Health Consultation

DEPOT STEAKHOUSE

DERRY, ROCKINGHAM COUNTY, NEW HAMPSHIRE

EPA FACILITY ID: NHD018905216

FEBRUARY 22, 2008

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service
Agency for Toxic Substances and Disease Registry
Division of Health Assessment and Consultation
Atlanta, Georgia 30333

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HEALTH CONSULTATION

DEPOT STEAKHOUSE

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EPA FACILITY ID: NHD018905216

Prepared By:

New Hampshire Department of Environmental Services
Environmental Health Program
Under a Cooperative Agreement with the
U.S. Department of Health and Human Services
Agency for Toxic Substances and Disease Registry

SUMMARY AND STATEMENT OF ISSUES

On September 12-13, 2007, the Environmental Protection Agency (EPA) collected indoor air samples from the Depot Steakhouse (DSH), located at 1 East Broadway in Derry, Rockingham County, New Hampshire. The building (Lot number 3022) is adjacent to a former dry cleaning establishment, Shamrock Cleaners site -NH DES Site # 200103051 (SCS). The September EPA indoor air sampling was conducted to determine whether volatile organic compounds (VOCs) below the SCS (in soils & groundwater) had migrated and were volatilizing into the DSH. EPA New England's Office of Site Remediation and Restoration, Emergency Planning and Response Branch excavated soils containing VOCs from the SCS in April - May 2007. EPA specifically analyzed three post-remediation air samples - one collected from the DSH basement, one from the DSH first floor and one from the outside ambient air (1).

The New Hampshire Department of Environmental Services (NHDES) Environmental Health Program (EHP) used the air sample data collected by EPA to complete this health consultation. The purpose of this health consultation (HC) is to determine if inhalation of air inside the DSH presents a human health risk. After thorough analysis of all air data collected, EHP concluded that the theoretical potential cancer risk posed by exposure to SCS-related air contaminants in the DSH is elevated. Moreover, the concentration of tetrachloroethylene (PCE) in the DSH basement has increased more than three-fold over the June, 2006 sample data. Non-cancer health effects, however, are not expected to result from long-term exposure to indoor air at the DSH.

PURPOSE

The Agency for Toxic Substances and Disease Registry (ATSDR) is a non-regulatory federal agency mandated by Congress to assess the public health impact of exposure to hazardous substances released to the environment. To fulfill its mandate, ATSDR enters into formal partnerships with state agencies throughout the nation to carry out site-related evaluations on environmental exposures and public health. For eighteen years, ATSDR and the Environmental Health Program (EHP) have maintained a cooperative agreement to conduct these activities in the state. EHP is a non-regulatory program within the (NHDES). It serves to assess the human health implications of hazardous chemical releases, and to make recommendations to protect the public health.

The purpose of this HC is to determine if inhalation of indoor air at the DSH presents a human health risk. The HC presents an evaluation of environmental data provided to EHP from air samples collected by EPA at the DSH located at 1 East Broadway on September 12-13, 2007 (1).

