Health Consultation

Evaluation of Community Health Concerns
Related to a Tetrachloroethylene (PCE) Release Site

50 TUFTS STREET

SOMERVILLE, MIDDLESEX COUNTY, MASSACHUSETTS

JANUARY 13, 2009

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

Health Consultation: A Note of Explanation

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

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Prepared By:

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Under a Cooperative Agreement with:

Public Health Service
Agency for Toxic Substances and Disease Registry
United States Department of Health and Human Services
Atlanta, Georgia

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I. INTRODUCTION

In March 2007, the Massachusetts Department of Public Health, Bureau of Environmental Health (MDPH/BEH) was contacted by a resident in the city of Somerville, Massachusetts, who was concerned about indoor air contamination from vapor intrusion of tetrachloroethylene (PCE) in her home associated with the nearby 50 Tufts Street site. In response to these concerns, the MDPH/BEH conducted an assessment of available indoor air data for the home and evaluated other community exposure concerns associated with the 50 Tufts Street site.

II. BACKGROUND AND COMMUNITY ENVIRONMENTAL CONCERNS

A. Community Concerns

According to information provided by the resident and staff from the Massachusetts Department of Environmental Protection (MDEP), subslab soil gas and indoor air samples were collected and analyzed during the site discovery and assessment process for a release site located at 50 Tufts Street in Somerville. A letter that accompanied the sampling data for the home showed results were above MDEP triggers for action for tetrachloroethylene [GEI 2007a]. The resident expressed concerns about cancer and non-cancer health effects from exposure to this compound in indoor air for herself and others in the residence, including her pre-school child. In addition, while the primary route of exposure for tetrachloroethylene and other VOCs detected in groundwater is via volatilization into indoor air, the resident also expressed concerns about exposures due to contact with soils around her house and the ingestion of food grown in the community gardens located nearby in the neighborhood as well as soil contact there.

B. Site History and Information

According to the MDEP on-line sites database, the 50 Tufts Street site was first reported as a hazardous materials release in October 2003. Based on discussions with MDEP and the Licensed Site Professional (LSP) for the site, there has been an industrial business at the 50 Tufts Street location for at least several decades. A primary business activity at the site was the

packaging of bulk tetrachloroethylene into smaller containers, such as 55-gallon drums, for transport for use as a dry cleaning solvent or other uses [MDEP 2007a].

It is not known when a release of tetrachloroethylene may have occurred. It is also unknown if it was a single large release, or the cumulative effects of several small releases over time. The contaminated site conditions were discovered during due-diligence activities as a part of a sale agreement for the property. One of the past owners, Uni-First, has accepted responsibility for the cleanup process and hired the consulting firm GEI to perform sampling, analysis, and cleanup procedures on the site in accordance with state law and regulation [MDEP 2007b].

Currently, both soil on the 50 Tufts Street site and groundwater in the vicinity of the site are known to be contaminated with tetrachloroethylene (PCE) and other chlorinated chemicals. During the site investigation process, a plume of PCE was discovered in groundwater moving away from the site to the east-northeast. The extent of the contaminated groundwater has been estimated based on sampling and analysis results in monitoring wells and is reported in the Comprehensive Site Investigation (CSI) for the site [GEI 2008]. Figure 1 is a map showing the location of the site, the neighborhood under discussion, and a school in the area, the Capuano School.

According to MDEP and the LSP, when it was discovered that contaminated groundwater had been found near the adjacent residential area, GEI began conducting soil gas sampling beneath some of these residences to determine if the contamination was impacting them. When levels of PCE in soil gas were measured higher than MDEP triggers for immediate action, GEI and Uni-First reportedly broadened the area of investigation, and also began mitigation measures in affected houses. Immediate responses included giving residents a portable air purifying system while concurrently designing and installing sub-slab depressurization systems (SSDS) to remove contaminated soil gases from beneath each house, and prevent the infiltration of these gases into the living spaces above [MDEP 2007b, GEI 2007c].

