Health Consultation

FORMER LAWSON'S CLEANERS UPDATE

MEMPHIS, SHELBY COUNTY, TENNESSEE

MARCH 18, 2011

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Foreword

This document is an update summarizing an environmental public health investigation performed by the Environmental Epidemiology Program of the State of Tennessee Department of Health. 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 have the potential to 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 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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Glossary of Terms

Acute: Occurring over a short time [compare with chronic].

Acute exposure: Contact with a substance that occurs once or for only a short time (up to 14 days) [compare with intermediate duration exposure and chronic exposure].

Additive effect: A biologic response to exposure to multiple substances that equals the sum of responses of all the individual substances added together.

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).

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: A theoretical risk for getting cancer if exposed to a substance every day for 70 years (a lifetime exposure). The true risk might be lower.

Carcinogen: A substance that causes cancer.

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.

Contaminant: A substance that is either present in an environment where it does not belong or is present at levels that might cause harmful (adverse) health effects.

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: a source of contamination (such as an abandoned business); an environmental media and transport mechanism (such as movement through ground water); a point of exposure (such as a private well); a route of exposure (eating, drinking, breathing, or touching), and a receptor population (people potentially or actually exposed). When all five parts are present, the exposure pathway is termed a completed exposure pathway.

Ground water: Water beneath the earth's surface in the spaces between soil particles and between rock surfaces.

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.

Lowest-observed-adverse-effect level (LOAEL): The lowest tested dose of a substance that has been reported to cause harmful (adverse) health effects in people or animals.

Intermediate duration exposure: Contact with a substance that occurs for more than 14 days and less than a year.

Migration: Moving 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.

No-observed-adverse-effect level (NOAEL): The highest tested dose of a substance that has been reported to have no harmful (adverse) health effects on people or animals.

Plume: A volume of a substance that moves from its source to places farther away from the source. Plumes can be described by the volume of air or water they occupy and the direction they move. For example, a plume can be a column of smoke from a chimney or a substance moving with ground water.

Point of exposure: The place where someone can come into contact with a substance present in the environment.

ppb: Parts per billion.

Remediation: 1. Cleanup or other methods used to remove or contain a toxic spill or hazardous materials from a Superfund site; 2. for the Asbestos Hazard Emergency Response program, abatement methods including evaluation, repair, enclosure, encapsulation, or removal of greater than 3 linear feet or square feet of asbestos-containing materials from a building.

Remedial investigation: The CERCLA process of determining the type and extent of hazardous material contamination at a site.

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 [see population]. An environmental sample (for example, 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 the earth and soil. Such gases can be moved or driven out under pressure.

Solvent: A liquid capable of dissolving or dispersing another substance (for example, acetone or mineral spirits).

Source Area: The location of or the zone of highest soil or ground water concentrations, or both, of the chemical of concern. The source of contamination is the first part of an exposure pathway.

Toxicological profile: An ATSDR document that examines, summarizes, and interprets information about a hazardous substance to determine harmful levels of exposure and associated health effects. A toxicological profile also identifies significant gaps in knowledge on the substance and describes areas where further research is needed.

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

Ensuring the wellbeing of those living in, working in, or visiting Tennessee is a priority of the Tennessee Department of Health's Environmental Epidemiology Program.

EEP wrote this health consultation at the request of the Tennessee Department of Environment and Conservation (TDEC) Drycleaner Environmental Response Program (DCERP). It documents our review of an indoor air sampling conducted in May 2010 inside the former Lawson's Cleaners and in a preschool located on an adjacent property. Lawson's Cleaners is now a laundry and a drycleaning pick-up store. Lawson's Cleaners is located in a commercial area near other shops, a fuel station, restaurant, a preschool, and apartments.

The drycleaner chemical, tetrachloroethylene (PCE), was released at the cleaners due to improper handling or leaks from the former drycleaning machine. PCE has migrated into site soil and groundwater. PCE breakdown products have also migrated into site soil and groundwater. PCE, and its breakdown chemicals, can migrate upward into the indoor air of buildings. Therefore, the indoor air of the cleaner and adjacent leased spaces in the strip mall were initially tested in February 2009. In May 2010, the indoor air of the cleaner was tested again along with the indoor air of the preschool located northwest of the cleaner. The preschool was tested because of the ability of PCE and its breakdown products to migrate in both soil and groundwater and into indoor air, and because children are a sensitive population.

All data supplied for this health consultation were compared to the Agency for Toxic Substances and Disease Registry's (ATSDR) and the U.S. Environmental Protection Agency's (EPA) residential indoor comparison values. Comparison values are chemical concentrations 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 that the potential health risk requires further investigation.

CONCLUSIONS

EEP reached two conclusions in this health consultation:

Conclusion 1

EEP concludes that the concentrations of the drycleaner solvent PCE measured in the former Lawson's Cleaners is not expected to harm the health of workers or customers.

Basis for Conclusion

Indoor air in the former cleaner contained measureable levels of PCE. No drycleaner solvent breakdown chemicals were detected. Exposure to PCE at the measured concentration is not likely to lead to adverse health effects to workers putting in many hours over many years at the cleaner. Customers of the former cleaner would have a short and very limited exposure to PCE. They should not experience increased health effects by breathing the indoor air in the cleaner. It is not known if the PCE measured in the former cleaner is from vapor intrusion or from off-gassing from stored clothing to be picked up by customers.

Next Steps

DCERP will continue to oversee the remediation of the site. Further investigation of the groundwater contaminant plume by the responsible party is possible and is dependent on TDEC DCERP guidelines. If site conditions change or new sampling data becomes available, then EEP will reevaluate the site for TDEC DCERP.

Conclusion 2

Chemical vapors were not found in the air of the preschool near the former drycleaner. EEP concludes that breathing at the preschool will not harm people's health. This is because no drycleaning solvent vapor or breakdown chemical vapors were measured above laboratory detection limits.

Basis for Conclusion

Some detection limits for the chemicals that were tested for in the indoor air were above health comparison values. These detection limits were low enough to estimate that any vapors present would be in tiny amounts and not harmful to children or adults.

Next Steps

No further work is planned at the preschool.

FOR MORE INFORMATION

If you have any questions or concerns about your health, you should contact your healthcare provider. For more information on this site call TDEC DCERP at 615-532-0900 during normal business hours. For health information you can call TDH EEP at 615-741-7247, toll free at 1-800-404-3006, or contact us by email at eep.health@tn.gov.

Introduction

The Tennessee Department of Environment and Conservation's (TDEC) Drycleaner Environmental Response Program (DCERP) Facility ID No. D-79-103 (Figure 1) is a former drycleaner. The site is located at 3195 South Mendenhall Road in Memphis, Shelby County, Tennessee, 38115. The site is located in the northern portion of a strip mall shopping center (Figure 1). The drycleaner, Lawson's Cleaners, became a laundry and drycleaning pick-up location in 2008 when the drycleaning machine was removed from the property. Reportedly, waste drycleaning solvent and drycleaning chemicals were also removed at this time (Fisher & Arnold 2010).

The drycleaner solvent of concern at this site is tetrachloroethylene (PCE). At sites where drycleaning was performed for many years, it is not uncommon to find that cleaning solvents lost through routine operations have contaminated the soils and groundwater underneath buildings. In some cases the contamination may spread to adjacent properties. The State of Tennessee established the DCERP to provide oversight of the voluntary cleanup activities conducted on properties where drycleaning operations have lead to environmental pollution. DCERP asked the Tennessee Department of Health's (TDH) Environmental Epidemiology Program (EEP) to assess the indoor air quality in the Lawson's Cleaners and the neighboring Knight Arnold Preschool as related to soil contamination at the cleaner.

In September 2009, TDEC DCERP initially contacted TDH EEP to evaluate the results of indoor air sampling conducted within the former cleaner's space and adjacent leased spaces in a strip mall shopping center. As part of their continued commitment to maintaining former drycleaner sites for safe new uses, the TDEC DCERP recommended indoor air sampling as a component of the Prioritization Investigation – Task Group B (PIB) activities conducted at the site by the registered Drycleaner-Approved Contractor (DCAC), Fisher & Arnold Environmental.

