

Health Consultation

FORMER FASHION CLEANERS

SHELBYVILLE, BEDFORD COUNTY, TENNESSEE

**Prepared by the
Tennessee Department of Health**

SEPTEMBER 16, 2009

Prepared under a Cooperative Agreement with the
U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Agency for Toxic Substances and Disease Registry
Division of Health Assessment and Consultation
Atlanta, Georgia 30333

Health Consultation: A Note of Explanation

A health consultation is a verbal or written response from ATSDR or ATSDR's Cooperative Agreement Partners 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 or ATSDR's Cooperative Agreement Partner which, in the Agency's opinion, indicates a need to revise or append the conclusions previously issued.

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HEALTH CONSULTATION

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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 Environmental Epidemiology Program 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. Reducing or eliminating the health hazard will prevent possible harmful health effects. The role of the Environmental Epidemiology Program in dealing with hazardous waste sites is to be an advisor. Often, our recommendations will be actions 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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Introduction

The Tennessee Department of Health's (TDH) Environmental Epidemiology Program (EEP) was asked by the Tennessee Department of Environment and Conservation's (TDEC) Drycleaner Environmental Response Program (DCERP) to investigate the Former Fashion Cleaners Site. The small drycleaner property was sold and redeveloped as a church. As the use of the property had changed from commercial to residential, an investigation was appropriate. Indoor air vapor intrusion of drycleaner solvent and breakdown product vapors needed to be evaluated to ensure the health and safety of the people attending or working in the church.

Background

The Former Fashion Cleaners was a stand-alone building that was operated from 1990 until approximately 2002. It was located at 508 Elm Street, Shelbyville, Bedford County, Tennessee, 37160. The drycleaner owner participated in the TDEC DCERP. The site was assigned DCERP Facility ID No. D-02-101. DCERP performed an initial environmental evaluation of the site. Contamination from past drycleaning activities was found in soil and near-surface groundwater. The contaminant plume seemed to have remained on site, mostly underneath the building.

Later, the property was sold. The approximately 4,000 square foot building was put into reuse as a small church. Now there is a lobby, main church area with pews, restrooms, and child nursery with cribs within the building. There is no office in the building; thus there is no staff present during the week. The pastor and members of the church meet for Sunday service and occasional meetings at other times. As part of their continued commitment to maintaining former drycleaner sites for safe new uses, the TDEC DCERP expanded their environmental investigation of the site. An 8-hour Summa canister was used to collect an indoor air sample on September 27, 2005. Drycleaner solvent and breakdown product vapors were found in the indoor air. After this result, the DCERP requested EEP assistance with site investigation to ensure that the new church congregation would be kept safe from past drycleaner activities.

On October 27, 2005, Mr. David Borowski of EEP visited the Former Fashion Cleaners Site with Dr. Charles Rowan of DCERP. Mr. Joe George of EnSafe, the Drycleaner Approved Contractor for the site, collected a second round of indoor air samples. Two Summa canisters were used to collect the additional indoor air samples. EEP encouraged the samples to be collected from frequented areas within the church such as near the pews and the children's nursery. The children's nursery was the former boiler room of the drycleaner. Both samples were collected at typical breathing zone heights for the potentially exposed populations (Figures 1 and 2).

DCERP acted proactively. They encouraged the church to enroll as a DCERP participant as part of the purchase agreement between the former drycleaner and the church owners. DCERP made a plan for site cleanup. EEP provided fact sheets about exposure to drycleaner chemicals. At this point, EEP offered to speak with and educate the church congregation about exposure. The church leaders were appreciative, but felt the situation was well understood and declined the outreach offer. In January 2006, contaminant source removal was done. Church pews were moved to dig a trench in the floor. Soil was removed from beneath the building. A shallow injection system was installed for lactate to filter through soil and bedrock to groundwater.

Lactate can improve the biodegradation rate of the waste. After the contaminated soil was removed, the church floor was repaired. No large-scale source of contamination was discovered. After the injection of lactate within vertical injection points installed in the soil removal area, a four-quarter groundwater sampling program for the site was developed by DCERP. This groundwater sampling plan was to assess the benefits of the lactate injection. As part of the plan, the indoor air was sampled again on June 20, and December 17, 2007. This health consultation is a retrospective look at the entire DCERP cleanup process. It documents EEP's assistance, site visit, outreach education, and scientific reviews of indoor air data. This document also describes the public health implications of any exposure to drycleaner solvent or breakdown products.