The investigation and remediation of the 50 Tufts Street Site and affected areas, including additional residential sampling, is ongoing and is likely to be in process for several years. The

home of the concerned resident is one of the approximately 66 off-site properties (residential and commercial) sampled to date. According to Middlesex County property records, the home is a 2-story single-family woodframe house. According to the resident, the house has a basement with a concrete slab except for an addition which has a dirt floor basement. The neighborhood is densely populated, relatively flat, and contains mixed building types, including single- and multi-family residences, and commercial buildings.

The house is located about 500 feet from the edge of the 50 Tufts Street property, almost due east. According to a presentation by the LSP, the plume of PCE-contaminated groundwater has traveled in this direction from the release site. Concentrations of PCE in groundwater below this location have not been directly measured, but the location of other groundwater monitoring wells suggests that the groundwater directly under the site has concentrations of PCE greater than 50 µg/l[GEI 2008].

III. REVIEW OF ENVIRONMENTAL SAMPLING DATA

MDPH/BEH reviewed available environmental data for the residence. This included soil gas, indoor air, and outdoor soil contaminant data. Health assessors use a variety of health-based screening values, called comparison values, to help decide whether compounds detected at a site might need further evaluation. These comparison values include environmental media evaluation guides (EMEG), reference dose media evaluation guides (RMEG), cancer risk evaluation guides (CREG), and maximum contaminant levels for drinking water (MCL). These comparison values have been scientifically peer reviewed or were derived from scientifically peer-reviewed values and published by the Agency for Toxic Substances and Disease Registry (ATSDR) or USEPA. EMEG and RMEG values are used to evaluate the potential for non-cancer health effects. CREGs are estimated contaminant concentrations that would be expected to cause no more than one excess cancer in a million (1×10^{-6}) persons exposed during their lifetime (70 years). ATSDR's CREGs are calculated from USEPA's slope factors for oral exposures or unit risk values for inhalation exposures. These values are based on USEPA evaluations and assumptions about hypothetical cancer risks at low levels of exposures. For

chemicals that do not have these comparison values available for the medium of concern, USEPA risk-based concentrations (RBCs) developed by USEPA regional offices, are used. If the concentration of a compound exceeds its comparison value, adverse health effects are not necessarily expected. Rather, these comparison values help in selecting compounds for further consideration. For example, if the concentration of a chemical in a medium (e.g., air) is greater than the EMEG for that medium, the potential for exposure to the compound should be further evaluated for the specific situation to determine whether non-cancer health effects might be possible. Conversely, if the concentration is less than the EMEG, it is unlikely that exposure would result in non-cancer health effects. EMEG values are derived for different durations of exposure, according to ATSDR guidelines. Acute EMEGs correspond to exposures lasting 14 days or less. Intermediate EMEGs correspond to exposures lasting longer than 14 days to less than a year. Chronic EMEGs correspond to exposures lasting one year or longer. CREG values are derived assuming a lifetime duration of exposure. RMEG values also assume chronic exposure. All the comparison values are derived assuming opportunities for exposure in a residential setting.

To evaluate resident concerns regarding the indoor air results described above, MDPH conducted a screening evaluation of the compounds detected to identify which substances, if any, warranted further analysis for possible health concerns. Maximum detected concentrations in indoor air were compared to health-based comparison values established for ambient air by ATSDR, if an ATSDR comparison value was not available for the substance of concern in the media of concern, other health-based screening values were used.

