts noticing CVOC odors when concentrations are above 10,000 parts per billion (AIHA 1989), which is similar to occupational inhalation guidelines and over 1,000 times above acceptable exposure thresholds for commercial and residential settings. Additionally, most PIDs typically do not register vapor concentrations less than 1,000 parts per billion. DHFS staff discussed these issues with school officials and the possibility that CVOCs could be in the water infiltrating into the school and, if present, could be volatilizing into the air of the basement. School officials agreed to allow DHFS staff to test for CVOCs in the indoor air of the basement, as well as sample groundwater infiltrating into and flowing across the basement floor.

Table 1: Volatile Organic Compounds in Groundwater

St. Katharine Drexel School, 117 West Maple Street
Beaver Dam, Dodge County, Wisconsin

Chemical	2006 Monitoring Well Sampling				2007	Wisconsin NR140 Enforcement Standard
	Shallow Groundwater (12 feet)		Deep Groundwater (36 feet)		Sample of Groundwater Infiltrating into School Basement	
	Lowest Level Detected	Highest Level Detected	Lowest Level Detected	Highest Level Detected		
<i>cis</i> -1,2-dichloroethylene	36.0	40.0	nd	0.4	4.8	70
<i>trans</i> -1,2-dichloroethylene	2.6	2.6	nd	nd	nd	100
tetrachloroethylene	7.5*	28.0*	nd	nd	1.3	5
trichloroethylene	6.7*	7.1*	4.5	5.5*	1.6	5
Vinyl chloride	22.0*	35.0*	nd	nd	7.4*	0.2

Note: All concentrations in micrograms per liter ($\mu\text{g/L}$)
* - exceeds Wisconsin NR140 Enforcement Standard
nd - substance not detected

On March 2, 2007, DNR and DHFS staff visited the school and observed in the basement a stream of water steadily flowing from beneath the doorway to a former coal storage room. Inside of the former coal storage room water percolated down an approximate 10 to 15 foot length of the northern and eastern walls, and then ran across a sloped concrete floor, where it ultimately entered a 3 inch wide 1 inch deep channel in the floor (Figure 1). These external walls are approximately 50 to 60 feet away from the Beaver Cleaners, and approximately 15 feet from the contaminated monitoring well situated on the southeast corner of the school property.

Water then moved into a floor channel and flowed beneath the coal room door, across the basement floor, and emptied into a floor drain. Staff collected a water sample in the coal storage room. The water sample was submitted to the Wisconsin State Laboratory of Hygiene and underwent analysis following EPA Method 8260B.

Results of the infiltrated groundwater sample had slightly elevated levels of four CVOCs, all of which can be associated with dry cleaning compounds. Vinyl chloride was found at 7.4 $\mu\text{g/L}$ and is the only CVOC above its Wisconsin Public Health Groundwater Quality Enforcement Standard (Wisc Admin Code, 2004), which is 0.2 $\mu\text{g/L}$. This data appears in the fifth column in Table 1. Since no one is consuming or having direct contact with this water, the ingestion of CVOC-containing water at the school poses No Public Health Hazard.



Figure 1: Former Coal Storage Room, Primary School Campus, St. Katharine Drexel School, Beaver Dam, Wisconsin.

Each of the CVOCs found in groundwater infiltrating into the school property can readily transition from a dissolved form in surface water to a vapor, which then can be released into the air and be breathed. On February 14, 2007, DHFS staff placed three 3M[®] 3520 Organic Vapor Monitor (OVM) badges inside of the school, two at adult breathing levels in the basement and one on the stage in the auditorium/lunchroom, which is directly above the basement. Two additional OVM badges were placed outside of the school, one in a bush on the north side of the school on maple street, and one above a doorway on the east side of the school and along a sidewalk than runs between the school and Beaver Cleaners. The OVM badges were left in place

for 15 days. On March 2, 2007, DHFS returned and collected all badges, with the exception of the OVM badge placed outside on the east side of the school, which was missing. These four OVM badges were submitted to the Wisconsin State Laboratory of Hygiene, Occupational Health Laboratory and underwent analysis following OSHA Method 7. Analytical results for the four OVM badges did not detect 1,2-dichloroethylene, tetrachloroethylene, or trichloroethylene (with detection limits at 5.2, 10, and 8.5 $\mu\text{g}/\text{m}^3$, respectively). Analytical chemists reported that no evidence of vinyl chloride was observed in any of the four samples.

When DHFS staff reported to officials of St. Katharine Drexel School the results of testing infiltrating groundwater and indoor air samples (DHFS March 21, 2007), they requested permission to collect another round of air samples in the basement and auditorium using sampling equipment and a laboratory method that can detect much lower levels of these chemicals in air. This was approved by school officials.