Discussion

Introduction to Chemical Exposure

To determine whether persons have been or are likely to be exposed to chemicals, the Tennessee Department of Health's (TDH) Environmental Epidemiology Program (EEP) evaluates mechanisms that could lead to human exposure. 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. The pathway is considered an incomplete exposure pathway if there is no evidence that at least one of the five elements listed has been, is, or will be present at the site. For this site, there was a completed exposure pathway for the inhalation of drycleaner solvent vapors inside the former drycleaner building.

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 public 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.

The purpose of this public health consultation is to examine any potential health hazard from drycleaner-related chemicals present at the site. 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 might be exposed. If concentrations are above the comparison values for a particular chemical, then further evaluation of that chemical is in order.

Exposure to drycleaner vapors at this church is limited to about two hours each Sunday and two hours on Wednesday nights. Other exposures of about two hours may occur sporadically for special events at the church. No staff work at the church during the week.

Health Comparison Values

The federal Agency for Toxic Substances and Disease Registry (ATSDR) provides Minimal Risk Levels (MRLs) to be used in evaluating environmental data for non-cancer effects. The ATSDR uses the no observed adverse effect level/uncertainty factor (NOAEL/UF) approach to derive non-cancer adverse health effect MRLs for hazardous substances. MRLs are set below levels that, based on current information, might cause adverse health effects in people. MRLs are derived for acute (1 to 14 days), intermediate (15 to 364 days), and chronic (365 days and longer) exposure durations, and for the oral and inhalation routes of exposure. ATSDR does not use serious health effects, such as irreparable damage to organs or birth defects, as a basis for establishing MRLs. Exposure to a level above the MRL does not mean that adverse health effects will occur (ATSDR 2008a). At this site, the indoor air results were compared to chronic MRLs to represent a long-term, worst case scenario. If there was no published chronic MRL, then an intermediate MRL value was substituted.

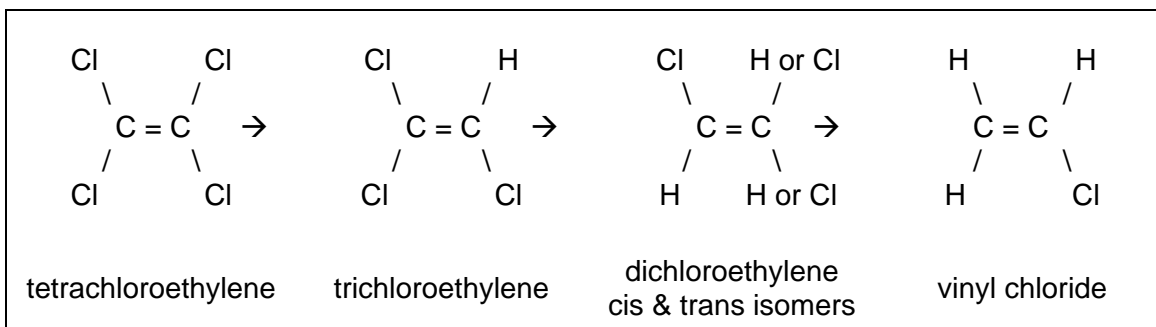
Concentrations of drycleaner solvent and breakdown products were also compared to ATSDR's cancer risk evaluation guides (CREGs) that represents a level that would theoretically result in 1 excess cancer per 1,000,000 people exposed during their lifetime (70 years). CREGs are calculated from EPA's cancer slope factors for oral exposures or unit risk values for inhalation exposures. These values are based on EPA evaluations and assumptions about hypothetical cancer risks at low levels of exposure.

The US Environmental Protection Agency (EPA) also provides several types of their own comparison values. In 2002, the Office of Solid Waste and Emergency Response (OSWER) issued Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils. This OSWER directive provided additional tools for screening environmental data including target indoor air concentrations to satisfy both the cancer risk level of 10^{-4} and the non-cancer hazard index of 1. EPA provides additional guidance through memorandums (2001, 2009). Some EPA regional offices also provide comparison values. For example, EPA Region 3 has published chemical specific screening levels to assist with the cleanup of waste sites (2009a).