TDH EEP reviewed the results of indoor air testing in the former cleaners and in leased spaces next to the cleaners. The leased spaces included a tobacco and beverage store and a Chinese restaurant. TDH EEP issued a Letter Health Consultation that evaluated the September 2009 sampling on December 10, 2009. Based on the indoor air data collected, EEP concluded that the health of workers and customers of the cleaner and adjacent leased spaces would not be harmed by breathing dry cleaner solvent in the indoor air of these spaces. The Letter Health Consultation can be found in the Appendix.

TDEC DCERP requested further testing at the former cleaner and an adjacent preschool. Testing was done by Fisher & Arnold (F&A) Environmental in May 2010. TDEC DCERP asked EEP to review results of this recent investigation. After the evaluation of the indoor air investigation data, EEP prepared this updated health consultation for the site.

Background

The former Lawson's Cleaners operated as a laundry from 1971 until 1990. During this time period, drycleaning was conducted at the facility for 2 to 3 months (unknown as to when) while another Lawson's Cleaners location was not in operation (F&A 2008a). In 1990, Lawson's Cleaners added drycleaning services at this location. From 1990 until 2008, Lawson's Cleaners used a single drycleaning machine at this facility. The machine was removed in 2008. The former cleaner is again being used as a laundry and is also used as a drycleaning pick-up location. All drycleaning is performed off-site. Drycleaned clothing is delivered to the site for customer pick up.

The cleaner is located in the northern portion of a strip mall shopping center which faces Mendenhall Road near the intersection of Knight Arnold Road in Memphis. The strip mall includes a tobacco and discount beverage store immediately to the north of the site, a Chinese restaurant immediately to the south, a barber shop, grocery store, and a liquor store further to the south (Figure 1). A gas station is located immediately north of the tobacco and discount beverage store. Immediately west of the gas station is a preschool and west of the preschool is another coin-operated laundry and drycleaner. It is not known if this cleaner is an active drycleaner. Across Mendenhall Road from the strip mall is a condominium complex. A former apartment complex is also located immediately west of the site. It was noted at the time of the recent indoor air investigation that this entire apartment complex was boarded up and vacant (F&A 2010).

The approximate 2,975 square foot lease space of the former cleaners has been in continuous operation since 1971 as a laundry. Drycleaning began in 1990 at the location and ended in 2008. Photographs of the strip mall and the cleaner are shown in Photos 1 through 6. The drycleaning equipment and other facility items have been removed from the cleaner.

DCERP allowed further investigation of the site by F&A in the form of a Prioritization Investigation – Task Group B (PIB). F&A submitted the PIB report to DCERP on November 6, 2008 (F&A 2008b). The F&A PIB report further identified site soils in the northwestern portion of the site to have low levels of the drycleaning solvent, PCE and its breakdown products. Only one soil sample collected from a depth of 20 feet below ground surface during the PIB investigation had a PCE concentration above the U.S. Environmental Protection Agency's (EPA's) Regional Screening Levels (RSLs) for soil.

No groundwater monitoring wells were installed at the site as part of the PIB investigation. Instead, groundwater monitoring wells from the fuel station and convenience store north of the cleaners were sampled. Depth-to-groundwater measurements could not be obtained from all monitoring wells at the convenience store due to some of the wells being "dry." Therefore, a groundwater flow map could not be prepared from the recent data. Previous data indicate groundwater flow is to the east (F&A 2008a), away from the cleaner, apartments, and preschool. No PCE was found in the groundwater samples. However, the drycleaner solvent breakdown product, cis-1,2-dichloroethene (cis-1,2-DCE), was found at extremely low concentrations, at 8 parts per billion (ppb), in two groundwater samples (F&A 2008b). The cis-1,2-DCE was measured in two of the eastern-most wells near the pump island of the fuel station and

convenience store. Neither of the concentrations identified were above EPA's Primary Drinking Water Maximum Contaminant Level (MCL) of 70 ppb for cis-1,2-DCE. Groundwater directly beneath the laundry was not sampled as part of the recent investigations because of the proximity of fuel station and convenience store wells.

As part of the 2008 PIB investigation, DCERP required investigation of the indoor air at the site. Indoor air sampling was conducted at one location inside the former cleaners. The indoor air sample was collected near the former location of drycleaning machine. Drycleaned clothing waiting to be picked up was not removed from the area while the testing occurred. Early in 2009, DCERP requested another indoor air investigation of adjacent leased spaces in the strip mall. These spaces included a Chinese restaurant and a tobacco and beverage store. TDEC DCERP requested TDH EEP review the indoor air data from these leased spaces to understand if there could be an inhalation health concern from the vapor intrusion pathway. In a report dated December 10, 2009, EEP concluded that based on the results of the indoor air investigations in the restaurant and tobacco store, breathing indoor air in these leased spaces would not be harmful to the health of workers or customers.

Also in 2009, TDEC DCERP instructed the cleaner to conduct a soil-gas investigation to understand if the chemical contamination from the drycleaner traveled beyond the property boundary. F&A conducted a soil-gas investigation in November 2009 that indicated drycleaner solvent and breakdown products in soil-gas on the property containing Lawson's Cleaners, and extending toward the properties to the west.

A preschool, a condominium complex, and an abandoned apartment complex are also located very close to the site. The nearby preschool west of the former cleaners provides a potentially exposed population that could be affected by chemicals released to soil and groundwater. Based on the results of the November 2009 soil-gas investigation, another indoor air investigation was conducted at the site in May 2010. The laundry and former cleaner leased space and the preschool were sampled at that time. This health consultation assesses the indoor air quality in the former Lawson's Cleaners and the neighboring preschool based on the May 2010 measurements.

Discussion

Introduction to Chemical Exposure

To determine whether persons have been or are likely to be exposed to chemicals, TDH 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. An exposure pathway is considered incomplete if one of the five elements is missing.

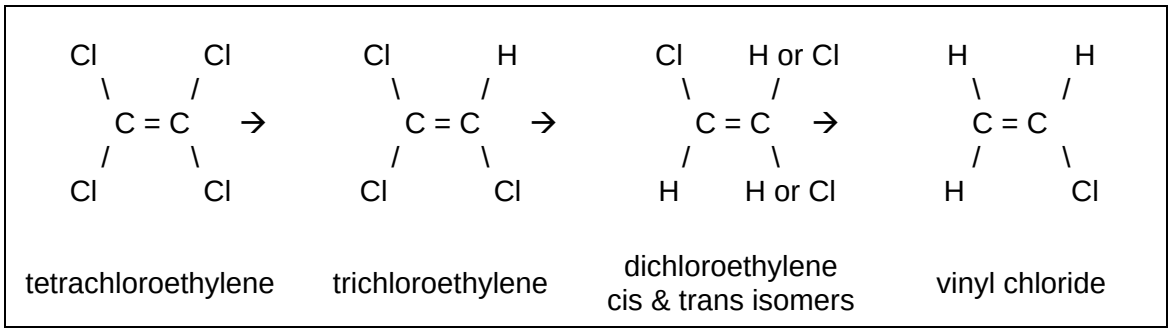
Physical contact alone with a potentially harmful chemical in the environment by itself does not necessarily mean that a person will develop adverse health effects. A chemical's ability to affect public health is controlled by a number of other factors, including:

- 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 assess the indoor air quality in the former Lawson's Cleaners, which is now a laundromat and a drycleaning pick-up store, and a neighboring preschool. The source of the PCE is likely from accidental spills of the drycleaning solvent over the years the drycleaner was in operation. Investigations showed that site soils, soil-gas, and likely groundwater have been impacted by drycleaner solvent. Solvent vapors from the soil or groundwater may be able to migrate inside the former cleaner leased space, leading to vapor intrusion. This consultation will assess the impact from breathing air containing the drycleaning solvent, PCE; in the former drycleaner. It will also assess the impact from breathing the PCE breakdown product TCE, in the former cleaner and in the preschool. One potentially exposed population would be the workers of the former cleaner who would work a 40-hour week, 5 days per week. Another exposed population would be the customers who, overall, would have a very short and limited potential exposure time. The third potentially exposed population would be the workers and the children at the preschool. The children at the preschool are defined as a sensitive population because of their higher breathing rate and because their bodies are still developing.

