Health Consultation

INDOOR AIR INVESTIGATION

AT A DAY CARE

MEMPHIS, SHELBY COUNTY, TENNESSEE

JANUARY 26, 2012

Disclaimer: This report was supported by funds from the Comprehensive Environmental Response, Compensation, and Liability Act through a cooperative agreement with the Agency for Toxic Substances and Disease Registry, U.S. Department of Health and Human Services. 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.

Foreword

This document summarizes an environmental public health investigation performed by the State of Tennessee Department of Health's Environmental Epidemiology Program. Our work is conducted under a Cooperative Agreement with the federal Agency for Toxic Substances and Disease Registry. In order for the Health Department to answer an environmental public health question, several actions are performed:

Evaluate Exposure: Tennessee health assessors begin by reviewing available information about environmental conditions at a site. We interpret environmental data, review site reports, and talk with environmental officials. Usually, we do not collect our own environmental sampling data. We rely on information provided by the Tennessee Department of Environment and Conservation, U.S. Environmental Protection Agency, and other government agencies, businesses, or the general public. We work to understand how much contamination may be present, where it is located on a site, and how people might be exposed to it. We look for evidence that people may have been exposed to, are being exposed to, or in the future could be exposed to harmful substances.

Evaluate Health Effects: If people could be exposed to contamination, then health assessors take steps to determine if it could be harmful to human health. We base our health conclusions on exposure pathways, risk assessment, toxicology, cleanup actions, and the scientific literature.

Make Recommendations: Based on our conclusions, we will recommend that any potential health hazard posed by a site be reduced or eliminated. These actions will prevent possible harmful health effects. The role of Environmental Epidemiology in dealing with hazardous waste sites is to be an advisor. Often, our recommendations will be action items for other agencies. However, if there is an urgent public health hazard, the Tennessee Department of Health can issue a public health advisory warning people of the danger, and will work with other agencies to resolve the problem.

If you have questions or comments about this report, we encourage you to contact us.

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Glossary of Terms and Acronyms

adverse health effect: A change in body function or cell structure that might lead to disease or health problems

ambient: Surrounding (for example, *ambient* air).

ATSDR: Agency for Toxic Substances and Disease Registry.

background level: An average or expected amount of a substance in a specific environment, or typical amounts of substances that occur naturally in an environment.

cancer: Any one of a group of diseases that occur when cells in the body become abnormal and grow or multiply out of control.

cancer risk: The theoretical excess risk for getting cancer if exposed to a substance every day for 70 years (a lifetime exposure). The true risk might be lower. The excess cancer risk is often expressed as $1x10^{-6}$ for one excess cancer in 1 million people.

chronic exposure: Contact with a substance that occurs over a long time (more than 1 year).

comparison value (CV): Calculated concentration of a substance in air, water, food, or soil that is unlikely to cause harmful (adverse) health effects in exposed people. The CV is used as a screening level during the public health assessment process. Substances found in amounts greater than their CVs might be selected for further evaluation in the public health assessment process.

concentration: The amount of a substance present in a certain amount of soil, water, air, food, blood, hair, urine, breath, or any other media.

detection limit: The lowest concentration of a chemical that can reliably be distinguished from a zero concentration.

EPA: United States Environmental Protection Agency.

Epidemiology: The study of the distribution and determinants of disease or health status in a population; the study of the occurrence and causes of health effects in humans.

exposure: Contact with a substance by swallowing, breathing, or touching the skin or eyes. Exposure may be short-term (acute exposure), of intermediate duration, or long-term (chronic exposure).

exposure pathway: The route a substance takes from its source (where it began) to its end point (where it ends), and how people can come into contact with (or get exposed to) it. An exposure pathway has five parts: 1) a source of contamination (such as an abandoned business), 2) an environmental media and transport mechanism (such as movement through ground water), 3) a point of exposure (such as a private well), 4) a route of exposure (eating, drinking, breathing, or

touching), and 5) a receptor population (people potentially or actually exposed). When all five parts are present, the exposure pathway is termed a completed exposure pathway.

health consultation: A review of available information or collection of new data to respond to a specific health question or request for information about a potential environmental hazard. Health consultations are focused on a specific exposure issue. Health consultations are therefore more limited than a public health assessment, which reviews the exposure potential of each pathway and chemical.

inhalation: The act of breathing. A hazardous substance can enter the body this way.

migration: Chemical movement from one location to another.

minimal risk level (MRL): An ATSDR estimate of daily human exposure to a hazardous substance at or below which that substance is unlikely to pose a measurable risk of harmful (adverse), noncancerous effects. MRLs are calculated for a route of exposure (inhalation or oral) over a specified time period (acute, intermediate, or chronic). MRLs should not be used as predictors of harmful (adverse) health effects.

