Health Consultation

C & K RESTAURANT

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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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 which, in the Agency's opinion, indicates a need to revise or append the conclusions previously issued.

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HEALTH CONSULTATION

C& K RESTAURANT

DERRY, ROCKINGHAM COUNTY, NEW HAMPSHIRE

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 C&K Restaurant (C&K), located at 3 East Broadway in Derry, Rockingham County, New Hampshire. The building (Lot number 3019) is adjacent to a nearby former dry cleaning establishment, Shamrock Cleaners site – NH DES Site #200103051 (SCS). The September EPA indoor air sampling event was conducted to determine whether volatile organic compounds (VOCs) below the SCS (in soils & groundwater had migrated and were volatilizing into C&K. 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 indoor air samples - one collected from the C&K first floor, two from the C&K basement, 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 is to determine if inhalation of indoor air inside C&K presents a human health risk. After thorough analysis of all air data collected, EHP has concluded that adverse health effects are not expected to result from exposure to site-related indoor air contaminants in C&K. The theoretical cancer risk posed by all VOCs (cumulative potential of site and non-site-related) in C&K, however, is slightly elevated. Non-cancer health effects are not expected to result from this cumulative exposure.

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 New Hampshire Department of Environmental Services (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 C&K Restaurant (C&K) presents a human health risk. The HC presents an evaluation of environmental data provided to EHP from air samples collected by EPA at C&K located at 3 East Broadway on September 12-13, 2007 (1).

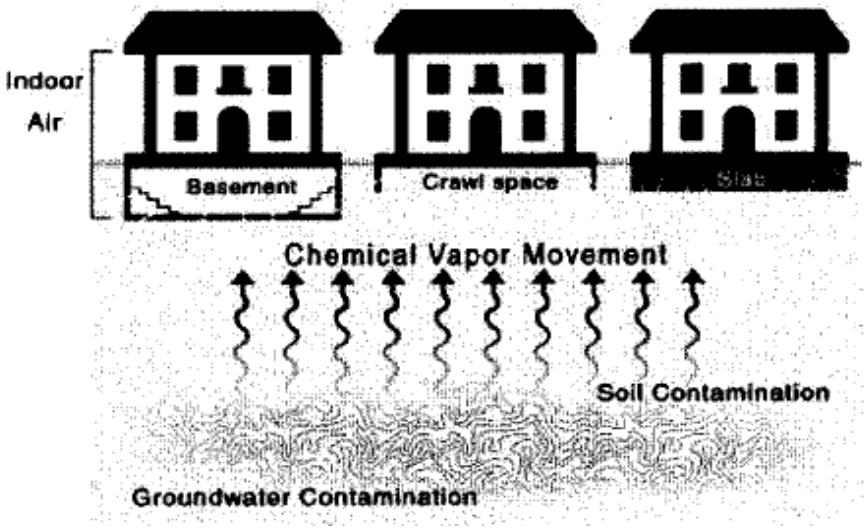
BACKGROUND

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 NHDES contractor, Sanborn, Head & Associates (SHA), conducted a series of investigations to determine the extent of contamination at the SCS. These investigations identified contaminants in the groundwater, especially PCE, at levels that could impact the soil above 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 gaps 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 SCS 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 SCS 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 C&K basement on June 1, 2006. The resultant indoor air data revealed a 24-hour average PCE level of 6.5 ppb in the C&K basement area. Indoor air samples were not taken on the first floor (4).

In April-May 2007 EPA excavated PCE-contaminated soils from the SCS. EPA subsequently conducted air quality sampling and analysis at C&K 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 C&K. 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 indoor air exposures to SCS-related compounds including PCE and its breakdown components. EHP evaluated an adult indoor air exposure; 10-hours per day (9-hours in on the first floor and 1-hour in the basement), 300-days per year, for a 25-year duration. This site-specific exposure information was assembled during a November 21, 2007 phone conversation with the C&K co-owner. This worst-case scenario is representative of the exposure experienced by C&K management who spend more time at C&K than employees or patrons (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 (C&K); 4) a route of human exposure (inhalation); and 5) a receptor population (C&K 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 C&K (indoor air in the primary work area and basement). This pathway is evaluated and discussed in the remaining sections of this HC. Public water is provided to this complex. Therefore, groundwater contamination at the SCS 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 C&K Restaurant (Lot No. 3019) located in Derry, New Hampshire.