Table 2: Indoor Air Sampling for Dry Cleaning Volatile Organic Compounds
 St. Katharine Drexel School, 117 West Maple Street
 Beaver Dam, Dodge County, Wisconsin
 April 9 to 10, 2007

Chemical	Sample Location				School Child Comparison Value
	Basement – Coal Storage Room	Basement – Janitor’s Desk	Main Floor – Gym Stage	Outdoor – Front of School	
<i>cis</i> -1,2-dichloroethylene	1.9	nd	nd	nd	37.0 ^a
tetrachloroethylene	2.0*	1.7	1.0	nd	1.9 ^b
Trichloroethylene	1.4*	0.8*	1.1*	1.9*	0.1 ^c
vinyl chloride	2.3*	0.4	nd	nd	1.3 ^d

Note: All concentrations in micrograms per cubic meter ($\mu\text{g}/\text{m}^3$)
 * - exceeds School Child Comparison Value
 nd - substance not detected
 a - Provisional EPA Reference-Dose based concentration for ambient air (EPA 2007b)
 b - Based on provisional EPA Cancer Slope Factor for tetrachloroethylene (EPA 2007b)
 c - Based on provisional EPA-NCEA Cancer Slope Factor for trichloroethylene (EPA 2007b)
 d - Based on EPA Cancer Slope Factor for vinyl chloride (EPA 2007a)

On April 9th, 2007, DHFS and DNR staff returned to the school and collected four air samples using 6-liter evacuated SUMMA[®] canisters. Three indoor air samples were collected; one from the former coal storage room in the basement; one from the janitor’s desk in the basement boiler room; and one from the main floor on the stage of the gym/lunchroom. An outdoor air sample was also collected from just outside of the school’s north entrance on West Maple Street. Each canister’s regulator and restrictor were adjusted to draw samples over a 24-hour period, and on

April 10th staff picked up the canisters. The canisters were submitted to the Wisconsin State Laboratory of Hygiene for analysis by gas chromatography and mass spectroscopy following EPA Method TO-15a.

The indoor air sample from the school's basement found slightly elevated levels of four CVOCs (Table 2) that were also found in the groundwater sample from the basement. The CVOCs found in both groundwater and indoor air samples were vinyl chloride, tetrachloroethylene, trichloroethylene, and *cis*-1,2,-dichloroethylene. These indoor air samples also had slightly elevated levels of other compounds that are not associated with the contaminated groundwater and are likely coming from other sources, such as commercial products used in the school or from outdoor air (WDHFS May 30, 2007).

Discussion

For each of the four CVOCs found in April 2007 indoor air samples of St. Katharine Drexel School, levels were screened against health-based comparison values. For the three CVOCs that are known or probable human carcinogens (tetrachloroethylene, trichloroethylene, and vinyl chlorides), the comparison values were derived from available cancer slope factors and took into account the exposure assumptions that a 10 kg child is present in the school for 8 hours/day, 250 days/year, for a duration of 10 years. For the air sample collected on the stage of the gym/lunchroom, the levels of tetrachloroethylene did not exceed its comparison value, while *cis*-1,2,-dichloroethylene and vinyl chloride were not detected. For the air sample collected from the janitor's desk, tetrachloroethylene and vinyl chloride also did not exceed their respective comparison values, and *cis*-1,2,-dichloroethylene was not detected. For the air sample collected in the coal storage room, tetrachloroethylene and vinyl chloride were slightly above their comparison values, and *cis*-1,2,-dichloroethylene did not exceed its comparison value. The levels of trichloroethylene in all samples were above its comparison value, but the data suggests that trichloroethylene found in the main floor was affected by an outdoor source.

Some of the CVOCs found in the basement air are apparently affected by the infiltrating groundwater. When comparing the levels of *cis*-1,2,-dichloroethylene, tetrachloroethylene and vinyl chloride measured in basement air with main floor air, the levels decreased or were no longer detected at the main floor. This trend is expected with a potential source in the basement and no identified source on the main floor. However, the levels of trichloroethylene did not decrease from the basement to the main floor, but remained similar to the coal storage room and then increased to the highest observed concentration in the outdoor air sample. This suggests that a portion or all of the trichloroethylene found in air on the main floor is potentially coming from a source external to the school.

Since students do not spend anytime in the basement, much less visit the coal storage room, they are not exposed to the levels of *cis*-1,2,-dichloroethylene, tetrachloroethylene, trichloroethylene, and vinyl chloride measured in the basement. DHFS staff were informed that only building maintenance staff go into the coal storage room, and such visits are infrequent. Even if staff

worked in this coal storage room all day, for their entire career, such an exposure to any of these CVOCs is not likely to cause illness or adverse health effects. Therefore, the level of CVOCs measured in the indoor air of the St. Katharine Drexel School is not a health concern, and poses a No Apparent Public Health Hazard.

Even though the levels of CVOCs inside the air of the school are not a health concern, actions can be taken to decrease CVOC levels in indoor air of the basement. An interim action could include ventilating basement air to the outside and bring in outdoor air, particularly inside the coal storage room. This could reduce the potential for CVOCs in basement air from migrating to other areas inside the school. A more permanent action could include halting the infiltration of contaminated groundwater that flows into the basement. This may be complicated and costly, therefore should school officials decide to pursue this course, DHFS recommends seeking the advice of a qualified building inspector or engineer. Even if the groundwater did not contain CVOCs, halting the infiltration of groundwater would likely reduce moisture levels in the basement.