ppb: parts per billion.

risk: The probability that something will cause injury or harm.

route of exposure: The way people come into contact with a hazardous substance. Three routes of exposure are breathing (inhalation), eating or drinking (ingestion), or contact with the skin (dermal contact).

sample: A portion or piece of a whole. A selected subset of a population or subset of whatever is being studied. For example, in a study of people the sample is a number of people chosen from a larger population. An environmental sample, such as a small amount of soil or water, might be collected to measure contamination in the environment at a specific location.

soil-gas: Gaseous elements and compounds in the small spaces between particles of earth and soil. Such gases can be moved or driven out under pressure.

Toxicology: The study of the harmful effects of substances on humans or animals.

volatile organic compounds (VOCs): Organic compounds that evaporate readily into the air. VOCs include substances such as benzene, dichloroethylene, toluene, trichloroethylene, methylene chloride, methyl chloroform, and vinyl chloride.

SUMMARY

INTRODUCTION Chemicals were found in soil-gas on a property the Memphis City Schools in Memphis, Tennessee, considered acquiring. A new school was considered to be built on the property. Environmental investigations done on the property showed that drycleaning chemicals were located near the property line that was shared with a strip mall, a vacant drycleaner, and a day care facility. The likely origin for the chemicals was a release(s) at the former drycleaner, Park Place Cleaners.

Tennessee Department of Environment and Conservation (TDEC) Division of Remediation (DoR), EEP, and the Shelby County Health Department were concerned about vapors from the chemicals found near the property border migrating up into and mixing with the indoor air in the day care. An additional soil-gas investigation was done to understand if the chemicals were coming from the cleaner. Drycleaning chemicals were found in the general area of the cleaner. The chemicals were also found to be located close to the day care facility. As a result, the indoor air in the day care was tested on September 24, 2011, to determine if children who attend the day care and day care staff were being exposed to various drycleaner-related chemicals.

EEP wrote this health consultation for the TDEC DoR. It documents EEP's work with other agencies and the review and evaluation of indoor air samples collected within a day care.

All data supplied for this health consultation was compared to the Agency for Toxic Substances and Disease Registry (ATSDR) and U.S. Environmental Protection Agency (EPA) residential indoor air comparison values. Comparison values are chemical concentrations or doses based on toxicology below which no adverse health effects are predicted to occur. When a comparison value is exceeded, it does not immediately indicate that people would be expected to develop adverse health effects. Instead, it means further evaluation is needed. The data was also compared to U.S. Environmental Protection Agency background levels for residential indoor air.

CONCLUSION

EEP reached one conclusion in this health consultation:

Conclusion

EEP concludes that day care workers or children attending the day care would not experience adverse health effects from breathing the indoor air of the day care.

Basis for Conclusion

There does not appear to be appreciable levels of chemical vapors migrating upward into the day care from nearby contaminated groundwater. The indoor air data collected from the day care was evaluated using common exposure time frames and then compared to available Agency for Toxic Substances and Disease Registry (ATSDR) and Environmental Protection Agency (EPA) health comparison values. The data was also compared to EPA background levels found in a typical home. In the evaluation, the PCE level was found to be less of a risk than the conservative and acceptable risk levels allowed by EPA. The detected level was also below the lower range of levels found in the EPA background study.

Next Steps

Additional indoor air testing inside the day care is recommended at some point in the future to confirm the September 2011 results.

FOR MORE INFORMATION

If you have any questions or concerns about your health, you should contact your healthcare provider. For more information on this environmental site call TDEC toll free at 1-888-891-8332. For more information on this health report, please call TDH EEP at 615-741-7247 or 1-800-404-3006 during normal business hours. You can also email TDH EEP at eep.health@tn.gov.

Introduction

The Memphis City Schools investigated property in Shelby County, Tennessee on which they considered acquiring and building a new school. The investigation revealed that petroleum hydrocarbons were present in the center of the property and that chlorinated solvents were present along the eastern property line. The Memphis City Schools informed the Tennessee Department of Environment and Conservation's (TDEC) Division of Remediation (DoR) of the situation. TDEC DoR discovered that the property line of the property considered for the new school was shared with a strip mall, a vacant drycleaner, and a day care facility. The former drycleaner, Park Place Cleaners, operated from 1990 until 2009 and used tetrachloroethylene (PCE or perc) as a solvent to dryclean clothes. There may have been a release(s) of the drycleaning chemical PCE during the operation of the cleaner.