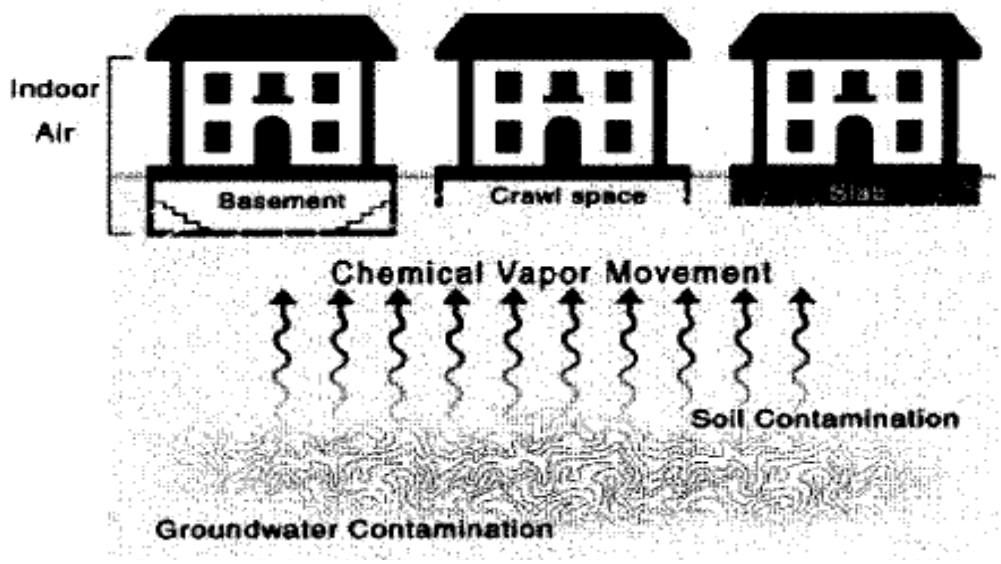
BACKGROUND

The SCS was the site of the former Shamrock Cleaners, a dry-cleaning establishment that operated from approximately 1950 until 2001. From about 1984 through 2001, tetrachloroethylene (also known as perchloroethylene, perc, or PCE) was used in dry-cleaning operations at this site. Prior to 1984 "Stoddard Solvent" based cleaners were

used for dry-cleaning. In August 2005 the former Shamrock Cleaners building (Lot No. 3017) and an adjacent unoccupied apartment building (Lot 3018) were demolished. A DES contractor, Sanborn, Head & Associates (SHA), conducted a series of investigations to determine the extent of contamination at the site. These investigations identified contaminants in the groundwater, especially PCE, at levels that could impact the soil above the groundwater (2).

Soil is composed of solid particles (minerals and organic matter). The space between these particles is filled with either liquids (usually water) or gases. Soil gas is a term used to describe the gas that fills these spaces. When VOCs contaminate and mix with groundwater, they tend to separate from a liquid phase into a soil gas phase. These soil gas contaminants can then migrate through the soil spaces and possibly enter confined building spaces (basements) through crawl spaces, plumbing holes, other floor holes (e.g., sumps) and foundation cracks. This could result in indoor air contamination. As a result of PCE contamination in groundwater, SHA conducted soil gas testing at the SCS; commonly known as a soil-gas survey. This method is routinely used to determine the existence or extent of soil contamination (from a groundwater source in this case) (2, 3).

Figure 1 – Movement of contaminant vapors from groundwater into soil & indoor air (3).



The SHA soil-gas survey of the site identified PCE ranging from approximately 2500 to 16000 ppb (2). Due to these elevated soil-gas concentrations and historical groundwater contamination data detected at the SCS, SHA proceeded to determine if SCS-related vapors were migrating into nearby buildings. Accordingly, SHA collected indoor air quality samples from the DSH basement on June 1, 2006. The resultant indoor air data revealed a 24-hour average PCE level of 14.7 ppb in the basement of DSH. Air samples were not taken on the first floor (4).

In April-May 2007 EPA excavated PCE-contaminated soils from the site. EPA subsequently conducted air quality sampling and analysis at the DSH on September 12-

13, 2007 in order to ascertain the post-remedial air contaminant levels. Specifically, 24-hour indoor air samples were taken in the basement and first floor of the DSH. EPA also simultaneously collected an outdoor ambient air sample to be used for comparison purposes (1). EHP reviewed the EPA report and evaluated the potential for adverse health effects to occur from repeated indoor air exposures to site-related compounds including PCE and its breakdown components. EHP evaluated an adult indoor air exposure; 8-hours per day (7-hours in on the first floor and 1-hour in the basement), 250-days per year, for a 25-year duration. This site-specific exposure information was assembled during a November 13, 2007 phone conversation (with the DSH co-owner) for purposes of evaluating this adult indoor air exposure (5).