Most of these comparison values use standard assumptions in computing the theoretical risk level. The standard assumptions used for calculating residential guidance values would not apply at this site. The exposure frequency and exposure duration would both be much smaller than standard assumptions. So the resulting theoretical inhalation health risk values will overestimate conditions at the former Fashion Cleaners.

Drycleaner 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 (PCE) or perc. It is a colorless liquid and has a sweet smell (ATSDR 1997). Perc 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 products has slightly different chemical properties and toxicities.



For example, tetrachloroethylene (PCE) can breakdown to trichloroethylene (TCE), then to isomers of dichloroethylene (DCE), and then to vinyl chloride (VC). Each of these breakdown products can act independently. The only way to truly know the ratio of these breakdown products is to collect environmental samples. The drycleaner solvent, tetrachloroethylene, and all of its breakdown products were considered in preparing this report.

Drycleaner solvent is typically purchased as a liquid. Spills that occurred while using drycleaner solvent can lead to contamination of soil and groundwater. As the solvent evaporates and the gas mobilizes, vapor intrusion into indoor spaces is possible. Drycleaner solvent or breakdown product vapors that become trapped indoors are the main concern when considering the health of persons coming into contact with waste from the former Fashion Cleaners.

Indoor Air Sampling

Indoor air samples were collected on September 27, and October 27, 2005. Air monitoring was performed using Summa canisters at two locations within the former drycleaner turned church. A Summa canister was deployed at breathing height near the pews (Figure 1). Another Summa canister was placed in the children's nursery - the former boiler room of the cleaner (Figure 2). Air samples were collected over an 8-hour time period and were analyzed using Method TO-15.

Drycleaner solvent and breakdown product vapors were detected in both air samples. The indoor air results for drycleaner solvent and breakdown products are shown in Table 1. In 2005, the drycleaner solvent tetrachloroethylene (PCE) and four of its chemical breakdown products,

trichloroethylene (TCE), cis-1,2-dichloroethylene (cis-1,2-DCE), trans-1,2-dichloroethylene (trans-1,2-DCE), and 1,1-dichloroethylene (1,1-DCE) were detected in the indoor air. Some of the measurements were high.

Table 1. Summary of indoor air data collected in 2005 from the church and nursery located in the Former Fashion Cleaners, Shelbyville, Bedford County, TN. Summa canister 8-hour samples. All measurements in parts per billion (ppb) (EnSafe 2008). Comparisons made to ATSDR health guidance levels (ATSDR 2008, 2008a).

Chemical	Acronym	09/27/05	10/27/2005		non-cancer effects (HI=1) MRL/EMEG	cancer effects (10 ⁻⁶ risk)
		church	church	nursery		
Tetrachloroethylene	PCE	33.01	110.02	91 (92)	40	0.06 ^{E3}
Trichloroethylene	TCE	404.06	3.40	3.0 (3.1)	100i	0.22 ^{E3}
1,1-Dichloroethylene	1,1-DCE	1.61	ND	ND	20i	nc
cis-1,2-Dichloroethylene	cis-1,2-DCE	7.05	3.20	2.9 (3.0)	ngv	nc
trans-1,2-Dichloroethylene	trans-1,2-DCE	1.51	ND	ND	200i	nc
Vinyl chloride	VC	ND	ND	ND	30i	0.04 ^{AC}
1,1-Dichloroethane	1,1-DCA	ND	ND	ND	ngv	0.38 ^{E3}
1,2-Dichloroethane	1,2-DCA	ND	ND	ND	600	0.01 ^{AC}

Notes:

(92) = duplicate sample result
 ATSDR MRL/EMEG = Minimal Risk Level / Environmental Media Evaluation Guide for Hazard Index = 1
 AC = ATSDR CREG = Cancer Risk Evaluation Guide for 1x10⁻⁶ excess cancer risk
 E3 = EPA Region 3 residential indoor air screening values (EPA R3 2009a)
 i = intermediate value (15 - 365 days)
 nc = not classified as a carcinogen
 ND = Not Detected (based on the analytical detection limit)
 NY = use of New York state's guidance in absence of federal guidance
 ngv = no guidance value established by ATSDR for this chemical/compound