Quickly, the Tennessee Department of Health's Environmental Epidemiology Program (EEP), TDEC, and the Shelby County Health Department (SCHD) worked together to further investigate the situation. A conference call was held to discuss the proximity of the chlorinated solvent pollution to the offsite businesses, specifically the sensitive population in the day care. All agencies agreed that more data was needed to better understand the potential problem. To protect the workers and children in the day care from possible exposure, the needed data had to be acquired quickly. Therefore, additional soil-gas testing and, as a follow up, indoor air testing were done to evaluate if there was a problem in the day care.

Background

EEP, TDEC, and SCHD decided that TDEC would perform soil-gas testing all around the vacant Park Place Cleaners building. The soil-gas testing would be done to: (1) determine if the former cleaner was the source of the pollution and (2) check if the pollution had migrated toward the day care building, potentially causing vapor intrusion.

A few weeks later, EEP, TDEC, and SCHD had a second conference call to discuss the results of the soil-gas testing around the drycleaner. The additional soil-gas data showed that PCE was concentrated in the area behind the cleaner. The data also showed the chemicals appeared to be moving away from the cleaner and not in the direction of the day care. The location of the breakdown products of PCE, including trichloroethylene (TCE) and cis-1,2-dichloroethylene (cis-1,2-DCE), in soil-gas showed that those chemicals also appeared to be moving away from the cleaner to the south, toward the strip mall and not toward the day care.

Even with the information from two soil-gas investigations, there still was not enough data to rule out whether there was a health threat inside the day care. If vapor intrusion was occurring, then staff who work in and children who attend the day care would be exposed. The day care was constructed of brick and was built on a concrete slab foundation at ground level. Many walls inside the day care did not reach the ceiling. This allowed for mixing of the indoor air from room to room. All agencies agreed that the indoor air of the day care should be tested. The day care regional facility manager agreed to allow the indoor air testing. The indoor air was tested on September 24, 2011.

The State of Tennessee does not have promulgated environmental regulatory guidance for conducting indoor vapor intrusion investigations at these types of sites. Therefore, the investigation was conducted using various procedures that are generally accepted by other state and federal regulatory agencies and outlined in various indoor air sampling guidance documents.

Discussion

Introduction to Chemical Exposure

To determine whether persons have been or are likely to be exposed to chemicals, TDH EEP evaluates ways that could lead to human exposure. Chemicals released into the environment have the potential to cause harmful health effects. Nevertheless, a release does not always result in exposure. People can only be exposed to a contaminant if they come into contact with it. If no one comes into contact with a contaminant, then no exposure occurs, and thus, no health effects could occur. An exposure pathway contains five parts:

- a source of contamination
- contaminant transport through an environmental medium
- a point of exposure
- a route of human exposure, and
- a receptor population.

An exposure pathway is considered complete if there is evidence that all five of these elements have been, are, or will be present at the site. An exposure pathway is considered incomplete if one of the five elements is missing.

The source of contamination is the place where the chemical was released. For this site, the source could be spills and leaks from the former drycleaner next door to the day care. The environmental media transports the contaminants. Environmental media are groundwater, soils, surface water, or air. For this site, the chemicals are likely transported through the groundwater and indoor air. The point of exposure is the place where people come into contact with the contaminated media. Indoor air is the point of exposure for this site. The route of exposure is the way the contaminant enters the body. Ways a contaminant can enter the body are through ingestion, inhalation, or dermal contact. For this site, the route of exposure is inhalation or breathing of indoor air.

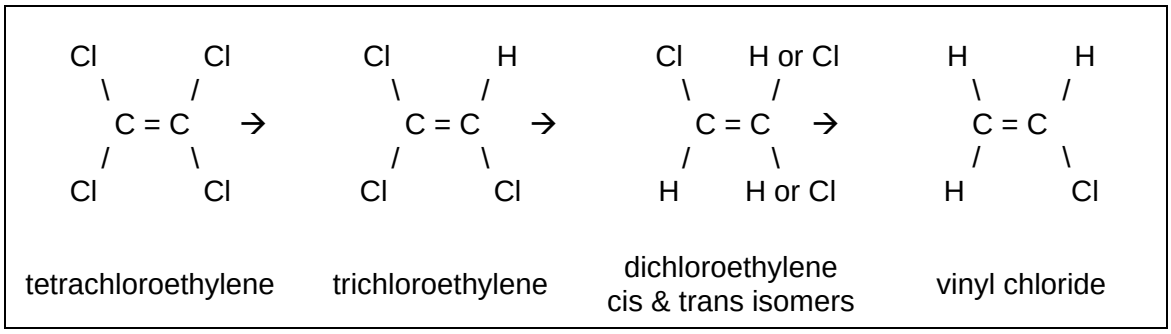
Physical contact alone with a potentially harmful chemical in the environment by itself does not necessarily mean that a person will develop adverse health effects. A chemical's ability to affect health is controlled by a number of other factors, including:

- the amount of the chemical that a person is exposed to (dose)
- the length of time that a person is exposed to the chemical (duration)
- the number of times a person is exposed to the chemical (frequency)
- the person's age and health status, and
- the person's diet and nutritional habits.