A sample of soil gas was collected from the residence on March 21, 2007, from beneath the concrete basement slab in the residence. This sample was collected using SUMMA™ canisters and analyzed for chlorinated VOCs using the US Environmental Protection Agency Method (USEPA) TO-15 [GEI 2007a]. Based on this sample which showed greater than 15,000 ppb of PCE and lower but detectable concentrations of trichloroethylene (TCE) and other compounds in the soil gas, GEI recommended a Sub-slab Depressurization System (SSDS) for the residence. The resident requested that indoor air samples inside the house be collected and analyzed before they would agree to the SSDS installation [GEI 2007a]

No health-based comparison values are available for soil gas, as exposures to the concentration measured in soil gas do not typically occur. Rather, soil gas measurements are an indication of the potential for constituents in soil gas to migrate to another medium such as indoor air which can result in exposure opportunities. Soil gas analyses results are also used to show whether a completed pathway from a contaminated site (e.g., via groundwater) to indoor air may exist.

GEI performed indoor air sampling on April 18, 2007 in the residence. These samples were also collected using SUMMA™ canisters and analyzed using USEPA Method TO-15. One sample was collected from the basement, and one from the first floor living area [GEI 2007b]. Each sample was collected from about 4 feet above the floor. The windows in the house were closed for the entire sampling event, and no ventilation fans were on during that time [GEI 2007d].

On May 30, 2007, a SSDS was installed in the house. Indoor air sampling was conducted in June 5, 2007 and, based on the results, GEI installed an additional vapor extraction point for the residence as well as performed sealing of the dirt floor areas of the basement to decrease the amount of contaminated soil gas entering the residence [GEI 2007d]. Another round of indoor air sampling was conducted on August 23, 2007. Results of this sampling showed levels of carbon tetrachloride of 0.11 ppb (a "J" flagged, thus estimated value) in both basement and first floor air samples, and levels of PCE of 0.52 ppb and 0.34 ppb in the basement and first floor sample respectively.

In December of 2007, an additional vapor barrier and venting system was installed tailored to the basement configuration [GEI 2007d]. Additional indoor air sampling of the residence was conducted on November 15, 2007, December 23, 2007, and December 28, 2007 to confirm the operation of the SSDS. During these three rounds, no VOCs were detected [GEI 2008].

Results from all sampling rounds (pre and post-SSDS installation), demonstrated that none of the contaminants detected in the home exceeded ATSDR comparison values for non-cancer health effects. Carbon tetrachloride (0.12 ppb estimated) did exceed the ATSDR comparison value for cancer, CREG of 0.01 ppb. See Table 1.

It is important to note that the levels of carbon tetrachloride measured in the indoor air, when detected, are estimated values, based on the detections being between the method detection limit, which is not reported, and the method quantification limit (0.20 ppb). This denotes confidence that the compound is present in the indoor air, but that the level detected may not be accurately measured by the analysis. In addition carbon tetrachloride is ubiquitous in both indoor and outdoor air samples in the United States, and background levels in both outdoor and indoor air in Massachusetts are estimated to be between 0.1 ppb and 0.6 ppb [ATSDR 2005b]. GEI did collect outdoor air samples in the neighborhood. Results ranged from 0.10 ppb to 0.13 ppb [GEI 2008]. Therefore, the estimated level detected in the residence and neighborhood is within the range considered to be background for urban areas in Massachusetts and the United States. For these reasons this compound will not be further evaluated in this health consultation. In addition, since carbon tetrachloride was not detected in the subslab soil gas, the presence of this compound in the indoor air may not be associated with contaminated groundwater or the 50 Tufts Street site.

In December of 2007, GEI also performed sampling of soils beneath the slab in the basement of the residence and two samples were collected of surface soils outside the residence, one in the front of the house and one in the back yard. Because there is no opportunity for contact with the subslab soils, these samples were not reviewed here. There is opportunity for contact with shallow surface soils and hence opportunity for exposure to these soils is reviewed [GEI 2008].

The surface soil samples were analyzed for the specific chlorinated organic compounds of concern. No chlorinated VOCs were found in these surface soil samples [GEI 2008].