The September 27, 2005, air sample collected in the church contained 33 ppb of PCE and 404 parts per billion (ppb) of TCE. These results suggested that there could be a health hazard from breathing indoor drycleaner solvent and breakdown product vapors. The concentration of TCE in the church was above the ATSDR's intermediate non-cancer EMEG or health guidance value for exposures lasting less than one year. The intermediate minimal risk level (MRL) is based on decreased wakefulness in rats exposed to either 50 ppm TCE for eight hours a day, 5 days a week, with an uncertainty factor of 300. This intermediate MRL should be protective of people

exposed to TCE for four hours per week. The level of TCE was well below the acute EMEG, suggesting that someone in the church for two, two-hour services each week would not be exposed in such a manner as to likely lead to adverse health effects. Concentrations of PCE and TCE were above chronic cancer health guidance values. These elevated indoor air results led to the additional October sampling event and request for TDH EEP's assistance.

On October 27, 2005, TDH EEP staff visited the site and helped to place the Summa canisters in locations representative of the breathing zones for adults and young children. Near the church pews, PCE was measured at 110 ppb. In the children's nursery, PCE was measured at 91 ppb. The TCE value at 3.4 ppb was lower in October compared to September. Overall, the indoor air data suggested that both PCE and TCE could be a potential long-term health inhalation concern. Two other drycleaner breakdown product vapors were detected during in the 2005 air sampling. Cis and trans -1,2-DCE, were both measured to be below published health comparison values.

There was evidence that drycleaner solvent and breakdown product vapors from the contaminated groundwater and soil were evaporating and becoming trapped within the former drycleaner building. This process, known as vapor intrusion, created a potential past health hazard to past users of the building. The hazard is likely overestimated as most people either worked in (during Sunday services or for cleaning) or attended services in the church building for short periods of time on an infrequent basis. This would result in only a short exposure duration. Furthermore, any exposures would have only been acute or intermediate and not chronic in frequency. As DCERP had been proactive and planned for site cleanup, the exposure scenario soon changed.

Removal of contaminated soil and injection of lactate into groundwater was performed. Church pews were moved aside, and a trench was dug across the floor. No large-scale contamination was discovered. With no large-scale contamination and removal of or bio-remediation of the small-scale contamination, site conditions were believed to have been improved. Based on these source reduction actions, future site conditions should continue to improve.

After cleanup actions, air monitoring was performed on June 20, and December 17, 2007. The indoor air results for drycleaner solvent and breakdown product vapors are shown in Table 2. The follow up air sample contained three chemicals, PCE, TCE, and cis-1,2-DCE.

Table 2. Comparison of the 2007 indoor air data from the church and nursery to Agency for Toxic Substances and Disease Registry health comparison values in the location of the Former Fashion Cleaners, Shelbyville, Bedford County, TN. Summa canister 8-hour samples. All measurements in parts per billion (ppb) (EnSafe 2008 & ATSDR 2008, 2008a).

Chemical	Acronym	06/20/2007		12/17/2007		non-cancer effects (HI=1) MRL/EMEG	cancer effects (10 ⁻⁶ risk)
		church	nursery	church	nursery		
Tetrachloroethylene	PCE	5.25	6.5	53	39.8	40	0.06 ^{E3}
Trichloroethylene	TCE	0.35	0.44	0.91	0.73	100i	0.22 ^{E3}
1,1-Dichloroethylene	1,1-DCE	ND	ND	ND	ND	20i	nc
cis-1,2-Dichloroethylene	cis-1,2-DCE	ND	0.35	0.40	1.21	ngv	nc
trans-1,2-Dichloroethylene	trans-1,2-DCE	ND	ND	ND	ND	200i	nc
Vinyl Chloride	VC	ND	ND	ND	ND	30i	0.04 ^{AC}
1,1-Dichloroethane	1,1-DCA	ND	ND	ND	ND	ngv	0.38 ^{E3}
1,2-Dichloroethane	1,2-DCA	ND	ND	ND	ND	600	0.01 ^{AC}

Notes:

ATSDR MRL/EMEG = Minimal Risk Level / Environmental Media Evaluation Guide for Hazard Index = 1