For this project, the potentially exposed populations included the children who attend and the staff who work in the day care.

Solvent Explanation

The process of drycleaning is not truly dry, but it uses so little water that it has come to be known as drycleaning. Instead of water, chemical solvents are used in the cleaning process. The most commonly used solvent for drycleaning is tetrachloroethylene or perc. It is colorless liquid and has sweet smell (ATSDR 1997). PCE is a volatile organic compound. It will quickly evaporate into a gas at room temperature. As its name implies, tetrachloroethylene has four chlorine anions on a two-carbon molecule. As these chlorine anions react, the molecule breaks down into other chlorinated volatile organics. Each of these breakdown chemicals has slightly different chemical properties and toxicities. The following diagram is an example of how one chemical can break down to form another.



In this example, PCE can break down to TCE, then to dichloroethylene (DCE), and then to vinyl chloride (VC). The only way to truly know the ratio of these breakdown chemicals is to collect environmental samples. The drycleaner solvent, PCE, and all of its breakdown chemicals were carefully considered in developing this report.

Comparison Values

To evaluate exposure to a hazardous substance, health assessors often use health comparison values. If the chemical concentrations are below the comparison value, then health assessors can be reasonably certain that no adverse health effects will occur in people who are exposed. If concentrations are above the comparison values (ATSDR 2011a, 2011b, EPA 2011a) for a particular chemical, then further evaluation is needed.

The Agency for Toxic Substances and Disease Registry (ATSDR) develops Minimal Risk Levels (MRLs) using conservative or "worst case" assumptions. MRLs are an estimate of the daily human exposure to a substance that is likely to be without appreciable risk of adverse health effects during a set time of exposure. ATSDR uses the term 'conservative' to refer to values that are protective of public health in essentially all situations. Environmental Media Evaluation Guidelines (EMEGs) are calculated by ATSDR from their MRLs. EMEGs represent concentrations of substances in water, soil, and air to which humans may be exposed during a specified period of time (acute, intermediate or chronic) without experiencing adverse health effects. EMEGs only consider non-cancer adverse health effects. These exposure durations are defined as acute (14 days or less), intermediate (15–365 days), or chronic (365 days or more). Chronic EMEGs are generally the more conservative and assume exposure for 24 hours per day, 7 days per week, 52 weeks each year, 365 days per year, for 1 year or longer. Exposure to a level above the EMEG for a chemical does not necessarily mean that adverse health effects will occur (ATSDR 2007).

To understand the degree that PCE could lead to excess cancers from breathing indoor air containing these chemicals, the measured indoor air levels of these chemicals were also compared to ATSDR Cancer Risk Evaluation Guides (CREGs). The levels of chemicals measured in the environment are compared to CREGs to understand the additional risk of cancer from exposure to the chemical (ATSDR 2011a, 2011b). Lifetime exposure to a chemical at an amount equal to its CREG comparison value could theoretically result in a one in a million risk of developing cancer in addition to the background risk of developing cancer. The background risk is that risk of developing cancer from daily life activities. Both ATSDR and EPA prefer to base health comparison values on 1 excess cancer in 1,000,000 people or $1x10^{-6}$. Residential comparison values were used for evaluation of exposure for those working in and going to the day care (ATSDR 2006a). When making remedial action decisions, EPA uses an acceptable cumulative carcinogenic site risk "target range" of 1 in 10,000 to 1 in 1,000,000, or 10^{-4} to 10^{-6} (EPA 1991).

PCE is thought to be *"reasonably anticipated to be a human carcinogen"* (IARC 1995, NTP 2011). PCE is readily absorbed following inhalation. For this site, we were concerned with the inhalation of PCE from vapor intrusion into indoor air of the day care.

The carcinogenic and non-carcinogenic toxicity of PCE has been under review for a number of years by a variety of state, federal, and other human health and environmental organizations. ATSDR recently adapted California Environmental Protection Agency's (CaEPA's) oral cancer slope factors to generate interim CREGs for PCE (ATSDR 2011b). The interim inhalation PCE CREG is 0.03 ppb. The U.S. Environmental Protection Agency (EPA) has a residential setting PCE inhalation RSL for one excess cancer in 1,000,000 people of 0.06 ppb (EPA 2011a).