Neither PCE nor trichloroethylene (also known as TCE) has a CREG value. Both compounds have been under review for their cancer-causing potential for many years. However, EPA currently has a provisional guidance for evaluating the possible cancer risk from exposure to PCE or TCE. Thus PCE and TCE will be further evaluated in this health consultation. In addition, MDEP recently proposed a cancer risk guideline for PCE to be used to evaluate state hazardous waste sites

IV. EVALUATION OF POTENTIAL EXPOSURE PATHWAYS

An evaluation of potential exposure pathways was conducted to help evaluate potential health concerns from exposure to compounds detected at the residence. A person must first be exposed to a chemical before any potential adverse health effects can result. Five conditions must be present for exposure to a chemical to occur. First, there must be a source of the chemicals. Second, an environmental medium must be contaminated by the source or by chemicals transported away from the source. Third, there must be a location where a person could potentially come in contact with the contaminated medium. Fourth, there must be a means by which the contaminated medium could enter the person's body, such as ingestion, inhalation or dermal absorption. Fifth, there must be a population to be exposed. Even if a person is exposed to a chemical, it doesn't mean the person will be harmed. For a person to be harmed by exposure, the chemical must actually reach the target organ susceptible to the toxic effects caused by the particular substance at a sufficient dose and for a sufficient exposure time for an adverse effect to occur.

A completed exposure pathway indicates that exposure to humans occurred in the past, is occurring in the present, or will occur in the future. A potential exposure pathway exists when one or more of the five elements is missing or uncertain and indicates that exposure could have occurred in the past, may be occurring in the present or could occur in the future. An exposure pathway can be eliminated if at least one of the five elements is missing and will not likely be present in the future.

A. Indoor Air

The indoor air in the residence represents a completed exposure pathway. At this time, it is not known how long PCE and TCE have been present in the indoor air, but it is possible that residents have been exposed to these compounds for many years. Based on a search at the Middlesex County Registry of Deeds, at least one adult has been living at this address for about

ten years. To evaluate the potential for cancer concerns that may result from exposures to PCE and TCE at this residence, we made the following assumptions:

For an adult resident: an inhalation rate of 11.3 cubic meters per day [ATSDR 2005a]; a body weight of 60 kg (about 130 pounds) [EPA 1997]; an exposure duration of 10 years; and an exposure frequency of 350 days per year.

For the current child resident of three to five years of age: an inhalation rate of 8.3 m^3/day, a body weight of 16 kg (about 35 pounds), an exposure duration of 5 years and an exposure frequency of 350 days per year.

The resulting estimated daily exposure over the specified time period is then combined with a cancer slope factor to estimate the risk of cancer posed to individuals by that exposure.

The basic equation for determining this risk is:

$$Risk = Dose \times Slope\ Factor$$

Where:

$$Dose(\mu g / kg - day) = \frac{concentration(\mu g / m^3) \times inhalation\ rate(m^3 / day) \times 350(days / year) \times years}{body\ weight(kg) \times 365\ days / year \times 70 years}$$

Because PCE and TCE are considered to be potential human carcinogens, the potential for these exposures to cause cancer in humans is evaluated.

PCE:

As shown in Table 1, levels of PCE measured in indoor air are below the EMEG for both acute and chronic exposure so non-cancer health effects are not evaluated for this compound.

The cancer risk calculations presented here use the indoor air concentration from the sample collected on April 18, 2007 (prior to SSDS installation) on the first floor, of 35 µg/m^3 (0.035 mg/m^3), as the contaminant concentration. This is because most time is expected to be spent in the living spaces of the house, not in the basement where the other measurement was taken. The resulting dose estimates for the adult[1] is 9.03 x 10^{-4} mg/kg/day and for the child[2] is 1.24 x 10^{-3} mg/kg/day.

The cancer slope factor used to assess cancer risk was derived from an USEPA Provisional Value which was converted from the Inhalation Unit Risk (IUR) value[3]. This slope factor is 0.0207 and has the units of the inverse of mg/kg/day or (mg/kg/day)$^{-1}$ such that the cancer risk calculated is unitless.