AC = ATSDR CREG = Cancer Risk Evaluation Guide for 1x10⁻⁶ excess cancer risk

E3 = EPA Region 3 residential indoor air screening value (EPA R3 2009a)

i = intermediate value (15 - 365 days)

nc = not classified as a carcinogen

ND = Not Detected (based on the analytical detection limit)

ngv = no guidance value established by ATSDR for this chemical/compound

The June 20, 2007, indoor air samples contained 5.25 and 6.5 ppb of PCE. The December 17, 2007, air samples measured more PCE at 53 ppb in the church and 39.8 ppb nursery. Neither EEP nor TDEC DCERP knows why the values were higher in December. The average measurement from the higher day in December 2007 of 46.4 ppb PCE was used to create a reasonable worst case scenario for the purpose of calculating risk. The average value was near the ATSDR chronic, non-cancer EMEG of 40 ppb (ATSDR 2008a). At the time of this report, ATSDR had not published a CREG to evaluate cancer risk due to PCE as EPA's carcinogenicity assessment for PCE was still pending (EPA IRIS 2009). EPA Region 3 (2009a) had a cancer comparison value for PCE of 0.06 ppb. The EPA Region 3 inhalation unit risk was 5.9x10⁻⁶ µg/m³. Multiplying the inhalation unit risk by the average measurement from the higher day of 46.4 ppb computed to a risk of 2.7x10⁻⁴ for PCE exposure. This theoretical risk value suggests 2.7 excess cancers per 10,000 people. This value is an overestimation of the risk because in this

church building no person would have a lifetime of daily exposure to PCE in air. The maximum exposure is four hours per week.

EPA Region 3 used California's carcinogenicity assessment in its residential air screening value for PCE. This is not likely an appropriate screening value because EPA's Scientific Advisory Board, in its review of EPA's carcinogenicity assessment, stated that the overall weight-of-evidence places PCE on a continuum between categories B2 (probable human carcinogen with inadequate human and sufficient animal studies) and C (possible human carcinogen with no human and limited animal studies).

Trichloroethylene (TCE) was measured to be 0.35 and 0.44 ppb in the Summa canister samples in June 2007. TCE was measured at 0.91 and 0.73 ppb in December 2007. These values were less than ATSDR's intermediate EMEG of 100 ppb (ATSDR 2008). The TCE measurement was below EPA Region 3's non-cancer guidance value of 7.4 ppb (EPA R3 2009a). For cancer, TCE was slightly higher than EPA Region 3's 0.22 ppb guidance value. As all guidance values are based on conservative assumptions, the difference between the guidance value of 0.22 ppb and the range of 0.35 to 0.91 ppb of TCE in air is relatively small. The EPA Region 3 inhalation unit risk for TCE is $2.0 \times 10^{-6} \mu\text{g}/\text{m}^3$. When the inhalation unit risk is multiplied by the average measurement from the higher day in December 2007 of 0.82 ppb, it results in a theoretical risk of 1.6×10^{-6} or 1.6 excess cancers per 1,000,000 people. The New York State Department of Health's guidance value of for TCE in air is 0.93 ppb (NYSDOH 2006). The measured indoor air values of TCE were lower than the NYSDOH's guidance which considers both non-cancer and cancer endpoints.

In 2007, the breakdown product, cis-1,2-DCE, was measured to between non-detect and 1.21 ppb. There are were no published health guidelines for cis-1,2-DCE by ATSDR or EPA. It is not classified as a carcinogen. In the absence of a cis- value, the ATSDR intermediate trans-inhalation EMEG of 200 ppb was considered. The 1.21 ppb value for cis-1,2-DCE was well below this intermediate comparison value suggesting no health concern.

Another way to screen the indoor air data is use EPA OWSER guidance (2002 & EPA 2009). This guidance provides target concentrations. These target concentrations are set at a hazard index (HI) of 1 for non-cancer effects or a specific risk level for cancer effects, whichever is lower. If the measurements are greater than the target concentrations, then the site would need further consideration in regards to that chemical of concern. The results of drycleaner solvent and breakdown product air samples collected in June and December 2007 along with the EPA OSWER target values are presented in Table 3. The PCE measurements in December 2007 were above the target level for a 10^{-4} risk based on cancer effects. As mentioned previously, the carcinogenicity of PCE was still being investigated. Thus, this theoretical risk may be an overestimation. Both TCE measurements in 2007 were within EPA risk range of 10^{-4} to 10^{-6} (EPA 2001) based on cancer effects. For cis-1,2-DCE all measurements were less than a hazard index of one (HI=1) based on non-cancer effects. These risk values are for constant and long-term exposure. No person would be exposed to these solvent vapor levels 24 hours a day, 7 days a week, and 365 days per year. Actual exposure duration at this church are approximately four hours per week. Again, the theoretical risks will overestimate the actual health risk.