Introduction to Vapor Intrusion

Volatile and semi-volatile chemicals evaporate from impacted subsurface soil and/or groundwater beneath a building and move toward areas of lower chemical levels such as the atmosphere, utility conduits, or basements. Subsurface vapors can enter a building due to two main factors: (1) environmental effects and (2) building effects. Some examples of these factors are barometric pressure changes, wind load, temperature currents, or depressurization from building exhaust fans. Chemicals can migrate up and enter indoor air through foundation slabs, crawl spaces, or basements. The chemical migration depends on the construction of the building, if there are any unsealed joints or cracks in the foundation, the buildings heating and ventilation characteristics, and other factors. The rate of movement of the vapors into the building is difficult to measure and depends on soil type, chemical properties, building design and condition, and the pressure differences (ITRC 2007). Upon entry into a structure, chemical vapors mix with the existing air through the natural or mechanical ventilation of the building.

Commonly found concentrations of chemicals in indoor and outdoor air are referred to as "background levels." These levels are generally determined from the results of samples collected in homes, offices, and outdoor areas not thought to be affected by "outside" sources of volatile chemicals. For example, a home not known to be near a chemical spill, a hazardous waste site, a drycleaner, or a factory. Background levels of volatile chemicals are considered when conducting an investigation of the vapor intrusion pathway (NYSDOH 2006).

Indoor Air Sampling Methods and Results

Indoor and outdoor air samples were collected using Summa canisters that had flow controllers calibrated to collect a sample over a minimum eight-hour time period (Alison Campany, TDEC, personal communication). TDEC staff collected four indoor air samples (3 samples and 1 duplicate sample), one outdoor air sample, and one sample of air within the sanitary sewer. The sewer runs behind the day care and east of the proposed school property (Figure 1). Because of the lack of access, the sewer sample was a grab sample with the sampling time indicated as being very short, just over a minute. Results of the September 2011 air sampling are shown in Table 1.

Sampling was conducted using generally accepted procedures (NYSDOH 2006, ITRC 2007, EPA 2008). Both the indoor and outdoor air samples were collected using certified clean, 6-liter Summa canisters with 8-hour calibrated individual flow controllers. This certification process is how the subcontract laboratory, Environmental Science, Inc., in Mount Juliet, Tennessee, ensured the cleanliness of the canisters when dealing with low reporting limits. The air samples collected were analyzed for many different chemicals, including those used in the drycleaning process, using the EPA Method TO-15 for VOCs.

The Summa canisters were positioned in areas where children and workers would be most. These areas included sleeping areas and areas where activities were carried out during the day.

The equipment used for testing air samples was sophisticated and could detect extremely small levels of chemicals in air. The U.S. Environmental Protection Agency (EPA) has compiled statistics on normal background levels of many chemicals in residential indoor air (EPA 2011b). Outdoor and indoor air can contain low background levels of many chemicals, such as those from vehicle exhaust, cleaning products, drycleaned clothing, paint, colored markers, and chemicals from many other consumer products that are a part of normal daily activities.

The day care air test results showed there were several chemicals in the indoor air samples and in the outside air sample, although at very low levels. Most of the chemicals found in the day care, such as ethanol, acetone, and 2-propanol (isopropyl alcohol), were likely from products such as paints, cleaners, detergents, and disinfectants that are all used as part of everyday activities. Other chemicals found in the indoor air, such as benzene and ethylbenzene, are likely related to automobile exhaust. Finding gasoline-related chemicals in indoor air is typical in urban and suburban settings. Other chemicals were found that are commonly used in the water disinfecting process. These were chloroform and chloromethane. The very low PCE level found was also within the background range for PCE. All levels of chemicals found in the indoor air would not be unexpected based on EPA's background data (EPA 2011b).

As mentioned earlier, PCE was the main chemical used to dry-clean clothing at the cleaner. TCE is an important breakdown chemical of PCE. Two other chemicals, cis-1,2-DCE and vinyl chloride, are also breakdown chemicals of both PCE and TCE.

Of the four indoor air samples collected inside the day care, only one sample contained PCE. The one PCE measurement was 0.26 parts per billion (ppb). The PCE level was just above a stringent analytical detection limit of 0.20 ppb. The PCE-breakdown chemical TCE was not found. The PCE and TCE breakdown chemicals, cis-1,2-DCE and vinyl chloride, were also not found.

None of these chemicals were detected in the outdoor air sample.