The attached laboratory report shows many other chemicals were found at very low levels in the indoor air of the school. A number of studies show that very low levels of chemicals, including CVOCs, are common in the indoor air of businesses, schools, and homes. These other chemicals found in indoor air of the school include many products that have domestic and commercial uses, such as solvents, paints, fingernail polish, drinking & rubbing alcohol, paint thinners and removers, mothballs, and refrigerants. For example, there were a number of cleaning and painting products stored in the basement boiler room, including a penetrating-oil spray with tetrachloroethylene comprising 80% of the active ingredients. This is a key reason why we requested that staff use no solvents, paints, or sprays prior to or during sampling; we wanted to avoid introducing chemicals that were coming from another source that could interfere with indoor air results.

Child Health Considerations

DHFS recognizes that children can be especially sensitive to contaminants. Children are often at greater risk than adults to certain kinds of exposure from hazardous chemicals in the environment. Children engage in activities, such as playing outdoors and hand-to-mouth behaviors that increase their exposure to hazardous substances. Being much smaller than adults and playing on their hands and knees, children breathe air close to the ground that can have more dust, soil particles, and vapors. Children have a lower body weight, but a higher intake rate which results in a greater dose to hazardous substances per unit body weight. Also, children's bodies are developing and have permanent damage if toxic exposures are high enough during critical growth stages. For that reason, DHFS considers children as one of the most sensitive population evaluated in this health consultation, and always takes into account children when evaluating exposures to contaminants. In evaluating the implications of potential CVOC inhalation exposures by students, DHFS used worst case exposure assumptions and considered that children are more susceptible to CVOC-associated health effects than adults.

Conclusions

1. The levels of chlorinated volatile organic compounds measured in groundwater infiltrating in the basement of the Primary School Campus of St. Katharine Drexel School poses a No Public Health Hazard.
2. The levels of chlorinated volatile organic compounds measured in the indoor air of the Primary School Campus of St. Katharine Drexel School poses a No Apparent Public Health Hazard.
3. Halting or reducing groundwater from infiltrating into the basement of Primary School Campus of St. Katharine Drexel School could reduce moisture and very low levels of chlorinated volatile organic compounds in the indoor air of the school.

Recommendations

1. If school officials decide to halt or reduce groundwater infiltration into the school, DHFS recommends seeking the advice of a qualified building inspector or engineer.

Public Health Action Plan

DHFS is willing to meet with school officials to discuss these sample results and investigation findings, as well as present this information to interested school board members, staff, teachers, or parents, either in a small gathering or in a larger, formal meeting.

DHFS will continue to work with the Dodge County Health Department to address health concerns and questions related to chemicals and contamination found at the St. Katharine Drexel School.

References

MSA Professional Services. November 2006. Site Investigation Report – Former Beaver Cleaners. MSA: Beaver Dam, WI.

State of Wisconsin. February 2004. Groundwater Quality, Chapter NR 140.10. Wisconsin Administrative Code.

U.S. Environmental Protection Agency. 2007a. Integrated Risk Information System. Vinyl Chloride (CASRN 75-01-4). Washington DC: EPA. Available from URL: <http://www.epa.gov/iriswebp/iris/subst/1001.htm>.

U.S. EPA. 2007b. Human Health Risk Assessment, Risk Based Concentration Table System. Region 3 Office. Washington DC: EPA. Available from URL: <http://www.epa.gov/reg3hwmd/risk/human/index.htm>.

Wisconsin Department of Health and Family Services, Division of Public Health. March 21, 2007. Sample Results from West Maple Street School. Correspondence to B Haase, St. Katharine Drexel School. WDHFS: Madison, WI.

WDHFS. May 30, 2007. Sample Results from West Maple Street School. Correspondence to B Haase, St. Katharine Drexel School. WDHFS: Madison, WI.

Consultation Preparer

Henry Nehls-Lowe
Bureau of Environmental and Occupational Health
Division of Public Health
Wisconsin Department of Health & Family Services

ATSDR Regional Representative

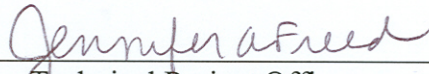
Mark Johnson
Division of Regional Operations, Region V
ATSDR

ATSDR Technical Project Officer

Jennifer Freed
Cooperative Agreement and Program Evaluation Branch
Division of Health Assessment and Consultation
ATSDR

Certification

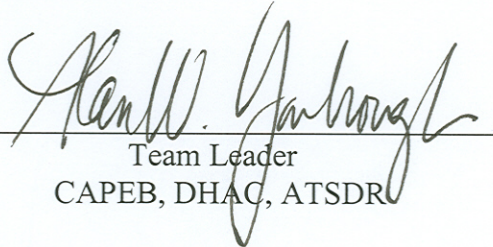
This Health Consultation on Vapor Intrusion at Primary School Campus of St. Katharine Drexel School, was prepared by the Wisconsin Department of Health and Family Services under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with the approved methodology and procedures existing at the time the Health Consultation was begun. Editorial review was provided by the cooperative agreement partner.



Technical Project Officer

Division of Health Assessment and Consultation (DHAC)
ATSDR

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



Team Leader

CAPEB, DHAC, ATSDR