Table 3. Comparison of 2007 indoor air data to Environmental Protection Agency (EPA) Office of Solid Waste and Emergency Response (OSWER) target levels in the location of the Former Fashion Cleaners, Shelbyville, Bedford County, TN. Summa canister 8-hour samples. All measurements in parts per billion (ppb) (EnSafe 2008; EPA OSWER 2008; EPA 2009).

Chemical	Acronym	06/20/2007		12/17/2007		EPA OSWER target 10 ⁻⁶ risk or HI=1	EPA OSWER target 10 ⁻⁴ risk or HI=1
		church	nursery	church	nursery		
Tetrachloroethylene	PCE	5.25	6.5	53	39.8	0.12	12
Trichloroethylene	TCE	0.35	0.44	0.91	0.73	0.22	22
1,1-Dichloroethylene	1,1-DCE	ND	ND	ND	ND	0.50	50
cis-1,2-Dichloroethylene	cis-1,2-DCE	ND	0.35	0.40	1.21	0.088	8.8
trans-1,2-Dichloroethylene	trans-1,2-DCE	ND	ND	ND	ND	0.18	18
Vinyl Chloride	VC	ND	ND	ND	ND	0.11	11
1,1-Dichloroethane	1,1-DCA	ND	ND	ND	ND	1.2	120
1,2-Dichloroethane	1,2-DCA	ND	ND	ND	ND	0.023	2.3

Concentrations of Other Compounds in Site Indoor Air

The initial indoor air samples collected at the site also identified the presence of other chemical vapors including acetone, chloromethane, dichlorodifluoromethane, ethanol, heptane, 2-propanol methylene chloride, 2-butanone, 4-methyl-2-pentanone, toluene, tetrahydrofuran, 1,1,1-trichloroethane, and 1,2,4-trimethylbenzene. Many of these chemicals could have been associated with the chemicals typically used to remove stains and spots on clothing. Some could be associated with petroleum products. Concentrations of these chemicals that have established ATSDR MRLs were below their respective health guidance values. Therefore, the concentrations of these chemicals at the site would not be a risk to health. Furthermore, as the DCERP cleanup removed source contamination beneath the church floor, future site conditions should remain safe.

Children's Health Considerations

In communities faced with air, water, or food contamination, the many physical differences between children and adults demand special emphasis. 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. It was estimated that children spend approximately two hours in the nursery room during a church activity. One Summa canister was specifically set to test the air in the children's nursery for each sampling event following the initial site discovery sampling. The canister was set equal in height to the baby cribs (Figure 2). As presented in Tables 1 and 2, the nursery samples had vapor levels slightly less than within the church proper. No risks to children's health that required special consideration were uncovered during this investigation.

Conclusions

The Tennessee Department of Health and the Agency for Toxic Substances and Disease Registry conclude that breathing air at the Former Fashion Cleaners, Shelbyville, Bedford County, Tennessee, is not expected to harm people's health. There were some drycleaner solvent and breakdown products measured in the indoor air of the church. The amounts were low enough that given the limited amount of time a person might be working in or attending services in the church, there should not be any health effects. In addition, the site was cleaned up to remove drycleaner solvent from the ground underneath and near the church building.

Recommendations

DCERP should continue with their cleanup plan for the Former Fashion Cleaners Site.

Public Health Action Plan

The DCERP remediation plan for the site included removing contaminated soil from beneath the church floor. With the some of the pollution source removed, there is little reason to suspect future exposure. In addition, an injection of lactate to the top of bedrock beneath the building has also been performed in an attempt to bioremediate contamination in the groundwater.

The Environmental Epidemiology Program will provide this document to DCERP and its partners to assist in their environmental cleanup activities for the Former Fashion Cleaners.