Figure 1. Indoor air sampling locations (marked as "stars") inside a day care, Memphis, Shelby County, Tennessee. Indoor air samples were collected on September 24, 2011, over 8 hours using Summa canisters by Tennessee Department of Environment and Conservation Division of Remediation staff from the Memphis, and Jackson, Tennessee Field Offices. (Source: Alison Campany, TDEC, October 5, 2011).

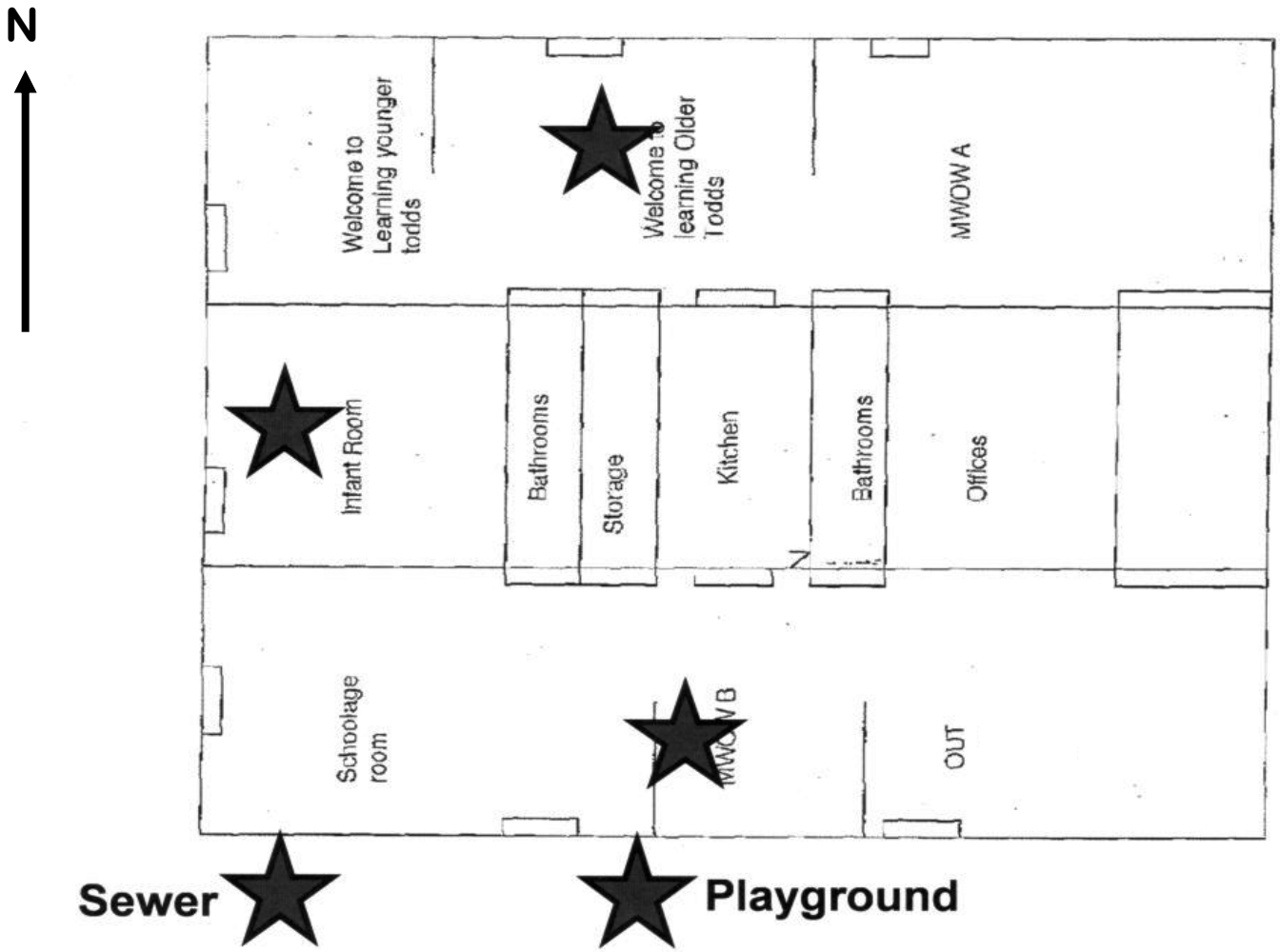


Table 1. Air results for the day care. Samples collected on September 24, 2011, over 8-hours. All results are reported in parts per billion (ppb) by volume.