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 PCE. 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 products has slightly different chemical properties and toxicities. The following diagram is an example of how one chemical can breakdown to form another.



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

Vapor Intrusion

Vapor intrusion is the movement of volatile chemicals from the subsurface into overlying buildings. Volatile chemicals in buried wastes and/or contaminated groundwater can emit vapors that migrate through subsurface soils and into the indoor air of overlying buildings. Vapors may accumulate in buildings to levels that pose safety hazards, health risks, or odor problems. Vapor intrusion has been documented in buildings with basement, crawlspace, or slab-on-grade foundation types. Vapor intrusion can be an acute health hazard. Usually, indoor vapor levels are low. Low levels of vapors, breathed over a long period of time, may or may not be a chronic health concern.

Comparison Values

To evaluate exposure to a hazardous substance, health assessors often use 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 2010) for a particular chemical, then further evaluation is needed.

The Agency for Toxic Substances and Disease Registry's (ATSDR) environmental media evaluation guidelines (EMEGs) were developed using conservative assumptions. EMEGs consider non-cancer adverse health effects. Exposure durations are defined as acute (14 days or less), intermediate (15–365 days), and chronic (365 days or more) exposures.

To understand if concentrations of the drycleaning solvent PCE or its breakdown products could cause excess cancers, measured concentrations of these chemicals were also compared to ATSDR cancer risk evaluation guides (CREGs). The CREG comparison values are established for no more than one theoretical excess cancer in 1,000,000 people exposed during a 70-year lifetime. 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.

EPA's residential inhalation Regional Screening Levels (RSLs) were also used in evaluating the results of the testing. EPA's residential inhalation comparison values were used because the exposure to workers and customers of the former cleaner is involuntary. The workers and customers may not know that there are potential exposure issues at the cleaner. Federal Occupational Safety and Health Administration (OSHA) work place standards were not used because the employees of the former cleaner are not covered under a workplace safety plan.

Environmental Sampling

Two indoor air samples were collected as part of the May 2010 indoor air investigation. One air sample was collected inside the former Lawson's Cleaners leased space. A second air sample was collected inside the preschool property northwest of the former cleaners. Air samples were collected from the afternoon of May 27, 2010, to the morning of May 28, 2010. Fisher & Arnold personnel performed the sampling. Air samples were analyzed by Galson Laboratories in East Syracuse, New York. SUMMA mini-canisters were used to collect both samples. Figure 1 shows the location of the indoor air samples for this investigation. The sample from the former cleaners was collected at the south end of the reception counter. The sample from the preschool was collected on a small end table behind the receptionist desk near the entrance to the preschool. The air samples were collected over a 12-hour time frame when both the cleaner and preschool were closed.

Results

Indoor air measurements for all three sampling events conducted at the former Lawson's Cleaners are presented in Table 1. Low concentrations of the drycleaner solvent PCE were found in the May 2010 indoor air samples of the former cleaner. This may be due to off-gassing of the PCE from drycleaned clothing before it was picked up or from vapor intrusion. A detection of 46 parts per billion (ppb) of PCE was noted in the former cleaner. This is similar to the 37 ppb PCE reported in September 2008, but more than the one PCE result from the front portion of the former cleaner in February 2009. PCE breakdown products were not found in indoor air of the former cleaner.

There were no detections of PCE or breakdown chemicals in the preschool. All compounds were reported as less than the detection limit of 5 ppb for the preschool indoor air sample.

Toxicology of Tetrachloroethylene

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.

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 odor of PCE in the air at

TABLE 1. Indoor air data for leased spaces and an off-site property near the former Lawson's Cleaners, Memphis, Shelby County, TN. Values reported in parts per billion (ppb). Health screening guidelines based on chronic exposure duration (ATSDR 2010) and EPA Risk-Based Concentrations (EPA 2010). Data provided by Fisher & Arnold Environmental Inc., June 2010.

Chemical	Acronym	09/24-25/08	02/02–03/09			05/27-28/10		ATSDR EMEG (non-cancer)	ATSDR CREG / EPA RSL (10^{-6} excess cancer risk)
		Rear of Cleaners	Front of Cleaners	Chinese Restaurant	Tobacco and Beverage Store	Counter at Cleaners	Preschool Reception		
		ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
tetrachloroethylene	PCE	37	15	ND[1]	5	46	ND[1]	40	0.06[EPA]
trichloroethylene	TCE	18	ND[2]	ND[1]	ND[1]	ND[1]	ND[1]	7.4[EPA*]	0.22[EPA]
1,2-dichloroethane	1,2-DCA	ND[1]	ND[2]	ND[1]	ND[1]	ND[1]	ND[1]	600	0.01
vinyl chloride	VC	ND[1]	ND[2]	ND[1]	ND[1]	ND[1]	ND[1]	30i	0.04

Notes:

ND[1] = not detected in the air sample (above the analytical detection limit of 5 ppb for compounds listed).

ND[2] = not detected in the air sample (above the analytical detection limit of 0.2 ppb for compounds listed).

EPA = EPA Residential Indoor Air Regional Screening Levels (EPA 2010)

EPA* = There is not a published EMEG for TCE. The results were compared to the EPA's provisional comparison value for the potential health risks from exposure to TCE of 7.4 ppb (EPA 2008).

i = ATSDR comparison intermediate value for 15-365 days exposure; typically higher than a chronic value

ngv = no guidance value available

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).

PCE is readily absorbed following inhalation and oral exposure as well as direct exposure to the skin. Pulmonary absorption of PCE is dependent on the ventilation rate, on the duration of exposure, and at lower concentrations, on the proportion of PCE in the inspired air. Compared to pulmonary exposure, uptake of PCE vapor by the skin is minimal. Once PCE is absorbed, it results in distribution to fatty tissue. Because of its affinity for fat, PCE is found in milk, with greater levels in milk with a higher fat content. For this site, we are concerned with the inhalation of PCE from vapor intrusion into indoor air.

Exposure and Public Health Implications

The results were compared to ATSDR and EPA indoor air comparison values and discussed below for both the former cleaner and the preschool.

Former Lawson's Cleaners

Concentrations of drycleaner solvent and one of its breakdown products, TCE, were measured in the September 2008 indoor air sampling. Only the drycleaner solvent PCE was measured in the March 2009 and May 2010 investigations. The May 2010 data are assessed in the discussion below.

Non-Cancer Evaluation

In the most recent sampling event of May 27 through 28, 2010 (Table 1), PCE was measured at 46 ppb. This was slightly above the established ATSDR EMEG of 40 ppb. Exposure to a level above the EMEG does not necessarily mean that adverse health effects will occur (ATSDR 2007). EMEGs are established for an exposure that occurs 24 hours per day, 7 days per week, for 365 days per year. In this case, the PCE indoor air result was compared to the chronic PCE EMEG to represent an exposure over a longer period of time for individuals working in the former cleaner's space. Typical workers or customers of the former Lawson's Cleaners would not experience this type of exposure duration. Even though levels of PCE in the indoor air are slightly higher than the non-cancer effects EMEG, it is unlikely that the concentrations of PCE in the indoor air would affect the health of the workers or customers of the cleaners.

Rather than vapors migrating up from contaminants beneath drycleaner sites, TDEC DCERP has found off-gassing of PCE from drycleaned clothing could be the origin of the PCE in the indoor air. DCERP has found this to be the case in studies of other former cleaners that have been converted to pick-up stores. ATSDR (1997) has found studies that showed measured concentrations of PCE in air in a residential closet ranged from 74 to 428 ppb after 1 day of storage of the newly drycleaned garments. A pick-up location storing drycleaned garments

would likely, based on the number of garments, have at least a similar concentration of PCE in the indoor air.