DISCUSSION

A. Exposure Pathways

Human exposure to environmental contamination occurs only when there is a completed pathway. A *completed* pathway exists when the following five critical elements are present: 1) a source of contamination or release (subsurface soil & groundwater); 2) environmental fate and transport (contaminated soil/groundwater to indoor air); 3) a point or area of exposure (DSH); 4) a route of human exposure (inhalation); and 5) a receptor population (DSH employees). These five elements determine the extent of past, present, or future site-related exposures. In a *potential* exposure pathway, one or more of the critical elements may not be present, but information is insufficient to eliminate or exclude it. For example, an exposure could have occurred in the past, could be occurring at present, or could occur in the future. An exposure pathway is *eliminated* if one or more of the critical elements are missing. Eliminated exposure pathways may also be referred to as incomplete (6).

Table 1 presents the onsite exposure pathway for DSH (indoor air in the primary work area and basement). This pathway is evaluated and discussed in the remaining sections of this health consultation. Public water is provided to this complex. Therefore, groundwater contamination at the SDH does not impact the quality of water supplied to workers and visitors. Water supplied from public water sources, is considered safe for drinking, bathing, and other domestic uses.

Table 1. Potential Onsite Pathway for the Depot Steakhouse (Lot No. 3022) located in Derry, New Hampshire.

Source	Environmental Transport And Media	Exposure Point	Exposure Route	Exposed Population	Time Frame	Status
Contaminated Soil & Groundwater (SCS)	Subsurface soil & Groundwater to **Indoor Air** through foundation	Indoor Air Onsite	Inhalation	Employees	Past	Completed
					Present	Completed
					Future	Potential

Contaminants are migrating from the SCS through subsurface soil and groundwater via a groundwater contaminant plume. Vapors emanating from the plume may penetrate the DSH building foundation and mix with indoor air. Employees could be exposed by breathing contaminated indoor air.

B. Environmental Contamination Data

An integral element of every health consultation is a review of environmental contamination. In the preceding section, the indoor air pathway for possible human exposure was identified. This section examines indoor air contaminants that may pose a hazard to the DSH employees. Environmental sampling preparation, procedures, and results provided in the report prepared by EPA dated November 11, 2007 are summarized below for this potential pathway (1).

On September 12, 2007 EPA conducted a pre-sampling inspection, product inventory and physical layout/condition assessment of the DSH first floor work area and basement. These steps are conducted to identify potential sources of volatile organic compounds (VOCs), and to minimize the contribution of VOCs from common indoor sources or activities. At approximately 9:00 AM, they began to collect two 24-hour duration indoor air samples from the DSH first floor (coat rack area) and basement. Samples were collected in accordance with the EPA Region 1 Standard Operating Procedure for the Sampling of Trace Volatile Organic Compounds using Summa Polished Stainless Steel Canisters, ECASOP-Canister Sampling SOP4, August 31, 2007, Revision 4. The pre-evacuated 6-liter Summa canisters were fitted with mechanical flow controllers calibrated to 3.3-3.4ml/min (1).

The Summa canisters were subsequently gathered by EPA at approximately 9:00 AM on September 13, 2007 and verified to be below atmospheric pressure, thus indicating that the sample was properly collected. The samples were then transported to the EPA Laboratory, properly logged in, and analyzed for volatile organic compounds (VOCs) using EPA Method TO-15. Table 2 lists the concentrations of site-related VOCs that were detected in the indoor air samples (1).

Table 2: Concentration (ppbv) of Site-related VOC contaminants detected at the Depot Steakhouse (Lot No. 3022) located in Derry, New Hampshire on September 12, 2007 (1).

Contaminant	First Floor – Canister #1560 (ppbv)	Basement – Canister #6570 (ppbv)	Ambient – Canister #1582 (ppbv)
Tetrachloroethylene	1.4	46	0.04 L

"ppbv" - parts-per-billion volume

C. Environmental Data Evaluation & Contaminants of Concern

After exposure pathways are identified, environmental data are summarized, and site-related indoor air contaminants are evaluated. EHP uses a conservative, protective

approach to determine whether contaminant levels constitute a potential health hazard. Health-based Comparison Values (CVs) are used to identify levels of pollutants that are unlikely to present a health concern. CVs used in this report represent concentrations of contaminants that current scientific literature concludes are "harmless." CVs are conservative, and include ample safety factors in consideration of sensitive populations such as children, the elderly, and those with chronic respiratory disease. Therefore, CVs are protective of public health in most exposure situations. If a contaminant level is lower than its CV, it is unlikely that harmful effects will result, and is eliminated from further analysis. If a contaminant exceeds its CV, it is examined in greater detail and is subjected to a thorough scientific literature review to determine whether or not its level presents a public health hazard (6). Because CVs are based on conservative assumptions, the presence of concentrations greater than a CV does not necessarily indicate that adverse health effects will occur among exposed populations (6).