Sample Location		Welcome to Learning – Older Tots Room Sample (NR 10119)	Infant Room Sample (IR1-10470)	Infant Room - Duplicate Sample (IR2-10431)	MWOW B Room Sample (SR-10466)	Outdoor Air Playground Sample (PG-10478)	Sanitary Sewer Sample * (SG-10445)
Parameter	**Units**						
Acetone	ppb	14	14	14	13	4.8	11
Benzene	ppb	0.38	0.28	0.38	0.46	0.42	0.2
Chloroform	ppb	0.5	0.46	0.47	0.46	<0.20	<0.20
Chloromethane	ppb	0.48	0.48	0.48	0.46	0.41	0.32
Cyclohexane	ppb	0.42	0.22	0.66	0.38	<0.20	<0.20
1,4-Dichlorobenzene	ppb	0.29	0.25	0.27	0.23	<0.20	<0.20
cis-1,2-Dichloroethene	ppb	<0.20	<0.20	<0.20	<0.20	<0.20	10
Ethanol	ppb	1100 E	1100 E	1100 E	1100 E	9.4	6.3
Ethylbenzene	ppb	0.21	0.2	<0.20	0.21	<0.20	<0.20
Trichlorofluoromethane	ppb	0.65	0.6	0.62	0.6	<0.20	<0.20
Dichlorodifluoromethane	ppb	0.56	0.53	0.53	0.53	0.31	0.31
Heptane	ppb	0.33	<0.20	<0.20	0.21	<0.20	<0.20
n-Hexane	ppb	1.1	0.44	0.81	0.85	0.8	0.22
Methylene chloride	ppb	<0.20	0.44	<0.20	<0.20	0.31	<0.20
Methyl methacrylate	ppb	<0.20	<0.20	0.38	0.36	0.23	<0.20
MTBE	ppb	<0.20	<0.20	<0.20	<0.20	0.36	<0.20
2-Propanol	ppb	21	20	21	21	1.5	3.7
Styrene	ppb	0.25	0.23	0.24	0.22	<0.20	<0.20
Tetrachloroethylene	ppb	0.26	<0.20	<0.20	<0.20	<0.20	300
Toluene	ppb	1.4	1.2	1.2	1.4	0.75	0.35
Trichloroethylene	ppb	<0.20	<0.20	<0.20	<0.20	<0.20	12
2,2,4-Trimethylpentane	ppb	0.85	0.28	0.32	0.77	1.1	0.39
Vinyl chloride	ppb	<0.20	<0.20	<0.20	<0.20	<0.20	0.32
m&p-Xylene	ppb	0.51	0.48	0.43	0.5	<0.40	<0.40
o-Xylene	ppb	0.21	<0.20	<0.20	0.2	<0.20	<0.20

E = Test result exceeds upper calibration range of instrument. Actual test result is greater than the upper calibration range.

< 0.20 = Chemical not detected. Detection limit shown.

***** = Grab sample collected over an approximate 1 minute time frame.

It is not fully known if the process of vapor intrusion was occurring at the day care and caused the detection of PCE. Only one of four indoor air samples contained a trace amount of PCE. Because the PCE was not detected throughout the building, it does not suggest that vapor intrusion was occurring. Very small amounts of PCE could remain in the indoor air from a product used in the day care that contained PCE. The source of the single detection of PCE remains unknown.

Indoor Air PCE Result Evaluation

EEP evaluated the potential for adverse health effects from breathing the indoor air of the day care. EEP used a conservative, cautious approach by using the PCE amount found to represent the amount of PCE in all the indoor air of the day care. ATSDR has a health comparison value called an environmental media evaluation guide (EMEG) for PCE that is protective for non-cancer effects. This EMEG is 40 ppb (ATSDR 2011). An EMEG is the level below which no adverse health effects are expected from a life-time exposure to PCE. No non-cancer adverse health effects would be expected from exposure to PCE in the daycare.

Both ATSDR and EPA have comparison values for the risk of developing cancer, which is in addition to the background rate of cancer. ATSDR's cancer risk evaluation guide (CREG) for PCE at a one in a million excess cancer risk is 0.03 ppb (ATSDR 2011b). EPA's cancer risk comparison value for PCE at a one in a million excess cancer risk is 0.06 ppb. The measured PCE level of 0.26 ppb is greater than these very protective comparison values. Therefore, further evaluation was necessary.

Further evaluation of the PCE level was done using EPA's PCE inhalation unit risk. The inhalation unit risk of a chemical is the highest additional lifetime cancer risk estimated to result from continuous exposure to the chemical at a concentration of 1 microgram per cubic meter of air ($\mu g/m^3$), or 0.15 ppb for PCE. The inhalation unit risk for PCE of $5.9x10^{-6}$ per microgram per cubic meter of air $(\mu g/m^3)^{-1}$ assumes a lifetime breathing exposure to 1 $\mu g/m^3$ PCE for 24 hours per day, every day. Even with these exposure assumptions, the theoretical risk from breathing 0.26 ppb of PCE calculates to be 1 cancer in 100,000 people, in addition to the background cancer rate of 1 in 2 for men and 1 in 3 for women.