Source	Environmental Transport And Media	Exposure Point	Exposure Route	Exposed Population	Time Frame	Status
Contaminated Soil & Groundwater (Site)	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 C&K 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 C&K 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 C&K first floor 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 10:00 AM, they began to collect three 24-hour duration indoor air samples from the C&K first floor (service 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 10:00 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 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 SCS-related VOC contaminants detected at the C&K Restaurant (Lot No. 3019) located in Derry, New Hampshire on September 12, 2007 (1).

Contaminant	First Floor – Canister #4743 (ppbv)	Basement – Canister #1589 (ppbv)	Basement – Canister #6571 (ppbv)	Ambient – Canister #1582 (ppbv)
1,1,1-Trichloroethane	0.05 (est.)	0.13	0.14	0.047 (est.)
Tetrachloroethylene	0.10 L	1.9	2.1	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 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, SCS-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 highest 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 C&K employees. The conservative exposure scenario employed by EHP was based on an adult worker breathing indoor air for 10-hours per day (9-hours in on the first floor and 1-hour in the basement), 300 days per year, over 25-year duration of exposure (5). This scenario also assumed that the highest actual or “estimated” contaminant concentrations were present throughout the respective first floor and basement areas of C&K.

Table 3: Highest actual and estimated (est.) VOC concentrations (ppbv) detected in at the C&K Restaurant (Lot No. 3019) located in Derry, New Hampshire on September 12-13, 2007 with respective CVs (1, 7, 8, 9, 10).

Contaminant	First Floor Canister #4743 (ppbv)	Basement Canisters #1589 & #6571 (ppbv)	Ambient Canister #1582 (ppbv)	Non-cancer CV (ppbv)	Cancer CV (ppbv)
SCS-Related					
1,1,1-Trichloroethane	0.05 (est.)	0.14	0.047 (est.)	700 (c)	-
1,1-Dichloroethene	0.05 (est.)	0.047 (est.)	0.047 (est.)	20 (c)	-
Chloroethane	0.6 (est.)	0.55 (est.)	0.55 (est.)	4000 (a)	0.83 (f)
Tetrachloroethylene (PCE)	**0.10 L**	**2.1**	0.04 L	40 (b)	**0.046 (f)**
Trichloroethylene (TCE)	**0.05 (est.)**	**0.047 (est.)**	**0.047 (est.)**	100 (c)	**0.003 (f)**
Vinyl Chloride	**0.05 (est.)**	**0.047 (est.)**	**0.047 (est.)**	40 (a)	**0.04 (d)**
cis 1,2-Dichloroethene	0.05 (est.)	0.047 (est.)	0.047 (est.)	9.3 (e)	-
trans-1,2-Dichloroethene	0.05 (est.)	0.047 (est.)	0.047 (est.)	200 (c)	-
Non SCS-Related					
1,2,4-Trimethylbenzene	0.22	1.1	0.16	*1.22 (a)	-
1,3,5-Trimethylbenzene	0.06 L	0.33	0.04 L	*1.22 (a)	-
1,3-Butadiene	**0.27**	**0.095 (est.)**	**0.1 (est.)**	0.9 (a)	**0.01 (d)**
2-Hexanone	0.05 (est.)	0.11	0.05 (est.)	-	-
4-Ethyltoluene	0.23	1.0	0.15	-	-
Benzene	**0.42**	**0.59**	**0.30**	3.0 (b)	**0.03 (d)**
Carbon Tetrachloride	**0.10 L**	**0.10**	**0.09 L**	30 (b)	**0.01 (d)**
Chloroform	**0.58**	**0.26**	**0.05 (est.)**	20 (b)	**0.008 (d)**
Cyclohexane	0.08 L J	0.37	0.05 (est.)	1700 (a)	-
Dichlorodifluoromethane	1.4 J	4.6 J	0.67 J	-	-
Ethylbenzene	0.25	0.90	0.16	200 (a)	-
Hexane	0.60	1.3	0.41	200 (a)	-
m/p-Xylenes	0.70	2.6	0.47	23 (a)	-
Methyl Ethyl Ketone	0.62	1.2	0.22	1700 (a)	-
MtBE	0.08 L	1.9	0.05 (est.)	700 (b)	-
Methylene Chloride	0.09 L	0.11	0.07 L	300 (b)	1.09 (f)
o-Xylene	0.25	1.1	0.17	23 (a)	-
Styrene	0.15	0.19	0.09	60 (b)	-
Toluene	1.2	3.7	0.84	80 (b)	-
Trichlorofluoromethane	0.39	0.44	0.25	-	-
Trichlorotrifluoroethane	0.07	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 at C&K. Available sampling data indicate that of the eight SCS-related VOCs sampled, only PCE, trichloroethylene (estimated), and vinyl chloride (estimated) were detected above their respective cancer CVs (1, 8, 10). Of these three, only PCE was measured above its analytical detection limit. Trichloroethylene and vinyl chloride estimates were equal to corresponding estimated ambient levels ("estimated" levels were calculated based on identical analytical detection limits) (1). 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 "SCS-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 several hundred times higher than those measured in the C&K basement indoor air can cause dizziness, headache, sleepiness, confusion, nausea, difficulty in speaking and walking, and unconsciousness (1, 11). 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 SCS-related VOC indoor air contaminants at C&K. Exposure to the concentration of PCE, as well as estimated levels of trichloroethylene, and vinyl chloride, does not pose a significant increased cancer risk among the C&K employees and visitors. The cumulative theoretical excess lifetime cancer risk for all recorded and estimated concentrations of carcinogenic, SCS-related VOCs is also not significant.