In the case of the breakdown chemical TCE, ATSDR does not have a chronic EMEG published. Therefore, the results were compared to the EPA Regional Screening Level (RSL) (EPA 2010) for TCE of 7.4 ppb. No measured amount of TCE was noted in the May 2010 indoor air test. If the 5 ppb detection limit is used as the theoretical concentration, it would fall below the 7.4 ppb comparison value. Therefore, there should be no adverse health effects from TCE for those working in or visiting the former cleaners.

Other PCE breakdown chemicals tested for included 1,2-dichloroethane (1,2-DCA) and vinyl chloride. Neither breakdown chemical was measured above the method detection limits for the test. 1,2-DCA could be related to drycleaning activities or chemicals used by cleaners to treat spots on fabric. Considering the 5 ppb detection limit as a theoretical measured concentration for 1,2-DCA, the concentration would be below its comparison value.

Vinyl chloride is a more hazardous breakdown product of PCE. For vinyl chloride, a conservative assessment approach was used. The 5 ppb detection limit was used as the theoretical concentration. A 5 ppb concentration of vinyl chloride would be below its EMEG (Table 1).

Cancer Evaluation

PCE is classified as "*reasonably anticipated to be a human carcinogen*" (IARC 1995, NTP 2001). The cancer risk posed by PCE has been under evaluation for some time within EPA and the public health community. Its toxicity class is also under review and will likely change. Because of this lack of agreement, ATSDR does not have a published cancer risk evaluation guide (CREG) for PCE. Therefore, the PCE concentration of 46 ppb in the former cleaner reception area was compared to an EPA RSL calculated for PCE. The RSLs are health comparison values based on EPA evaluations and assumptions about hypothetical cancer risks at low levels of exposure. The EPA residential inhalation RSL for PCE for one excess cancer in 1,000,000 people is 0.06 ppb. For one excess cancer in 10,000 people, it is 6 ppb. PCE concentrations in the former cleaner were outside of this acceptable risk range. However, similar to the non-cancer discussion of PCE, the RSLs have been developed for chronic, lifelong exposure based on a 24-hour per day, 7 day a week, 365 day per year, 70-year lifetime exposure. The exposure at the former cleaner to workers and customers would be much less based on the amount of time workers and customers are in the building and breathing the indoor air.

In an attempt to calculate a site-specific unit risk using time worked at the facility, the risk was modified for a worker working 8-hours per day, 6 days per week, 50 weeks per year, for 10 years. The exposure duration modifier was calculated as follows:

$$\frac{8\ hours\ per\ day}{24\ hours\ per\ day} \times \frac{6\ days\ per\ week}{7\ days\ per\ week} \times \frac{50\ weeks\ per\ year}{52\ weeks\ per\ year} \times \frac{10\ years\ exposure}{70\ years\ exposure} = 0.04$$

The inhalation unit risk for PCE of 5.9×10^{-6} $(\mu g/m^3)^{-1}$ was used and was multiplied by the measured concentration of 46 ppb (312 $\mu g/m^3$) and then by the modified exposure factor of 0.04.

The calculated exposure risk was $7x10^{-5}$ or approximately 7 excess cancers in 100,000 people. This excess cancer risk is within the 10^{-6} to 10^{-4} excess cancer risk considered acceptable by EPA, and therefore, there should not be a health concern from breathing air containing these levels of PCE to workers or customers of the former cleaner.

The PCE breakdown product TCE is also classified as "*reasonably anticipated to be a human carcinogen*" (IARC 1995, NTP 2001). Similar to PCE, the cancer risk posed by TCE has also been under evaluation. Its toxicity class is also under review and will likely change. Because of this lack of agreement, ATSDR does not have a published CREG for TCE. EPA does have a RSL for residential inhalation situations. The RSL is 0.22 ppb for one excess cancer occurrence in 1 million people. TCE was not detected in the former cleaner in May 2010. Similar to the non-cancer discussion, if 5 ppb detection limit is considered the actual concentration measured, the theoretical risk would be in the range between 1 additional excess cancer in 10,000 to 1 additional excess cancer in 100,000 people. This risk is within the acceptable range of risk of between one excess cancer in 1 million and one excess cancer in 10,000 people (EPA 1991).

Like that for PCE, an attempt to calculate a site-specific unit risk using time worked at the facility, the risk was modified for a worker working 8-hours per day, 6 days per week, 50 weeks per year, for 10 years. The exposure duration modifier was calculated as follows:

$$\frac{8\ hours\ per\ day}{24\ hours\ per\ day} \times \frac{6\ days\ per\ week}{7\ days\ per\ week} \times \frac{50\ weeks\ per\ year}{52\ weeks\ per\ year} \times \frac{10\ years\ exposure}{70\ years\ exposure} = 0.04$$

The inhalation unit risk for TCE of $2.0x10^{-6}$ $(\mu g/m^3)^{-1}$ was used and was multiplied by the theoretical concentration of 5 ppb (27 $\mu g/m^3$) and then multiplied by the modified exposure factor of 0.04. The calculated exposure risk was $2.2x10^{-6}$ or approximately 2 excess cancers in 1,000,000 people. This excess cancer risk is within the 10^{-6} to 10^{-4} excess cancer risk considered acceptable by EPA. Therefore, there should be only a very slight increased risk of excess cancer from TCE from working or being a customer and breathing indoor air in the former cleaner.

There are additional drycleaner solvent breakdown products that have very low comparison values. In the air sample analyzed from the former cleaner, breakdown product chemicals were not found above the 5 ppb detection limit. It is unknown if any breakdown chemicals exist in any quantity. Therefore, no additional long-term health concerns should exist. To be thorough, the evaluation below was conducted using the detection limits for these breakdown products. This assessment is similar to what was done for the non-cancer evaluation at the former cleaner.

The toxicology of 1,2-DCA is less understood (ATSDR 2001). It is anticipated to be a human carcinogen, but the data are less certain. The lifetime inhalation unit risk for 1,2-DCA is $2.6x10^{-5}$ $(\mu g/m^3)^{-1}$. An attempt to calculate a site-specific unit risk using time worked at the facility, the risk was modified for a worker working 8-hours per day, 6 days per week, 50 weeks per year, for 10 years. The inhalation unit risk of $2.6x10^{-5}$ $(\mu g/m^3)^{-1}$ was used and was multiplied by the theoretical concentration of 5 ppb (20.2 $\mu g/m^3$). The calculated exposure risk was $1.9x10^{-5}$ or approximately 2 excess cancers in 100,000 people. This excess cancer risk is within the 10^{-6} to 10^{-4} excess cancer risk considered acceptable by EPA.

A worker or customer to this site would have a shorter exposure duration. The toxicology of the carcinogen vinyl chloride (VC) is well understood. EPA's adult inhalation unit risk for VC is $4.4x10^{-6}$ $(\mu g/m^3)^{-1}$ (ATSDR 2007). Using the theoretical assumption of the 5 ppb (13 $\mu g/m^3$) analytical detection limit for VC and the IUR of $4.4x10^{-6}$ $(\mu g/m^3)^{-1}$, the theoretical risk would be about 2 additional excess cancers in 1,000,000 people, or $2.2x10^{-6}$. This theoretical risk is for a worker working 8-hours per day, 6 days per week, 50 weeks per year, for 10 years.

Preschool

There were no detections of the drycleaner solvent PCE or breakdown chemicals TCE, 1,2-DCA, or vinyl chloride tested in the indoor air of the preschool. All these chemical results were below their respective analytical detection limit.

Non-Cancer Evaluation

No chemicals were detected in the indoor air of the preschool. To be protective, the concentrations of chemicals were estimated to be the 5 ppb detection limit. These concentrations were compared to each chemical's respective non-cancer health comparison values. All were well below any published comparison values.

