CORRESPONDENCE / MEMORANDUM

STATE OF WISCONSIN
Department of Health & Family Services
Division of Public Health
Bureau of Environmental and Occupational Health
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608-266-3479

Date: April 3, 2006

To: Jim Schmidt, Wisconsin DNR – Southeast Regional Office

From: Henry Nehls-Lowe

Subject: **Residential Indoor Air Investigation – Redi-Quik Dry Cleaners**

Elevated levels of tetrachloroethylene were detected in the indoor air of a West Allis household located next to a dry cleaner. This poses a *public health hazard* to residents due to an unacceptable level of increased cancer risk. However, these levels are not likely to cause non-cancer health effects associated with much higher tetrachloroethylene exposures. DPH recommends that the homeowner open basement windows to remove any vapors due to vapor intrusion. DPH suggests the family visit a physician for a medical checkup. DPH will conduct another round of indoor air samples and also collect sub-slab soil gas samples. DPH recommends that the dry cleaner to immediately shut down all exhaust venting to the north side of the building and right next to the home. DPH recommends that the dry cleaner investigate for vapor migration and intrusion to the indoor air pathway in nearby homes. Also the dry cleaner needs to mitigate vapor intrusion impacts of affected home.

Background and Issues

In January 2006, you requested assistance from the Division of Public Health (DPH) to investigate for possible vapor migration and intrusion to the indoor air pathway of a home at 1361 95th Street, West Allis. This residential property is immediately north of the Redi-Quik Dry Cleaners, an operating business establishment located at 9508 West Greenfield Avenue (DNR Facility ID 241170490).

Environmental investigations at the Redi-Quik property have found groundwater and soils contaminated with elevated levels of tetrachloroethylene (perchloroethylene or PCE), which is commonly used in the dry cleaning industry. Monitoring wells found shallow groundwater is contaminated with PCE as high as 45,000 µg/L (micrograms per liter) on the Redi-Quik property, and 708 µg/L on the residential property (Shaw 2004). Sub-surface soil borings detected PCE levels up to 3,900 µg/kg (micrograms per kilogram) at the Redi-Quik property, and 230,000 µg/kg at the residential property (Envirogen 2001). Soil boring data from a monitoring well approximately 10 feet from this house (MW-12) found PCE at 129,000 µg/kg. Investigations on the residential property have not ruled out whether PCE-contaminated sub-

surface soils are in direct contact with the foundation of the home. Remediation actions to address PCE contamination have not been implemented at either the dry cleaner or residential properties.

The concentrations of PCE in shallow groundwater around the Redi-Quik property exceeds PCE screening levels, as cited in U.S. Environmental Protection Agency's (U.S. EPA) guidance on vapor migration and intrusion to the indoor air pathway (EPA 2002), and warrants further investigation of this pathway. Under certain circumstances, chlorinated solvents in unsaturated soils or shallow groundwater can be released as vapors, which then migrate through soil pore spaces and reach nearby buildings. Such vapors can enter the indoor air of buildings through cracks in concrete foundations, spaces around utility lines or pipes, or via unfinished dirt floors. This pathway is referred to as "vapor migration and intrusion". If substantial amounts of chlorinated solvent vapors reach and accumulate in the indoor air of a building, solvent levels can become an inhalation health concern for people who live or work inside the building.

In response to the DNR request, I first met with the owner of this West Allis home on February 9, 2006, and discussed the potential for vapor migration and intrusion into the home. At that time, I set up two 3M™ organic vapor passive diffusion monitors (OVM), one beneath the southwestern soffit of the house to monitor outdoor air, and one hanging from the ceiling joist in the basement to monitor indoor air. These OVMs were left in place at the home for 8 days, after which they were collected and placed inside of a sealed container and submitted to the Wisconsin State Laboratory of Hygiene (WSLH). Analysis by gas chromatography (NIOSH Method 7) detected PCE in both samples, equivalent to 34.0 $\mu g/m^3$ (micrograms per cubic meter) in outdoor air and 503.2 $\mu g/m^3$ in indoor air (Table 1). Currently, DPH is comparing outdoor and indoor air data obtained from OVMs with data provided by sampling methods more commonly used for indoor air investigations, such as EPA Method TO-14a.

On March 8, 2006, I returned to the West Allis home and collected 4 air samples using 6-liter evacuated SUMMA® canisters. Three indoor air samples were collected; one each from the breathing zones of the kitchen and the bedroom, and one from the southeast corner of the basement. An outdoor air sample was also collected from the front porch. Each cannister's regulator and restrictor were adjusted to draw samples over a 24-hour period and the canisters were collected on March 9th. The canisters were submitted to the WSLH for analysis by mass spectroscopy following EPA Method TO-14a (EPA 1999). PCE was detected in all indoor air samples, with 198.17 $\mu g/m^3$ in the bedroom, 183.67 $\mu g/m^3$ in the kitchen, and 231.60 $\mu g/m^3$ in the bedroom. PCE was also detected at 4.57 $\mu g/m^3$ in the outdoor air sample collected on the front porch (Table 1).