Individual site-related VOC contaminant levels measured in C&K indoor air were all below established non-cancer CVs. As an additional conservative measure, the potential for non-carcinogenic health effects was evaluated by a comparison with the calculated inhalation average daily dose. In all cases, each calculated inhalation average daily dose was below a level of concern for a lifetime of continuous exposure at C&K (6, 7). The cumulative potential (all SCS-related VOCs added) for non-cancer health effects also did not indicate that employees and visitors would experience adverse health effects from these exposures.

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

Available sampling data indicate that four of the twenty-one "non-SCS-related" VOCs detected in C&K indoor air were above their respective CVs – 1,3-butadiene, 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 C&K.

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 C&K indicated that marine fuel system cleaner, latex paint, adhesives, cleaners, insecticides, and detergents were identified in the basement prior to sampling (1). These indoor sources may account for portions of the non-SCS-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 (12).

The non-SCS-related VOCs 1,3-butadiene, benzene, carbon tetrachloride, and chloroform were detected in C&K at levels above their cancer CVs (1, 8). The specific levels, respective background comparisons, and possible sources of indoor air contamination are listed below.

- The first floor indoor air 1,3-butadiene level measured in C&K (0.27 ppb) exceeded its cancer CV. Basement and ambient air levels were, however, not measured above their analytical detection limits (0.19 and 0.20 ppb) (1, 8). This first floor value was nearly the same as average ambient background levels typically found in the ambient air of cities and suburbs in the US (0.30 ppb) (13). The level was also almost identical to levels measured in nearby buildings near the SCS (14).
- The C&K indoor air carbon tetrachloride levels all exceeded their cancer CV (0.10 ppb - first floor, 0.09 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 risks associated with such background concentrations would likely be experienced by the general population.
- The C&K indoor air benzene levels exceeded their cancer CV (0.42 ppb - first floor, 0.57 ppb and 0.059 ppb – basement, and 0.30 ppb ambient). The source(s) contributing toward the higher levels in the basement area are presumably attributable to: 1) household products such as the Pennzoil Marine Fuel System Cleaner and Stabilizer (80-90% petroleum distillates); and/or 2) possible underground VOC sources (nearby properties where leaking underground storage tanks were recently remediated) (1, 12, 15)
- The maximum indoor air level of chloroform measured in C&K (0.58 ppb in the basement) exceeded its cancer CV (1, 8). This chloroform level was more than twice as high as measured basement concentrations (0.25 & 0.26 ppb) (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). It is conceivable, however, that first floor chloroform sample levels were affected by emissions from the bar and kitchen areas (emissions from nearby running water and dishwashing activities). According to DES records, the public water supplied to C&K contains chloramines for disinfection purposes (16). When this water is dispensed, small amounts of chloroform gas could be released into the indoor air.