Cancer Evaluation

If present at all, the drycleaner solvent PCE and its breakdown chemicals TCE, 1,2-DCA, and vinyl chloride were below their respective detection limits. There is no indication that PCE or its breakdown chemicals have migrated to the preschool property. Some studies suggest the children are particularly susceptible to the toxic effects of PCE through inhalation (ATSDR 1997). Since the preschool is a sensitive population, a conservative estimation of chemical concentrations was done. We have no way of knowing if there are concentrations of PCE or its breakdown chemicals present in the preschool below the analytical detection limits of the test performed. We also do not know if there have been concentrations of PCE or its breakdown chemicals in the indoor air of preschool in the past or if there will be concentrations of these chemicals in the indoor air in the future. For a conservative evaluation, concentrations of the drycleaner solvent PCE and its breakdown chemicals were estimated to be the 5 ppb detection limit. We do know, however, that using the same risk calculations and exposure durations outlined in the cancer evaluation discussion for the former Lawson's Cleaners leased space above, there should not be any increased exposure to workers or children at the preschool from breathing indoor air containing these theoretical concentrations. Discussion of the theoretical exposures follows.

Since PCE was not evaluated previously at a theoretical concentration of its detection limit, an evaluation is done here. PCE's representative health comparison value for cancer endpoints was less than the detection level of the test. EPA (2010) published a lifetime inhalation unit risk for PCE which is $5.9x10^{-6}$ $(\mu g/m^3)^{-1}$. Using this lifetime inhalation unit risk and the concentration of 5 ppb, (33.9 $\mu g/m^3$) a theoretical increased cancer risk of 2 in 10,000 ($2.0x10^{-4}$) was calculated. This risk level is based on an exposure that is 24 hours per day, 7 days per week, 365 days per year, for a 70-year lifetime. Because workers and children at the preschool spend a typical

school day, the risk would be much less that the calculated value. In an attempt to calculate a more representative risk, the risk was modified for a worker working 10-hours per day, 5 days per week, 50 weeks per year, for 10 years at the preschool. The exposure duration modifier was calculated as follows:

$$\frac{10\ hours\ per\ day}{24\ hours\ per\ day} \times \frac{5\ days\ per\ week}{7\ days\ per\ week} \times \frac{50\ weeks\ per\ year}{52\ weeks\ per\ year} \times \frac{10\ years\ exposure}{70\ years\ exposure} = 0.04$$

Multiplying the inhalation unit risk by the concentration and the exposure modifier, a unit risk of $8x10^{-6}$ or 8 excess cancers in 1 million people was calculated. This theoretical risk suggests that there would not be any long-term health concerns from breathing air containing PCE to the workers in the preschool. For children, the risk was modified to include reflect a child being at the preschool 10 hours per day, 5 days per week, 50 weeks a year, for 6 years. The exposure duration modifier was calculated as follows:

$$\frac{10\ hours\ per\ day}{24\ hours\ per\ day} \times \frac{5\ days\ per\ week}{7\ days\ per\ week} \times \frac{50\ weeks\ per\ year}{52\ weeks\ per\ year} \times \frac{6\ years\ exposure}{70\ years\ exposure} = 0.02$$

A theoretical risk of $4.9x10^{-6}$ or 5 excess cancers in 1 million people was calculated. Again the calculated theoretical risk does not suggest there would be long term health concerns to children who attend the preschool.

For TCE, 1,2-DCA, and vinyl chloride, the theoretical risk evaluations would be the same as those completed in the cancer evaluation section for the former Lawson's Cleaner leased space. Based on this analysis, there should not be any long-term health concerns from levels of these chemicals that would be below the method detection limits. Again, no amount of drycleaner solvent was measured in the May 2009 indoor air sample.

Chemical Mixtures

PCE was the only drycleaner-related chemical present in the former Lawson's Cleaners space during the May 2010 sampling. In previous indoor air sampling events both PCE and TCE were present in the former cleaner. There are possible additive health effects from these chemicals to an exposed population (ATSDR 2004). There is no evidence to indicate that greater-than-additive interactions among TCE or PCE health effects might occur. This includes interactions for the most common liver and kidney or nervous system effects observed from PCE or TCE exposure.

Adding together the risks of PCE and TCE, the total excess cancer risk was still about one in 100,000. It is unlikely that the presence of both PCE and TCE in indoor air would affect those who breathe the indoor air by a customer or worker working in the former Lawson's Cleaners space or anyone working in or attending the preschool. Neither the drycleaning solvent PCE or its breakdown chemicals were measured in the preschool.

Future Considerations

It is understood that DCERP will continue to oversee the remediation of the site. If site conditions change or new sampling data becomes available, then EEP will reevaluate the site for TDEC DCERP.

Child Health Considerations

No drycleaner-related chemicals were measured in the indoor air of the preschool. In preparation of this health document, the health of children was thoughtfully considered. 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 (ATSDR 1998). Thus, adults need as much information as possible to make informed decisions regarding their children's health.

The former cleaner is now a pick-up store. Drycleaning is no longer conducted on the premises. Children are not likely to spend any time in a commercial business. However if they visit the business as a customer there would only be a minimal, limited exposure to drycleaner solvent and its breakdown chemicals. The preschool was of special concern because the children spend their entire school day there. Again, no drycleaner solvent or its breakdown chemicals were detected in the preschool test. Evaluation of the chemicals using standard risk assessment methods was completed and showed there should not be any theoretical increased adverse health effects to workers of or children that attend the preschool.

Conclusions

EEP reached two conclusions in this health consultation:

EEP concludes that the concentrations of the drycleaner solvent PCE measured in the former Lawson's Cleaners is not expected to harm the health of workers or customers. Indoor air in the former cleaner contained measureable levels of PCE. No drycleaner solvent breakdown chemicals were detected. Exposure to PCE at the measured concentration is not likely to lead to adverse health effects to workers putting in many hours over many years at the cleaner. Customers of the former cleaner would have a short and very limited exposure to PCE. They should not experience increased health effects by breathing the indoor air in the cleaner. It is not known if the PCE measured in the former cleaner is from vapor intrusion or from off-gassing from stored clothing to be picked up by customers.

Chemical vapors were not found in the air of the preschool near the former drycleaner. EEP concludes that breathing at the preschool will not harm people's health. This is because no drycleaning solvent vapor or breakdown chemical vapors were measured above laboratory

detection limits. Some detection limits for the chemicals that were tested for in the indoor air were above health comparison values. These detection limits were low enough to estimate that any vapors present would be in tiny amounts and not harmful to children or adults.

Recommendation

Based on the data available there are no specific recommendations at this time. Based on EEP's review of the indoor air sampling data, TDEC and TDH EEP should continue to work together to see that the public health continues to be protected during cleanup of the former drycleaner site.

Public Health Action Plan

The public health action plan for the former Lawson's Cleaners Site 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, eating, drinking, or touching 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 have been taken by TDH's EEP include:

- Reviewed the indoor air data collected over a 2 year time period at the site.
- Prepared this health consultation.

Public health actions that will be taken include:

- TDH EEP will provide copies of this health consultation to state, federal, and local government, environmental groups, community groups, and others interested in the Lawson's Cleaners site.
- TDH EEP will maintain dialogue with ATSDR, TDEC, EPA, and other interested stakeholders to safeguard public health and to prevent people from future exposure to chemicals related to the Lawson's Cleaners site.
- TDH EEP will be available to review newly collected or additional environmental data, and provide interpretation of the data, as requested by TDEC.