Table 3 lists the site and non-site-related VOC concentrations and their associated CVs used in this assessment. Table 3 also delineates the VOCs associated with the SCS (PCE and PCE- related contaminants), as well as additional contaminants that were detected but not SCS-related. These concentrations represent the maximum level that an individual may be exposed to assuming a continuous 24-hour exposure. They also specifically represent levels collected in the first floor work area (where workers spend the bulk of their time) as well as the basement (where workers may only occasionally enter for brief periods) (5). As a conservative measure, site-related VOCs not detected during laboratory analysis were also included at one-half of their analytical detection limit (referred to as “estimated” or “est.” in Table 3). For example, if the analytical device was unable to detect the target compound, EHP assigned a value on-half of the instrument’s lowest measurable quantity. These VOC concentrations were then compared to relevant ATSDR and EPA cancer and non-cancer air CVs. Bolded font indicates that the CV was exceeded (1, 6).

EHP compared the actual or the “estimated” contaminant concentrations to their respective CVs. The comparison revealed that SCS-related concentrations of PCE, trichloroethylene (estimated), and vinyl chloride (estimated), exceeded their respective CVs. EHP then conducted a site-specific risk assessment to determine if these concentrations represented a health concern to the DSH employees. The conservative exposure scenario employed by EHP was based on an adult worker breathing indoor air for 8-hours per day (7-hours in on the first floor and 1-hour in the basement), 250 days per year, over 25 year duration of exposure (5). This scenario also assumed that the actual or “estimated” contaminant concentrations were present throughout the respective first floor and basement areas of the DSH (1).

Table 3: Actual and estimated (est.) VOC concentrations (ppbv) detected in at the Depot Steakhouse (Lot No. 3022) located in Derry, New Hampshire on September 12-13, 2007 with respective CVs (1, 7, 8, 9, 10).

Contaminant	First Floor Canister #1560 (ppbv)	Basement Canister #6570 (ppbv)	Ambient Canister #1582 (ppbv)	Non-cancer CV (ppbv)	Cancer CV (ppbv)
SCS-Related					
1,1,1-Trichloroethane	0.032 (est.)	0.047 (est.)	0.047 (est.)	700 (c)	-
1,1-Dichloroethene	0.032 (est.)	0.047 (est.)	0.047 (est.)	20 (c)	-
Chloroethane	0.365 (est.)	0.5 (est.)	0.55 (est.)	4000 (a)	0.83 (f)
Tetrachloroethylene (PCE)	**1.4**	**46**	0.04 L	**40 (b)**	**0.046 (f)**
Trichloroethylene (TCE)	**0.032 (est.)**	**0.047 (est.)**	**0.047 (est.)**	100 (c)	**0.003 (f)**
Vinyl Chloride	0.032 (est.)	**0.047 (est.)**	**0.047 (est.)**	40 (a)	**0.04 (d)**
cis 1,2-Dichloroethene	0.032 (est.)	0.047 (est.)	0.047 (est.)	9.3 (e)	-
trans-1,2-Dichloroethene	0.032 (est.)	0.047 (est.)	0.047 (est.)	200 (c)	-
Non SCS-Related					
1,2,4-Trimethylbenzene	0.17	0.20	0.16	*1.22 (a)	-
1,3,5-Trimethylbenzene	0.05	0.06	0.04 L	*1.22 (a)	-
4-Ethyltoluene	0.13	0.18	0.15	-	-
Benzene	**0.27**	**0.29**	**0.30**	3.0 (b)	**0.03 (d)**
Carbon Tetrachloride	**0.07**	**0.10**	**0.09** L	30 (b)	**0.01 (d)**
Chloroform	**0.23**	**2.4**	0.047 (est.)	20 (b)	**0.008 (d)**
Dichlorodifluoromethane	0.52	0.69	0.67 J	-	-
Ethylbenzene	0.15	0.18	0.16	200 (a)	-
Hexane	0.52	0.53	0.41	200 (a)	-
m/p-Xylenes	0.40	0.49	0.47	23 (a)	-
Methyl Ethyl Ketone	0.43	0.66	0.22	1700 (a)	-
Methyl Isobutyl Ketone	0.13	0.27	0.047 (est.)	700(a)	-
Methylene Chloride	0.05	0.08	0.07 L	300 (b)	1.09 (f)
o-Xylene	0.14	0.19	0.17	23 (a)	-
Styrene	0.17	0.16	0.09 L	60 (b)	-
Toluene	0.98	1.0	0.84	80 (b)	-
Trichlorofluoromethane	0.29	0.42	0.25	-	-
Trichlorotrifluoroethane	0.05	0.07	0.07 L	-	-