EEP further evaluated what a typical exposure would be for a child attending the day care and a staff person working at the day care using the inhalation unit risk over a modified exposure time period. The theoretical risk was modified for a child being at the day care for 12 hours per day, 5 days per week, 50 weeks per year, for 8 years. The resulting risk of an excess cancer to a child from exposure to PCE at the day care was about 3 in ten million (1 in 3.3 million). The theoretical risk was then modified for a day care staff person being at the day care for 14 hours per day, 5 days per week, 50 weeks per year, for 15 years. The resulting risk of an excess cancer from exposure to PCE at the day care was about 9 in ten million (1 in 1.1 million). Both these theoretical risks of developing cancer are acceptable according to EPA's risk criteria (EPA 1991).

Other Considerations

The air sample collected from the sanitary sewer that is located behind the day care and the former drycleaner had the highest amounts of chemicals of all the air samples collected. This represents a potential source of PCE to the building through the sewer system if the day care's sewer trap(s) are not functioning properly. The local maintenance staff of the day care should inspect the day care's sewer trap(s) to make sure the trap is not "dry." A "wet" trap prevents sewer gas from flowing back into the indoor air of the day care facility through the sink and rest room drains.

Children's Health Considerations

Children could be at greater risk than adults from certain kinds of exposure to hazardous substances (ATSDR 1997, 1998). Children have lower body weights than adults. Although children's lungs are usually smaller than adults, children breathe a greater relative volume of air compared to adults. If toxic exposure levels are high enough during critical growth stages, the developing body systems of children can sustain permanent damage. Children are dependent on adults for access to housing, for access to medical care, and for risk identification. Thus, adults need as much information as possible to make informed decisions regarding their children's health.

In preparation of this health document, the health of children was thoughtfully considered. According to ATSDR, there is no indication that PCE affects children differently than adults (ATSDR 1997). The single measurement of PCE found in the indoor air of the day care was evaluated. The level was very small. The additional excess cancer risk was calculated and found to be insignificant. Based on EEP's evaluation, there should not be any harm to children that breathe the air in the day care.

Conclusion

EEP concludes that children attending the day care or day care staff would not experience adverse health effects from breathing the indoor air of the day care.

There does not appear to be appreciable levels of chemical vapors migrating upward into the day care from nearby contaminated groundwater. The indoor air data collected from the day care was evaluated using common exposure time frames and then compared to available Agency for Toxic Substances and Disease Registry (ATSDR) and Environmental Protection Agency (EPA) health comparison values. The data was also compared to EPA background levels found in a typical home. In the evaluation, the PCE level was found to be less of a risk than the conservative and acceptable risk levels allowed by EPA. The detected level was also below the lower range of levels found in the EPA background study.

Recommendations

The Tennessee Department of Health's Environmental Epidemiology Program recommends the following actions at this site:

- Collecting additional indoor air samples inside the day care at some point in the future to confirm the September 2011 results, and

- Following up with the local maintenance staff at the day care to confirm they have inspected the day care's sewer trap(s) to be sure that the trap is not "dry" and continues to prevent sewer gas from entering the day care.

Public Health Action Plan

The public health action plan for the day care contains a list of actions that have been or will be taken by EEP and other agencies. The purpose of the public health action plan is to ensure that this health consultation identifies public health hazards and offers a plan of action designed to mitigate and prevent harmful health effects that result from breathing hazardous substances in the environment. Included is a commitment on the part of EEP to follow up on this plan to ensure that it is implemented.

Public health actions that TDH EEP has taken included:

- Preparation of a letter to the day care regional facility manager explaining the results of the indoor air testing.

- Preparation of this health consultation.

Public health actions that will be taken include:

- TDH EEP and TDEC will provide copies of this health consultation to the regional facility manager.

- TDH EEP will provide copies, if asked, of this health consultation to state, federal, and local government, other community members, and community group members.

- TDH EEP will maintain dialogue with TDEC, ATSDR, other government agencies and interested stakeholders to safeguard public health.

- TDH EEP will be available to review additional environmental data, and provide interpretation of the data, as requested.

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Certification

This Public Health Consultation: *Indoor Air Investigation at a Day Care, Memphis, Shelby County, Tennessee*, was prepared by the Tennessee Department of Health's Environmental Epidemiology Program. It was prepared in accordance with the approved methodology and procedures that existed at the time the health consultation was begun.

Director of EEP, CEDS, TDH