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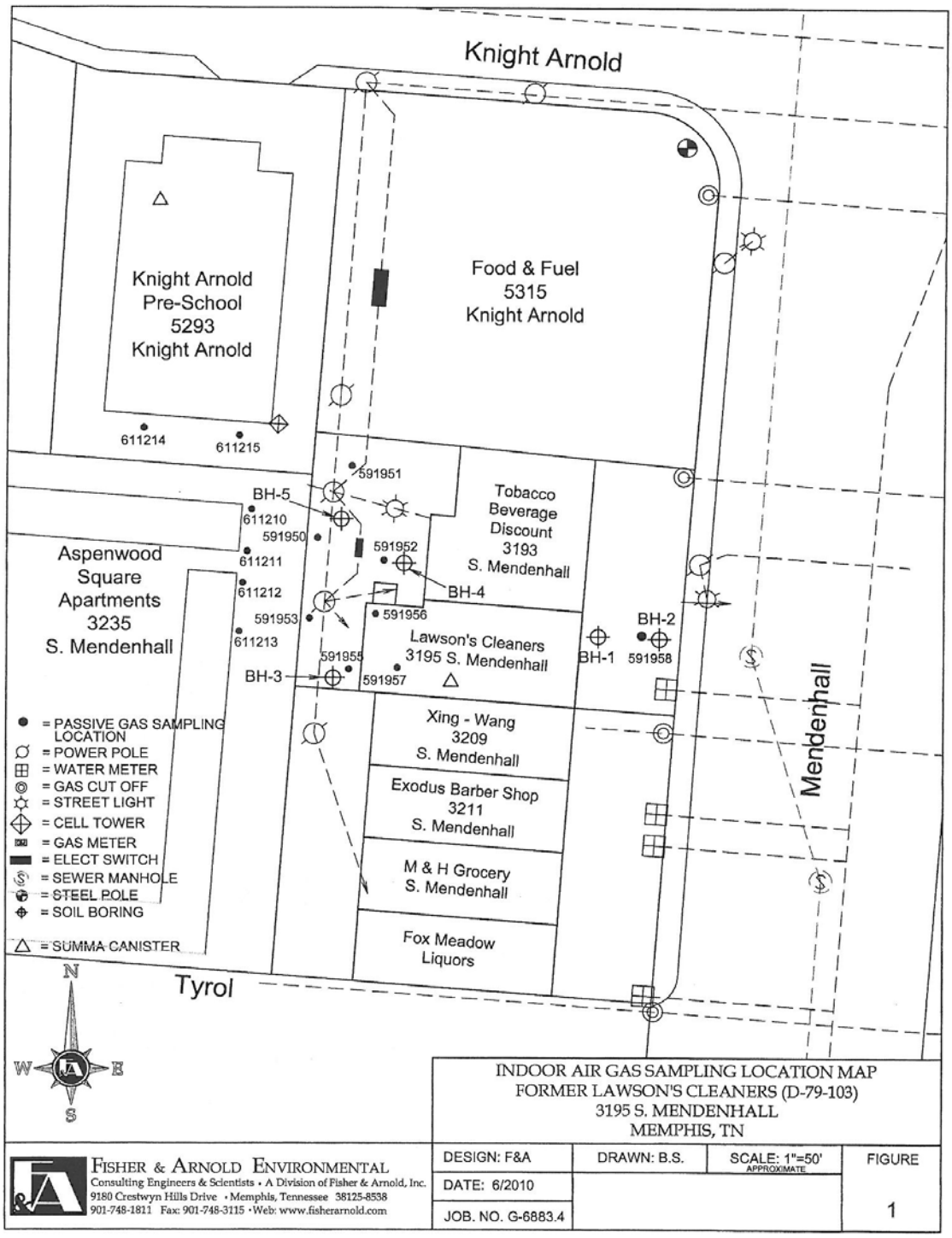
FIGURE 1 - Details of the Former Lawson's Cleaners and surrounding properties
Drawing Credit: Fisher & Arnold Environmental, Indoor Air Sampling Report, June 30, 2010.



Photos 1-6. (Source: Fisher & Arnold Environmental, Facility Inspection and Priority Investigation Report, June 16, 2008)

Photo 1: View of Lawson's Cleaners from the parking lot on the east side of the property.

Photo 2: View of the reception area of the cleaners.

Photo 3: Typical view of the clothes hanging area in the center of the building.

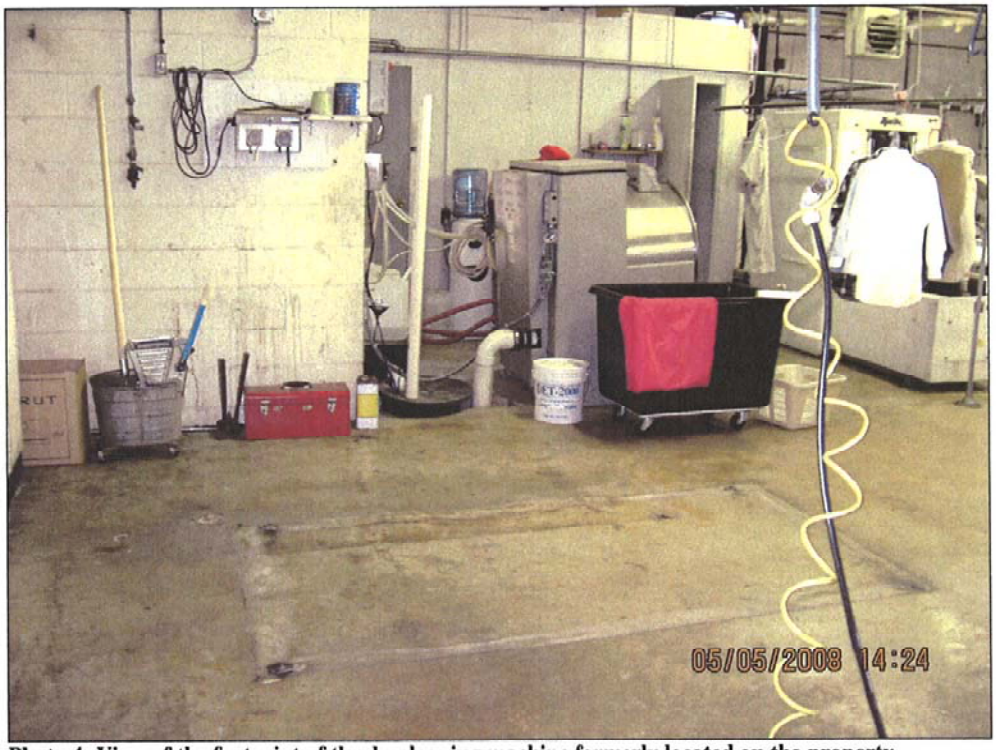


Photo 4: View of the footprint of the drycleaning machine formerly located on the property.

Photo 5: Typical view of the equipment located in the northwest corner of the facility.

Photo 6: View of drainage area near the equipment in the northwest corner of the facility.

Appendix

Letter Health Consultation

FORMER LAWSON'S CLEANER
MEMPHIS, SHELBY COUNTY, TENNESSEE
EPA FACILITY ID: TND083265587

Prepared by the
Tennessee Department of Health

DECEMBER 10, 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.

You May Contact ATSDR Toll Free at
1-800-CDC-INFO
or
Visit our Home Page at: http://www.atsdr.cdc.gov

LETTER HEALTH CONSULTATION

FORMER LAWSON'S CLEANERS

MEMPHIS, SHELBY COUNTY, TENNESSEE

EPA FACILITY ID: TND083265587

Prepared By:

Tennessee Department of Health
Under Cooperative Agreement with the
Agency for Toxic Substances and Disease Registry

STATE OF TENNESSEE
DEPARTMENT OF HEALTH
ENVIRONMENTAL EPIDEMIOLOGY PROGRAM
1ST FLOOR CORDELL HULL BUILDING
425 5TH AVENUE NORTH
NASHVILLE TN 37243

December 10, 2009

Ms. Nancy Boisvert, Program Manager
Tennessee Department of Environment and Conservation
Drycleaner Environmental response Program
11th Floor, L&C Tower
401 Church Street
Nashville, TN 37243

Dear Ms. Boisvert:

The Tennessee Department of Health's (TDH) Environmental Epidemiology Program (EEP) has reviewed the indoor air sampling results provided to us for the former Lawson's Cleaners site located at 3195 South Mendenhall Road, Memphis, Shelby County, Tennessee, DCERP Facility No.: D-79-103. The former cleaner was located in a strip mall shopping center at the intersection of South Mendenhall and Knight Arnold Roads. The cleaner began operations in 1971 as a laundry and added drycleaning as a service in 1990. Drycleaning was conducted until 2008 when the machine was sold. Lawson's continues to operate today as a laundry. The laundry/cleaner is located in a cinderblock leased space midway in the shopping center. The Tennessee Department of Environment and Conservation's (TDECs) Drycleaner Environmental Response Program (DCERP) wanted to investigate if the indoor air of the former leased space of the cleaner and adjacent leased spaces were impacted by drycleaner-related chemicals.