Comparison Value Sources

(a) EPA RfC (b) ATSDR Chronic MRL/EMEG (c) ATSDR Intermediate MRL/EMEG
(d) ATSDR CREG (e) EPA Region 9 PRG (f) EPA Region 3 RBC

"ppbv" - parts-per-billion volume
"-" - indicates that no comparison value has been established.
"estimated" – indicates the VOC was not detected by the laboratory, however EHP used ½ of the analytical detection limit as a conservative measure.
"*" – indicates the CV is provisional
"J" - indicates the contaminant concentration is a laboratory estimated value
"L" – indicates the contaminant concentration was that was below the laboratory instrument's calibration range and the concentration was reported as estimated.

D. Public Health Implications of Exposure - SCS-Related VOCs

This section evaluates the public health implications of SCS-related indoor air contaminants measured in the DSH. Available DSH sampling data indicate that of the eight SCS-related VOCs sampled, three were above their respective CVs. Of these three, estimates of trichloroethylene and vinyl chloride were equal to corresponding estimated ambient levels ("estimated" levels were calculated based on identical analytical detection limits). Specifically:

- The level of PCE on the first floor was above the cancer CV;
- The level of PCE in the basement was above both the cancer and non-cancer CV;
- The estimated levels of trichloroethylene (first floor, basement, and ambient air) and vinyl chloride (basement and ambient air) were above their respective cancer CVs;

Following is a review of the scientific literature on the health effects of PCE.

PCE is a liquid chemical used for dry cleaning, metal-degreasing, and for making ingredients used in consumer products (water repellents, silicone lubricants, fabric finishers, spot removers, adhesives, and wood cleaners). PCE evaporates easily into the air and has a sharp, sweet odor. Common background levels of PCE are several thousand times lower than those in some workplaces. Background levels found in outside ambient air are usually less than 1 ppb (11).

PCE is normally emitted into air by evaporation from industrial or dry cleaning operations that use this chemical. Clothes brought home from the dry cleaners (using PCE as the solvent) may release small amounts of PCE into the air as well. PCE can also be found in soil at contaminated sites. When PCE is present in soil, it can migrate through soil pores and contaminate ground water, where it can persist for many months without being broken down. Under certain soil conditions, bacteria will break down PCE to form new "daughter" chemicals (degradation products). These newly formed chemicals were included in EHP's analysis and are listed as "site-related" in Table 3 (11).

People can be exposed to PCE in air from environmental and occupational sources as well as consumer products. The amount of PCE entering your body depends on the level in air, how fast and deeply you are breathing, and how long you are exposed to it. The majority of inhaled PCE is immediately exhaled. The remainder is either metabolized (mostly by the liver) into other chemicals that leave your body within days, or is stored in body fat. PCE in fatty tissue remains in the body for several days or weeks before it is eliminated (11).