A review of the scientific literature on the specific health effects of 1,3-butadiene, carbon tetrachloride, benzene, and chloroform is available in Appendix B.

E. Cumulative Risk: SCS-Related and Non-SCS-Related VOCs

EHP considered the potential cumulative risk posed by levels of all VOCs measured in the indoor air at C&K. Specifically, EHP evaluated the exposure scenario for C&K's owner (10-hours/day, 6-days/week) using two potential VOC levels: the maximum actual; and "estimated" (5). The resultant theoretical excess lifetime cancer risk was slightly elevated (potential for 18 excess cancers per million persons exposed). The cumulative potential for non-cancer health effects did not indicate a significant risk for adverse health effects to occur from these exposures.

Although a theoretical potential cumulative risk is evident, it is likely that this risk is an overestimation for the following reasons:

- The exposure scenario employed in EHP's analysis assumed a 60-hour/week. C&K employees who work conventional 40-hour work weeks (or less), and/or do not enter the basement area receive less exposure and theoretically have less risk (5);
- SCS-related VOCs such as trichloroethylene and vinyl chloride were not detected above the analytical detection limits in the indoor air of C&K or any of the 26 total samples collected by EPA (from 9 buildings adjacent to the site) (1, 15);
- Carbon tetrachloride is not SCS-related, and was essentially equal to background levels (1, 8);
- VOCs including benzene and chloroform are not SCS-related, and their levels are likely influenced by indoor sources (1, 16).

CONCLUSIONS

After thorough analysis of all air data collected, EHP concludes that adverse health effects are not expected to result from inhalation exposure to SCS-related VOCs in C&K indoor air. Exposure to VOC contaminant levels in C&K indoor air (originating from the Former Shamrock Cleaners Site) is therefore *no apparent public health hazard.*

When the levels of both: 1) SCS-related; and 2) non-SCS-related VOCs are combined, there is a low increased lifetime cancer risk from long term exposure. If one million employees were exposed to this air for 25 years, there may be an additional 18 cases of cancer. This is a theoretical risk that is likely overestimated. In reality, a portion of this added non-SCS-related risk is actually associated with common ambient air contaminants (i.e., benzene from evaporating gasoline).

RECOMMENDATIONS

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

- EHP staff will evaluate any additional SCS-related indoor air monitoring data that may become available.
- If additional samples are collected, utilize 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 additional samples are collected, collect a simultaneous ambient air sample for risk assessment comparison purposes.
- Prior to any sampling, attempt to identify any additional sources of indoor air contaminants present in the C&K basement. Potentially remove all likely sources of VOC contaminants and evacuate indoor air prior to sampling.

PUBLIC HEALTH ACTION PLAN

Past Actions

- June 1, 2006 - SHA performed indoor air sampling and analysis of the C&K basement area.
- August 10, 2006 - EHP report evaluating the human health risk associated with breathing the C&K basement air (June 1, 2006 samples).
- EPA collected environmental samples at the SCS on February 27-28, 2007.
- EPA conducted a removal action at the 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 C&K first floor and basement area.

Present Actions

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

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.