Indoor air (vapor intrusion) sampling was performed in the rear portion of Lawson's Cleaners on September 24 and 25, 2008. More recent indoor air sampling was performed in the front portion of the former cleaner and in the adjacent leased space to the south (Chinese restaurant) and the adjacent leased space to the north (tobacco and beverage discount store) on February 2 and 3, 2009. Sampling was performed by environmental consultant Fisher & Arnold Environmental (F&A) of Memphis, Tennessee. F&A used SUMMA canisters that had flow controllers calibrated to collect a sample over a minimum fourteen-hour time period (F&A 2008 and 2009). Results of the September 2008 indoor air sampling are in Table 1. Both indoor air vapor intrusion sampling events were completed to determine if the indoor air in the lease spaces of the shopping center has the potential to be a public health hazard.

The resulting indoor air concentrations were compared to indoor air health comparison values published by the Agency for Toxic Substances and Disease Registry (ATSDR) (ATSDR 2008). For chemicals which ATSDR did not have comparison values, results were compared to U.S.

Environmental Protection Agency (EPA) Regional Screening Levels for residential indoor air (EPA 2008). Residential values were used because of the involuntary exposure that would be experienced by people working in or visiting the lease space of the former cleaner and other lease spaces in the shopping center. These individuals make up a potentially exposed population at this site. The individuals are not like workers who work in an environment with chemicals and are told about the hazards of them (OSHA Right-To-Know laws). Workers that work with or in areas near chemicals willingly accept the risks by continuing to work with them or be in the same area as the chemicals. These workers also have access to, and training on, the use of personal protective equipment (PPE) if they work with these chemicals.

This review specifically evaluates the indoor air concentrations of the chemical tetrachloroethylene (perchloroethylene or PCE) used in drycleaning. It also evaluates the indoor air concentrations of chemicals which break down from PCE. These chemicals include trichloroethylene (TCE) and vinyl chloride. The review of all the data collected is to protect the public health of those who visit and work in the businesses of the shopping center.

Unfortunately, concentrations of some chemicals that are considered classic breakdown products of PCE were not evaluated as part of this vapor intrusion study. This was because they were not included by the consultant in the list of compounds to be tested.

Former Lawson's Cleaners leased space

Indoor air within the former cleaner (current laundry) leased space was sampled on September 24 and 25, 2008, and February 2 and 3, 2009. The rear portion of the former cleaner was sampled in 2008 while the front portion of the former cleaner was sampled in 2009. Detections were noted for tetrachloroethylene (perc or PCE) at concentrations of 37 parts per billion (ppb) in the rear of the former cleaner in 2008 and 15 ppb in the front in 2009. Trichloroethene (TCE) was also detected in the 2008 indoor air sample collected from the former cleaner leased space. TCE was detected in 2008 at 18 ppb in the rear of the cleaner. There were no detections of TCE in the 2009 sample from the front of the cleaner leased space. Other drycleaner-related chemicals were not detected in the cleaner leased space in either 2008 or 2009.

The PCE concentrations of 37 ppb and 15 ppb in 2008 and 2009 respectively, were below the ATSDR non-cancer effects environmental media evaluation guide (EMEG) comparison value of 40 ppb for chronic (greater than 365 days) exposure. Futhermore, studies of PCE toxicity suggest effects to liver and kidneys with effects showing up with human lowest observed adverse-effects levels (LOAELs) at approximately 20 parts per million. These non-cancer effects are important endpoints for PCE. The levels measured in the indoor air of the Lawson's Cleaners space are far less than the LOAEL.

To adequately evaluate a site-specific exposure scenario, the concentration of PCE in indoor air of 37 ppb (251 $\mu g/m^3$) in the former cleaner was multiplied by the exposure time (8 hours), multiplied by the number of days worked per year (350), multiplied by number of years worked (25), divided by an averaging time of the number of hours in 70 years (613,200) to obtain an exposure concentration. This provides a concentration of 26.65 $\mu g/m^3$ or 4.2 ppb for comparison purposes. Thus, the exposure for working in this space for 8 hours per day over 25 years is within EPA's acceptable range of risk of 0.06 to 6 . Furthermore, the exposure concentration to those visiting the former cleaner would be much less than this calculated value. This is because

visitors would spend much less time in the former cleaner than the workers. Having a lower potential exposure would result in an appreciably low excess cancer risk.

TCE was detected in the indoor air in the former cleaner. There is no chronic non-cancer health effects comparison value established for TCE. EPA has a provisional value of 7.4 ppb. The concentration of TCE in the indoor air of the former cleaner is below this risk concentration. ATSDR has established a CREG of 0.22 ppb for TCE for a 1 in 1,000,000 excess cancer. Because EPA considers a cancer risk range of 1 excess cancer in 1,000,000 to 1 excess in 10,000 acceptable, these risks correspond to 0.22 ppb to 22 ppb. Therefore, the 185 ppb concentration of TCE in indoor air in the former cleaner is within this risk range. Therefore, there should be no appreciable increased risk of cancer health effects by breathing indoor air with TCE in the former cleaner. The total risk of cancer health effects is very low.

Other analyzed compounds in the former cleaner leased space were not detected. Detection limits were not low enough to apply CREGs or EPA RSLs appropriately. The limits of detection for analyzed chemicals were 5 ppb. Many of these compounds have a CREG comparison value or EPA RSL that is below the 5 ppb detection limit concentration. Assuming the concentrations of these compounds were one-half of the detection limit of the analysis for each, most of the chemicals would be in the 1 excess cancer in 1,000 (10^{-3}) to 1 excess cancer in 10,000 (10^{-4}). This range is for a lifetime exposure to these chemicals. This range would be outside of the excess cancer range considered acceptable by ATSDR and EPA. However, visitors and workers would not spend all day in the cleaner. They also likely would not visit or work in the leased space for a lifetime. Thus, the risk posed by any presence of these chemicals at or below the detection limit concentration of 5 ppb would likely be in EPA's acceptable risk range. Therefore, there should be no appreciable increased risk of cancer health effects by breathing indoor air containing these chemicals in the former cleaner. The total risk of cancer health effects is very low.

PCE and TCE are both present in the former cleaner. There are possible additive health effects from these chemicals on an exposed population. It is possible that PCE and TCE jointly act in an additive manner to impair nervous system function. There is no evidence to indicate that these chemicals jointly act on the nervous system in a less-than-additive or greater-than-additive mode.

A component-based hazard index approach that assumes additive joint toxic action and uses ATSDR MRLs based on neurological impairment is recommended for exposure-based assessments of possible health hazards from exposure to mixtures of TCE and PCE. There is no evidence to indicate that greater-than-additive interactions would cause liver and kidney effects to occur at exposure levels lower than those influencing the nervous system.

Based on the relatively low concentrations of PCE and TCE identified in the former cleaner, it is unlikely that additive health effects caused by the presence of both PCE and TCE in indoor air would create any increased harmful health effects to those who breathe the indoor air by visiting or working in the former cleaner.