Exposure to PCE concentrations over 100 times higher than those measured in the DSH first floor indoor air can cause dizziness, headache, sleepiness, confusion, nausea, difficulty in speaking and walking, and unconsciousness. These symptoms occur almost entirely in occupational or hobby environments. The OSHA limits for PCE is 100 parts in 1 million parts of air (100 ppm) for an 8-hour workday over a 40-hour workweek. Health effects from breathing PCE at low levels are not entirely certain, however, the risk from

ambient air levels (usually less than 1 ppb) is minimal. Animal studies have shown that PCE at high dosages can cause liver and kidney damage and liver and kidney cancers. The relevance of these studies to humans is unclear. PCE has not been shown to cause cancer in people, but the International Agency for Research on Cancer (IARC) has classified it as probably carcinogenic to humans (11).

EHP evaluated an exposure scenario for adult employees exposed to all recorded and "estimated" concentrations of SCS-related VOCs in the DSH indoor air. The cumulative potential for employees and visitors to experience non-cancer adverse health effects from these exposures was below a level of concern (based on a lifetime of continuous exposure). The cumulative theoretical excess lifetime cancer risk (a theoretical excess cancer risk of 25 per million exposed) from exposure to the carcinogenic VOCs, however, is significant according to the State of New Hampshire's Contaminated Sites Risk Characterization and Management Policy (6, 12). This risk is largely associated with long term exposure to the basement area air where levels of PCE (46.0 ppb) are approximately 33-times higher than that of the first floor (1.4 ppb). No carcinogenic health effects are likely for shorter-term (acute or intermediate) exposures.

E. Public Health Implications of Exposure - Non SCS-Related VOCs

Available sampling data indicate that three of the eighteen "non-SCS-related" VOCs detected in the DSH indoor air were above their respective CVs – benzene, carbon tetrachloride, and chloroform (1, 8). This section explores the possible sources of non-SCS-related VOCs, and evaluates their specific levels measured in the DSH.

According to DES Vapor Intrusion Guidance, background sources should always be considered when interpreting indoor air data. Background information is assembled by surveying the indoor sampling area for potential VOC sources (i.e., chemical containers, air fresheners, cleaners, paint, etc.), and by collecting an outside ambient air sample to be used for comparison purposes (3). EHP utilized the EPA 24-hour ambient air sample (canister #1582) for comparison purposes (1).

The EPA "Survey of Occupied Dwelling" form prepared for the DSH indicated that latex/acrylic paint, degreasers, cleaners, disinfectants, de-tarnishing solution, insecticides, air fresheners and sterno fuel were identified in the basement prior to sampling (1). These indoor sources may account for portions of the non-site-related VOCs identified. Other possible underground VOC sources may include two nearby properties where leaking underground storage tanks were recently remediated – Cumberland Farms located on 22 East Broadway and D&J Automotive located on 1 West Broadway. Additional plausible sources of air contaminants are fugitive air emissions from the Cumberland Farms gasoline filling station (across the street) as well as vehicular traffic along Broadway (13).

The non-SCS-related VOCs benzene, carbon tetrachloride, and chloroform were detected in the DSH at levels above their cancer CVs (1, 8). The levels of benzene and carbon tetrachloride, however, were almost exactly equal to the ambient concentrations

measured the outside environment (1). Risks associated with such background concentrations would likely be experienced by the general population. The specific levels, respective background comparisons, and possible sources of indoor air contamination are listed below.

- The DSH indoor air benzene levels exceeded their cancer CV (0.27 ppb - first floor, and 0.29 ppb - basement). These concentrations, however, were almost identical to ambient air levels (0.30 ppb) and are not associated with the SCS release (1, 8).
- The DSH indoor air carbon tetrachloride levels exceeded their cancer CV (0.07 ppb - first floor, and 0.10 ppb - basement). These concentrations, however, were almost identical to ambient air levels (0.09 ppb) and are not associated with the SCS release (1, 8).
- The maximum indoor air level of chloroform measured in the DSH (2.4 ppb in the basement) exceeded its cancer CV (1, 8). This chloroform level was more than 10-times higher than the first floor concentration (0.23 ppb). Due to the large number and variety of potential indoor VOC sources in the DSH basement, it is plausible that this chloroform level may have been affected by these sources (1). Chloroform is also not associated with the SCS release, and was not detected during any of the groundwater or soil-gas surveys performed by SHA (4).