When visiting the West Allis home on both March 8th and 9th, I also screened indoor air and outdoor air with a photo-ionization detector (PID), which is able to measure total volatile organic compounds (VOC) in the single-digit, parts-per-billion range. The purpose of indoor air screening of the home was two-fold. First, this allowed DPH to identify any unusual levels of

Table 1: Indoor and Outdoor Air Tetrachloroethylene Concentrations
1361 95th Street, West Allis, Wisconsin

Sample ID	Lab Method	Media & Location	Sample Date	Sample Period	PCE Concentration ppb	PCE Concentration µg/m³	Comparison Value (µg/m³)
PH 3910[1]	OSHA Method 7	Outdoor Air (SW Soffit)	2/9/06	8 days	5.0	34.00	0.31
PH 4001[1]	OSHA Method 7	Indoor Air (Basement)	2/9/06	8 days	74.0	503.20	0.31
RQDC-IA-01[2]	EPA TO-14a	Indoor Air (Bedroom)	3/8/06	24 hrs	29.143	198.17	0.31
RQDC-IA-02[2]	EPA TO-14a	Indoor Air (Kitchen)	3/8/06	24 hrs	27.010	183.67	0.31
RQDC-IA-03[2]	EPA TO-14a	Indoor Air (Basement)	3/8/06	24 hrs	34.059	231.60	0.31
RQDC-OA-04[2]	EPA TO-14a	Outdoor Air (Front Porch)	3/8/06	24 hrs	0.672	4.57	0.31

1- Passive 3M™ OVM monitor samples
2- Active SUMMA® cannister samples

VOCs in air in order to alert WSLH technicians if samples had the potential for high concentrations and required additional dilution. Second, this allowed DPH to identify indoor solvent sources or preferential vapor migration pathways in the home. Air screening inside of the first-floor living space of the home detected VOC concentrations ranging between 70 and 130 ppb (parts-per-billion). The basement had VOC concentrations in the breathing zone between 40 and 70 ppb. While there is no sump crock in the basement, air immediately above the floor drain had total VOCs ranging between 200 and 300 ppb. For outdoor air around the West Allis home, total VOCs were between 5 and 35 ppb. On March 9th, a dryer vent was operating on the north side of the Redi-Quik Dry Cleaner building. Air coming from this vent screened at 4,700 to 5,800 ppb.

Discussion

The concentration of PCE found in the indoor air of this West Allis home is a *public health hazard* for the residents because of an unacceptable increased excess lifetime cancer risk. This PCE concentration is not likely to cause non-cancer health effects associated with much higher PCE exposures.

The PCE levels found inside the West Allis home represent an approximate 7-in-1,000 excess lifetime cancer risk level for a residential setting and represents a *public health hazard* to people living in this house. The highest level of PCE in the living space of this West Allis home was 198 $\mu g/m^3$, which is approximately 700 times higher than the maximum target PCE level for a residential setting (0.31 $\mu g/m^3$), which is based on a 1-in-1,000,000 increased excess lifetime cancer risk. Studies of dry cleaner workers indicates there may be a connection between PCE exposure and increased risk of certain cancers, but the weight of the scientific evidence is not conclusive and PCE is not classified as a known human carcinogen (ATSDR 1997). Laboratory studies of mice exposed to PCE found increases in the rates of liver cancer when compared with unexposed mice. Previously, U.S. EPA classified PCE as a "B2 – Probable Human Carcinogen", but this carcinogen assessment was withdrawn by U.S. EPA in 1990 for further review and this currently is not clarified. Despite the current status of PCE , DPH continues to rely on the cancer slope factor derived from this mice study when estimating increased human cancer risk due to PCE exposures.

At very high concentrations and breathed by people over a long term, PCE in indoor air can cause adverse, non-cancer health effects (affecting the central nervous system, liver, kidney), but the levels detected inside of the West Allis home are not expected to cause such adverse, non-cancer health effects. The PCE level in the living space at the West Allis home was slightly above the U.S. EPA Reference Dose and slightly below the ATSDR MRL. The U.S. EPA Reference Dose for PCE is 0.01 mg/kg/day (milligrams per kilogram of body weight per day), which was derived from studies that found a "no observed adverse effect level" (NOAEL) for laboratory animals exposed to PCE (EPA 2006). For a person breathing indoor air with PCE at 200 $\mu g/m^3$, their daily PCE exposure would be 0.057 mg/kg/day, which is 5 times above the Reference Dose. A Reference Dose is a value established by the U.S. EPA that is an estimate, with built in safety factors, of the maximum daily, life-time exposure to a chemical that is <u>not</u> likely to cause harmful health effects. This Reference Dose was derived from laboratory studies that observed liver toxicity in mice and weight gain in rats when PCE doses exceeded 14 mg/kg/day. A safety factor of 1,000 was used to extrapolate this NOAEL for animals and derive a Reference Dose for humans. The indoor air PCE concentration of 200 $\mu g/m^3$ was less than the ATSDR chronic Minimal Risk Level (MRL) for PCE, which is 300 $\mu g/m^3$. A MRL is "An estimate of daily human exposure – by a specified route and length of time – to a dose of chemical that is likely to be without a measurable risk of adverse, noncancerous effects." The chronic MRL for PCE of 300 $\mu g/m^3$ was based on a study that observed unfavorable neurological responses in women who were exposed over a long term to PCE concentrations averaging 102,000 $\mu g/m^3$. At the lower PCE concentrations of 1,300 $\mu g/m^3$ the study did not observe such adverse neurological effects in workers. In summary, a long-term inhalation exposure to the level of PCE measured in the West Allis home is not expected to result in non-cancer health effects.