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FIGURES

Figure 1. Photo of the inside of the Former Fashion Cleaners after it was converted to a church. Note the electrical panel near which the dry cleaning machine would have been in operation. Also note the open doorway to the small nursery room (former boiler room). A Summa canister was used to collect an air sample at the breathing height of church-goers. (photo: dmb 10/27/05)



Figure 2. Photo of a Summa Canister set up to collect air data within the small nursery where the most sensitive population would be present for short periods of time. (photo: dmb 10/27/05)



APPENDIX

The paragraphs provide more detailed information about the toxicology of the drycleaning chemical, tetrachloroethylene, and its breakdown products.

Tetrachloroethylene (PCE) $Cl_2C=CCl_2$

PCE is commonly called “perchloroethylene” or “*perc*” in the drycleaning industry. Introduced in the 1930s, PCE is the solvent, or cleaning agent, most often used by professional drycleaners. PCE removes stains and dirt from all common types of fabric. Additionally, PCE can be reclaimed after the drycleaning process and reused, helping to make it a cost-effective professional cleaner.

Tetrachloroethylene (PCE) is a clear, colorless liquid said to produce a sharp, sweet smell. It evaporates very readily at room temperature. PCE is a synthetic chemical and is often used as a starting point for the manufacture of other chemicals (ATSDR 1997). People can detect the smell of PCE in the air at 1 part per million (ppm) or more. Background concentration of PCE in the environment is usually less than 1 ppb. PCE has been widely used in the drycleaning industry for decades. Clothes brought home from a drycleaners may release small amounts of PCE into the air. The significance of exposure to small amounts of PCE is unknown, but to date, they appear to be relatively harmless (ATSDR 1997).

Trichloroethylene (TCE) $HCIC=CCl_2$

Trichloroethylene (TCE) is a clear, colorless liquid said to produce a sharp, sweet odor and a sweet, burning taste. It is nonflammable and evaporates easily at room temperature. If TCE is released to surface water or surface soil, it will mostly evaporate into the air and disperse.

Most people can detect the smell of TCE in air at around 100 ppm. Background concentration of TCE in the environment is usually less than 1 ppb. TCE is used mainly as a solvent to remove grease from metal parts, but it is also an ingredient in adhesives, paint removers, typewriter correction fluids, and spot removers (ATSDR 1997).

cis-1,2-Dichloroethylene (cis-1,2-DCE) $ClHC=CClH$ and trans-1,2-Dichloroethylene (trans-1,2-DCE) $CHCl=CHCl$

cis-1,2-Dichloroethylene (cis-1,2-DCE) is an isomer, or form, of 1,2-Dichloroethylene (1,2-DCE). The other isomer of 1,2-DCE is trans-1,2-Dichloroethylene (trans-1,2-DCE). Isomers are molecules with the same chemical formula, but with different arrangements of their atomic structure. 1,2-DCE is a colorless liquid with a sharp, harsh odor. It is highly flammable and evaporates rapidly at room temperature.

Most people detect the smell of 1,2-DCE in air at around 17 ppm. The background concentration of 1,2-DCE in ambient air is usually less than 1 ppb (ATSDR 1996).

1,1-Dichloroethylene (1,1-DCE) $CCl_2=CH_2$

1,1-Dichloroethylene (1,1-DCE) is a colorless liquid with a mild, sweet smell. It is highly flammable, evaporates quickly from soil or water, and is insoluble in water. 1,1-DCE is used as a co-monomer in the polymerization of vinyl chloride, acrylonitrile, and acrylates. 1,1-DCE is used in semiconductor device fabrication for growing high purity silicon dioxide (SiO_2) films and used in flexible plastic wraps for food. The government regulates the concentration of 1,1-DCE in these wraps..

Most people detect the smell of 1,1-DCE in air at around 500 ppm. The background concentration of 1,1-DCE in ambient air is usually less than one part per trillion (ATSDR 1996).


Certification

This Public Health Consultation: *Former Fashion Cleaners, Shelbyville, Bedford County, Tennessee*, was prepared by the Tennessee Department of Health's Environmental Epidemiology Program under a Cooperative Agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). It was prepared in accordance with the approved methodology and procedures that existed at the time the health consultation was begun. Editorial review was completed by the Cooperative Agreement Partner.



Technical Project Officer, CAT, SPAB, DHAC, ATSDR

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



Team Leader, CAT, SPAB, DHAC, ATSDR