A review of the scientific literature on the specific health effects of benzene, carbon tetrachloride, and chloroform is available in Appendix B.

CONCLUSIONS

After thorough analysis of available air data, EHP concludes that non-cancer adverse health effects are not expected from inhalation exposure to the DSH indoor air. There is, however, a low increased lifetime cancer risk from this long term exposure {breathing indoor air for 8-hours per day (7-hours in on the first floor and 1-hour in the basement), 250 days per year, over 25 year duration}. This theoretical increased cancer risk is equivalent to an additional 25 cases of cancer if one million employees were exposed to this first floor/basement air for 25 years. Exposure to indoor air in the DSH is therefore a *public health hazard* because the cancer risk was above the State of New Hampshire's Contaminated Sites Risk Characterization and Management Policy criterion. It should be stressed that this is a theoretical risk; the actual health risk is likely overestimated, and is largely associated with exposure to basement area air (where levels of PCE are more than 30-times higher than that of the first floor). Furthermore, it should be recognized that this conclusion is based on the evaluation of one set of ambient air data collected after EPA's removal action of April-May 2007.

Nonetheless, EHP is concerned that the concentration of PCE measured in the basement of DSH during September of 2007 is approximately three-fold higher than the basement data from June of 2006 (14.7 ppbv vs 46 ppbv).

RECOMMENDATIONS

Based on the conclusions of this report, EHP makes the following recommendations:

- Collect additional samples from the DSH basement using the analytical Method TO-15 with SIM analysis. This analysis is capable of detecting VOC contaminants at a much lower level than Method TO-15.
- If possible, limit the time DSH employees spend in the basement area.
- EHP staff will evaluate any additional site-related indoor air monitoring data that may become available.
- Collect additional samples from the DSH first floor using the analytical Method TO-15 with SIM analysis. This analysis is capable of detecting VOC contaminants at a much lower level than Method TO-15.
- Collect a simultaneous ambient air sample for risk assessment comparison purposes.
- Prior to sampling, attempt to identify any additional sources of indoor air contaminants present in the DSH basement. Potentially remove all likely sources of VOC contaminants.
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PUBLIC HEALTH ACTION PLAN

Past Actions

- June 1, 2006 - SHA performed indoor air sampling and analysis of the DSH basement area.
- August 10, 2006 - EHP report evaluating the human health risk associated with breathing the DSH basement air (June 1, 2006 samples).
- EPA collected environmental samples at the SCS on February 27-28, 2007.
- EPA conducted a removal action at SCS beginning in April, 2007.
- April 4, 2007 - DES participated in an EPA Open House for the site to discuss public health issues.
- September 12-13, 2007 - EPA performed indoor air sampling and analysis of the DSH first floor and basement area.

Present Actions

- EHP is continuing to evaluate indoor air quality data for other properties potentially impacted by Shamrock Cleaners.

Future Actions

- EHP will distribute this health consultation to EPA and DES.
- EHP will evaluate any new site-related environmental sampling data that becomes available.

PREPARERS OF THE REPORT

Report Author
Eric K. Abrams, M.S., Environmental Health Risk Assessor
New Hampshire Department of Environmental Services
Environmental Health Program
Air Resources Division
29 Hazen Drive
Concord, New Hampshire 03301

ATSDR Technical Project Officer
Alan S. Crawford, REHS/RS
LCDR U.S. Public Health Service
Environmental Health Officer
ATSDR/DHAC/CAPEB Mail Stop E29
1600 Clifton Road
Atlanta, GA 30333

ATSDR Regional Representatives
William Sweet, Ph.D., DABT, Senior Regional Representative
Division of Regional Operations, Region I
Agency for Toxic Substances and Disease Registry
U.S. Department of Health and Human Services
One Congress Street, Suite 1100
Boston, Massachusetts 02114-2023

Certification

This health consultation on the evaluation of air data for the Depot Steakhouse located at 1 East Broadway was prepared by the New Hampshire Department of Environmental Services, Environmental Health Program, under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). It was prepared in accordance with methods and procedures approved at the time the consultation was initiated. 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 its findings.