It is important to note that PCE is commonly found in the indoor air of homes and offices, but the levels of PCE in the indoor air of this West Allis house are not typical for a home and are

apparently coming from a source outside the home. The highest level of PCE found inside the West Allis home was 231.60 $\mu g/m^3$ in the basement, which ranges 46 to 491 times higher than PCE concentrations typically found in the indoor air of homes and non-industrial businesses where PCE was not used. A 1988 review of indoor air sampling data from 2,195 "residential and workplace environments" found a median PCE concentration of 5.0 $\mu g/m^3$ and an upper 75th percentile of 11.0 $\mu g/m^3$ (Shah and Singh, 1988). Sexton et al. (2004) investigated various solvents in homes of three communities in the Minneapolis metropolitan area. For 292 indoor residential air samples with a 2-day average, PCE was detected in 97.6% of samples, with a median concentration of 2.9 $\mu g/m^3$, and a 90th percentile concentration of 3.8 $\mu g/m^3$. In another indoor air study of 120 Denver area homes that were not affected by vapor intrusion, PCE was detected in 69.9% of 282 air samples, with a median concentration of 1.0 $\mu g/m^3$, and a 90th percentile of 4.5 $\mu g/m^3$ (Kurtz & Folkes, 2002). Zhu et al. (2005) examined solvents in the indoor air of 75 homes in Ottawa, Canada, and found PCE in 97% of homes, with a median concentration of 0.47 $\mu g/m^3$, an a 90th percentile of 3.25 $\mu g/m^3$.

The PCE levels in outdoor air around the West Allis home are also well above PCE concentrations typically found in outdoor urban air. When Zhu et al. (2005) sampled solvents in the indoor air of homes in the City of Ottawa, they also sampled outdoor air and found a median PCE concentration of 0.015 $\mu g/m^3$, with a 90th percentile of 0.31 $\mu g/m^3$. Sexton et al. (2004) tested solvents in the outdoor air of the Minneapolis metropolitan area and found median PCE concentrations of 0.3 $\mu g/m^3$, and a 90th percentile of 0.7 $\mu g/m^3$. Shah and Singh (1988) found an outdoor air median PCE concentration of 0.35 $\mu g/m^3$, with an upper 75th percentile of 0.87 $\mu g/m^3$.

Follow-up Actions

While the residents of the West Allis home are not likely to develop adverse health effects from these exposures to PCE, DPH recommends that, as a precautionary measure, the family visit their personal health care provider for baseline medical evaluation, which would include basic blood and urine panels and standard organ function tests. Dr. Henry Anderson, the DPH Chief Medical Officer for Environmental and Occupational Health, is available to consult with the family's health care provider regarding this medical screening and results. Dr. Anderson can be contacted at 608-266-1253.

The laboratory results from the EPA Method TO-14a provides extremely low detection limits for indoor air sampling. Many factors can easily cause these results to vary. While indoor air screening did not identify any potential sources of PCE or other solvents, DPH recommends that at least one week prior to the next round of sampling that the homeowner remove all paint cans and other liquid containers from inside the West Allis home. In April 2006, DPH plans to collect another round of indoor and outdoor air samples at the West Allis home. At that time DPH will also collect soil gas samples drawn from beneath the basement concrete slab in the home.

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U.S. EPA. 2006. Integrated Risk Information System, Database for Risk Assessment. Available at: http://www.epa.gov/iriswebp/iris/index.html

Zhu J, Newhook R, Marro L, and Chan CC. 2005 Selected Volatile Organic Compounds in Residential Air in the City of Ottawa, Canada. Environ Sci Technol 39(11): 3964-3971.

Please contact me if I can be of further assistance to you regarding this matter.

cc: Binyotti Amungwafor – DNR Southeast Regional Office
Terry Evanson – DNR Central Office
Terry Brandenburg – West Allis Public Health Department
Tom Sieger – Division of Public Health
Property Owner of 1361 95th Street, West Allis, Wisconsin