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Certification

This health consultation on the evaluation of air data for the C&K Restaurant located at 3 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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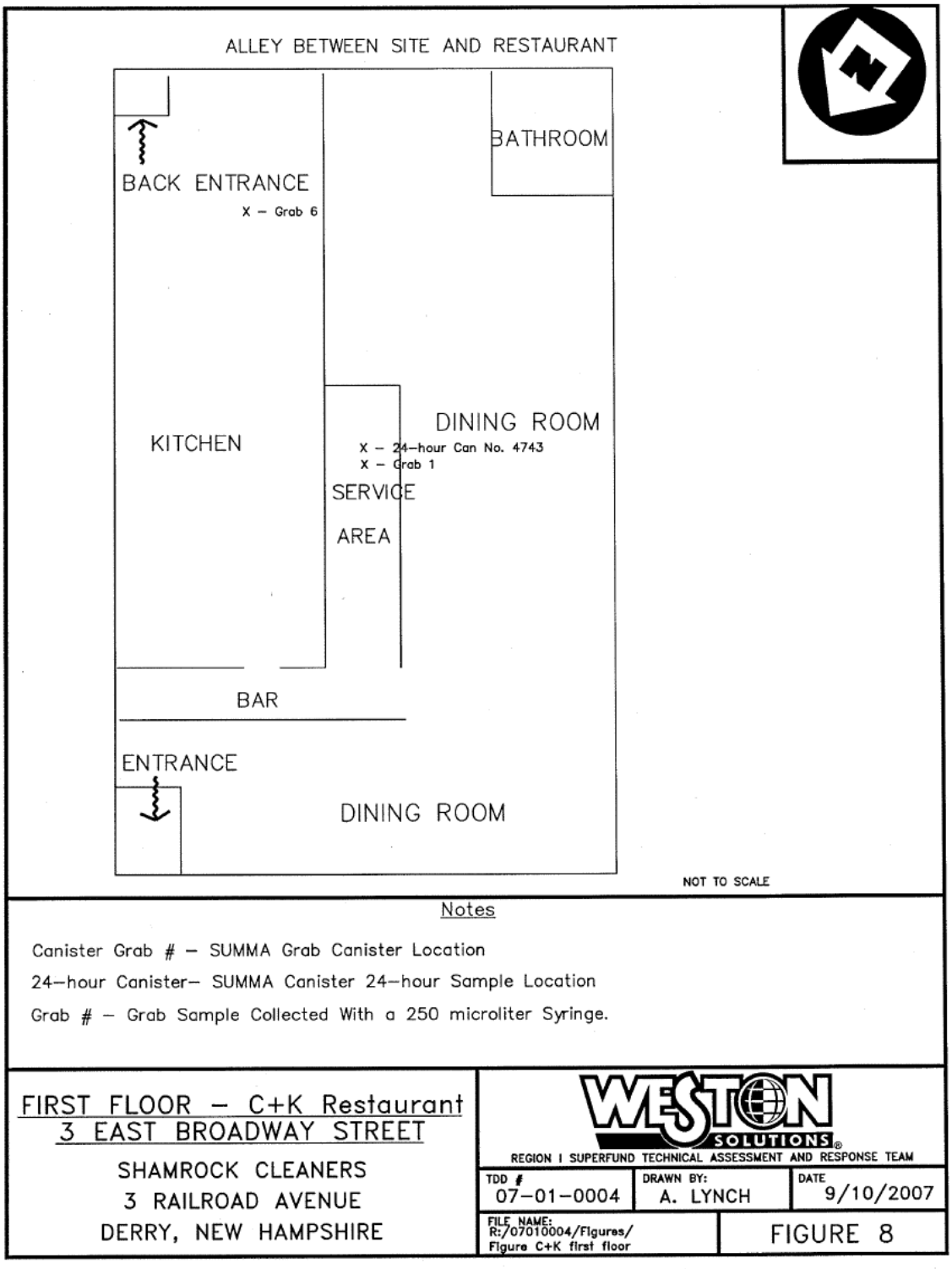
APPENDIX A

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

Figure 1. First Floor Map of C&K Restaurant - Derry, New Hampshire (17).



APPENDIX B

1. 1,3-Butadiene

1,3-butadiene is a colorless gas with a mild gasoline-like odor that breaks down quickly in the air. In fact, half of 1,3-butadiene goes away from the air in about 2 hours during sunny weather. 1,3-butadiene is produced from petroleum and is used to make man-made rubber (car and truck tires) and plastics. 1,3-butadiene is also found in gasoline, automobile exhaust, cigarette smoke, and wood fires. Thus, it is always present at very low levels in the air around cities and towns. (13).

Heart disease, blood disease, lung disease, and certain cancers are the principal health effects that can result from long-term exposure to low levels of 1,3-butadiene combined with other chemicals. The exact composition and proportion of these chemical combinations are unknown. Inhalation of 1,3-butadiene is mildly narcotic in humans at low concentrations and may result in a feeling of lethargy and drowsiness (13).

2. 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 (18).

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 (18).

3. 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 (19).

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 (19).

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 (19).

4. 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 evaporates easily into the air where it persists, 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 (20).

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 (20).