Cooperative Agreement Team Leader, CAPEB, DHAC, ATSDR

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APPENDIX A

Figure 1. Site Map - Derry, New Hampshire (2).

APPENDIX B

1. Benzene

Benzene is commonly found in the environment with industrial processes being the main source. The general population is mainly exposed to benzene through breathing air containing benzene. Benzene levels in the air can also be from industrial emissions, waste and storage operations, motor vehicle exhaust (about 20% of the total nationwide exposure), and evaporation from gasoline service stations. Tobacco smoke also contains benzene. About half of the entire nationwide exposure to benzene results from smoking tobacco or from exposure to environmental ("secondhand") tobacco smoke (14).

Benzene causes problems in the blood. Human studies show that chronic inhalation exposure to benzene can result in harmful effects in the tissues that form blood cells, especially the bone marrow. Excessive exposure to benzene can be harmful to the immune system, increasing the chance for infection and perhaps lowering the body's defense against cancer of the blood-forming organs (leukemia). The U.S. Department of Health and Human Services (USDHHS) categorizes benzene as a known carcinogen (14).

2. Carbon Tetrachloride

Carbon tetrachloride is a clear liquid that evaporates into the air very easily. It has a sweet odor that most people can begin to smell at about 10 ppm. Carbon tetrachloride does not occur naturally in the environment. It has been used in the past as a cleaning fluid or degreasing agent, as a grain fumigant, and industrially in the synthesis of refrigeration fluid and propellants for aerosol cans. Most of these uses have been discontinued. Nevertheless, carbon tetrachloride releases still occur primarily from industrial processes, or older cleaning agents remaining in the home. Inhalation appears to be the major route of exposure for workers and also for the general population (15).

Carbon tetrachloride degrades very slowly in the environment. Very low background levels of carbon tetrachloride are found in water, soil, and consequently in air from past and present releases. Average outdoor air concentrations in several areas of the United States range between 0.1–0.16 ppb, with some values reaching 1.4 ppb. Indoor air concentrations can be higher than in outdoor air because of carbon tetrachloride in building materials or household products (15).

Carbon tetrachloride has depressant effects on the central nervous system. These effects are most significant at high exposure levels. Carbon tetrachloride also produces irritant effects on the gastrointestinal tract. The liver and kidneys are the target organs in exposed humans and animals. Studies of occupational and general population exposures have produced no conclusive evidence that carbon tetrachloride is carcinogenic in humans. Carbon tetrachloride, however, has been shown to be carcinogenic in animals following chronic inhalation. IARC has classified carbon tetrachloride as possibly carcinogenic to humans (15).

3. Chloroform

Chloroform is a colorless liquid with a pleasant, non-irritating odor and a slightly sweet taste. Most of the chloroform found in the environment comes from chemical manufacturing, paper mills, and from sewage treatment and water-treatment plants. Chloroform persists in the air, but is eventually broken down. Chloroform was also one of the first inhaled anesthetics to be used during surgery, but it is not used for anesthesia today (16).

Most research on inhalation exposure to chloroform in humans is based on clinical reports describing health effects in patients under anesthesia. In humans, chloroform affects the central nervous system (brain), liver, and kidneys after a person breathes air or drinks liquids that contain large amounts of chloroform. Breathing elevated levels of chloroform for a short time also causes fatigue, dizziness, and headache. Based on animal studies, USDHHS concludes that chloroform may reasonably be anticipated to be a carcinogen. EPA has also determined that chloroform is a probable human carcinogen. These studies are based on oral, not inhalation exposure. However, because chloroform has identical toxicological end points following oral or inhalation exposure, CVs based on oral exposure to chloroform can be used to evaluate inhalation exposure (16).