Chinese Restaurant leased space
All drycleaner and drycleaner-related chemicals were below the method detection limit of 5 ppb in the indoor air of the Chinese restaurant. As with the drycleaner and drycleaner-related chemicals in the indoor air in the former cleaner leased space, detection limits were not appropriately low enough as the limits of detection for analyzed chemicals were 5 ppb. Many of the compounds analyzed for have a CREG comparison value that is below the 5 ppb detection limit concentration. As mentioned above, no compounds were detected in the air sample. In cases where the detection limits are above the ATSDR health comparison values or EPA regional screening levels for residential indoor air, they are treated as a detection, and one-half of the detection limit is used in the evaluation. Visitors and workers would not spend all day in the restaurant. They also likely would not visit or work in the leased space for a lifetime. Thus, the risk posed by any presence of these chemicals at or below the detection limit concentration of 5 ppb would likely be in the acceptable risk range and EEP believes there is no appreciable increased non-cancer or cancer risk that would harm people's health from breathing indoor air in the restaurant.

Tobacco and Discount Beverage Store leased space
The drycleaner chemical PCE was detected at 5 ppb in the tobacco and discount beverage store. All other compounds tested are below the 5 ppb detection limit. The PCE concentration of 5 ppb in February 2009 was below the ATSDR non-cancer effects EMEG of 40 ppb for chronic (greater than 365 days) exposure.

However, the PCE concentration was above the EPA RSL cancer effects comparison value concentration of 0.06 ppb for 1 in 1,000,000 (10^{-6}) excess cancers but within EPA's acceptable excess cancer risk range of 0.06 to 6 ppb, corresponding to the 1 in 1,000,000 (10^{-6}) to 1 in 10,000 (10^{-4}) excess cancer risk (EPA 1991). Again, these comparison values are established for someone being exposed to the chemical for 24 hours a day, 7 days per week, and 365 days per year. The comparison values therefore overestimate health risks as visitors do not spend a significant amount of time in the building and workers do not reside in the building. EEP believes there is no appreciable increased non-cancer or cancer risk that would harm people's health from breathing indoor air containing PCE in the tobacco and discount beverage store.

As with the other drycleaner-related compounds in the other leased spaces, detection limits were set at 5 ppb for the chemicals analyzed. Many of the compounds analyzed have a CREG comparison value that is below the 5 ppb detection limit concentration. In cases where the detection limits are above the ATSDR health comparison values or EPA regional screening levels for residential indoor air, they are treated as a detection and one-half of the detection limit is used in the evaluation. Visitors and workers would not spend all day in the store. They also likely would not visit or work in the leased space for a lifetime. Thus, the risk posed by any presence of these chemicals at or below the detection limit concentration of 5 ppb would likely be in EPA's acceptable risk range.

EEP concludes:
Results of the two sampling events suggest the indoor air of the former cleaner and the tobacco and discount beverage store contained PCE. The former cleaner also contains TCE.

EEP determined that the current concentrations of PCE and TCE in the former cleaner are not expected to harm people's health. Because of the limited amount of time visitors spend in the former cleaner, their health should not be harmed. Even though workers in the former cleaner spend more time than patrons visiting the space, the worker's health should also be unharmed.

No drycleaner-related chemicals were found in the indoor air sample collected in the Chinese restaurant. The detection limits for the drycleaner-related chemicals were not low enough to simply compare them to established comparison values. EEP believes exposures at concentrations at or below the detection limits of the analyses performed are not expected to have non-cancer or cancer adverse health effects by breathing indoor air in the restaurant.

The drycleaner-related chemical, PCE, was found in the indoor air sample collected in the tobacco and discount beverage store. Remaining drycleaner-related chemicals did not have appropriately low detection limits. Therefore, one-half of the detection limit was used as a conservative concentration for the other chemicals analyzed. EEP does not expect adverse non-cancer or cancer health effects from breathing indoor air in the tobacco and discount beverage store.

There are limitations with the data from the indoor air testing. Concentrations of some chemicals that are considered classic breakdown products of PCE were not evaluated as part of this vapor intrusion study. This was because they were not included in the list of compounds to be tested. The potential exposure at the site from chemicals such as cis-1,2-dichloroethene (cis-1,2-DCE), trans-1,2-dichloroethene (trans-1,2-DCE), and 1,1-dichloroethene (1,1-DCE) that could not be evaluated. However, these chemicals are expected to be minor contributors to the overall human health risk of the site relative to the concerns related to PCE and TCE in the indoor air. These exposures were evaluated as part of this health consultation.

EEP recommends:
No additional sampling be conducted at this time. If site conditions should change, DCERP should evaluate the need for additional sampling.

In the future, DCERP should provide environmental consultants with a list of drycleaner-related chemicals and breakdown products that should be tested for during vapor intrusion sampling (indoor air) events. The breakdown products of PCE which include the chemicals cis-1,2-dichloroethene (cis-1,2-DCE), trans-1,2-dichloroethene (trans-1,2-DCE), and 1,1-dichloroethene (1,1-DCE) should be evaluated as part of indoor air sampling events.

That DCERP also emphasize that detection limits less than 1 ppb should be used when analyzing for drycleaner-related chemicals in indoor air at former drycleaner sites and adjacent locations.

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Sincerely,

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Environmental Epidemiology Program

TABLE 1. Indoor air sampling results for the former Lawson's Cleaners, Memphis, Shelby County, TN, leased space, and adjacent leased spaces. Event samples were collected on September 24 and 25, 2008, and February 2 and 3, 2009, over 8 hours with Summa canisters (Fisher and Arnold 2008b, 2009). Values reported in parts per billion (ppb). Health screening guidelines based on chronic exposure duration (greater than 365 days - ATSDR 2008) unless otherwise noted and EPA Risk-Based Concentrations (EPA 2008).

Chemical / Sampling Data and Location	Acronym	09/24-25/08 Rear of Cleaners	02/2-3/09 Front of Cleaners	02/2-3/09 Chinese Restaurant	02/2-3/09 Tobacco and Beverage Store	ATSDR MRL/EMEG (unless noted) (non-cancer)	ATSDR CREG (unless noted) (10^{-6} excess cancer risk)
		ppb	ppb	ppb	ppb	ppb	ppb
Tetrachloroethylene	PCE	37	15	<5	5	40	0.06[E]
Trichloroethylene	TCE	18	<5	<5	<5	7.4[E]	0.22[E]
1,2-dichloroethane	1,2-DCA	<5	<5	<5	<5	600	0.01
1,1,2,2-Tetrachloroethane	1,1,2,2-PCA	<5	<5	<5	<5	ngv	0.001
1,1,2-Trichloroethane	1,1,2-TCA	<5	<5	<5	<5	ngv	0.01
vinyl chloride	VC	<5	<5	<5	<5	30i	0.04

Notes:

ATSDR MRL/EMEG = Agency for Toxic Substances and Disease Registry Minimum Risk Level / Environmental Media Evaluation Guide (ATSDR 2008). Chronic non-cancer exposure comparison values (exposure greater than 365 days) used to determine if chemical concentrations warrant further health-based screening.

ATSDR CREG = Agency for Toxic Substances and Disease Registry Cancer Risk Evaluation Guide (ATSDR 2008). Cancer risk comparison values for cancer risk of 1 excess cancer in 1,000,000 people used to determine if chemical concentrations warrant further health-based screening.

<5 = not detected in the air sample (above the analytical detection limit of 5 ppb for compounds listed)

E = EPA Regional Screening Levels for Residential Indoor Air (EPA 2008)

i = ATSDR comparison intermediate value for 15-365 days exposure; typically higher than a chronic value

nc = not classified as a carcinogen

ngv = no guidance value available

Certification

The Tennessee Department of Health prepared this Letter Health Consultation, Former Lawson's Cleaners, under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). At the time this Health Consultation was written, it was in accordance with the approved methodologies and procedures. Editorial review was completed by the Cooperative Agreement partner.

Technical Project Officer, Cooperative Agreement Team, CAPEB, DHAC, ATSDR

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

for Alan Yarbrough

Team Leader, Cooperative Agreement Team, CAPEB, DHAC, ATSDR

Certification

This Public Health Consultation: *Former Lawson's Cleaners Update, 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