This results in theoretical cancer risk estimates of 1.9 x 10^{-5} for an adult[4] and 2.6 x 10^{-5} for a child[5]. Based on guidance used nationally, the exposure opportunities that resulted in these risk estimates are not expected to result in unusual cancer concerns.

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[1] $Exposure\ dose = \frac{0.035\ mg/m^3 \times 11.3\ m^3/day \times 350\ days/year \times 10\ years}{60\ kg \times 25550\ days} = 9.03 \times 10^{-4}\ mg/kg/day$

[2] $Exposure\ dose = \frac{0.035\ mg/m^3 \times 8.3\ m^3/day \times 350\ days/year \times 5\ year}{16\ kg \times 25550\ days} = 1.24 \times 10^{-3}\ mg/kg/day$

[3] An IUR value is based on the inhalation rate and mass of a standard male (20 m^3/day and 70 kg). The slope factor accounts for this, as shown in this example

$$IUR = 5.9 \times 10^{-6}\ \frac{m^3}{\mu g}$$

$$Slope\ Factor = IUR \times \frac{70kg}{20m^3} = 5.9 \times 10^{-6}\ \frac{m^3}{\mu g} \times \frac{70kg}{20m^3} \times 10^3\ \frac{\mu g}{mg} = 0.0207\ \frac{1}{mg/kg/day}$$

[4] $CancerRisk = 9.03 \times 10^{-4}\ mg/kg/day \times 0.0207 (mg/kg/day)^{-1} = 1.9 \times 10^{-5}$

In addition, MDEP recently proposed a slope factor for PCE of 0.035 $(mg/kg/day)^{-1}$
Using this factor in the same calculation results in an increased theoretical risk of 3.2×10^{-5} for an adult[6] and 4.4×10^{-5} for a child[7], thereby not expecting to result in unusual cancer concerns.

Trichloroethylene

As shown in Table 1, levels of TCE measured in indoor air are significantly below the EMEG for acute and intermediate exposure and below the Chronic Reference Concentration (RfC) for chronic exposure, so non-cancer health effects are not evaluated for this compound.

The screening performed in Section III above used the higher of the two measurements for PCE in indoor air (taken in the basement, on April 18, 2007) of 2.7 $\mu g/m^3$ (0.0027 mg/m^3). The cancer risk calculations presented here use the indoor air concentration from the sample collected on the first floor, of 1.1 $\mu g/m^3$ (0.0011 mg/m^3) on April 18, 2007, as the contaminant concentration because this would more likely represent exposures to residents. The resulting dose estimates for the adult[8] is 2.84×10^{-5} mg/kg/day and for the child[9] is 3.91×10^{-4} mg/kg/day.

The International Agency for Research on Cancer (IARC) have determined that TCE is "probably carcinogenic" to humans. USEPA Region 8 issued a Technical Publication in 2005 discussing the prior and current assumptions regarding TCE toxicity, which gives two provisional options for a slope factor for determining cancer risk. The "less conservative" slope factor is 0.020 $(mg/kg/day)^{-1}$ while the "more conservative" slope factor is 0.40 $(mg/kg/day)^{-1}$.

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[5] $CancerRisk = 1.24\times10^{-3}\, mg/kg/day \times 0.0207 (mg/kg/day)^{-1} = 2.6\times10^{-5}$

[6] $CancerRisk = 9.03\times10^{-4}\, mg/kg/day \times 0.035 (mg/kg/day)^{-1} = 3.2\times10^{-5}$

[7] $CancerRisk = 1.24\times10^{-3}\, mg/kg/day \times 0.035 (mg/kg/day)^{-1} = 4.4\times10^{-5}$

[8] $Exposure\ dose = \frac{0.0011\, mg/m^3 \times 11.3\, m^3/day \times 350\, days/year \times 10\, years}{60\, kg \times 25550\, days} = 2.84\times10^{-5}\, mg/kg/day$

[9] $Exposure\ dose = \frac{0.0011\, mg/m^3 \times 8.3\, m^3/day \times 350\, days/year \times 5\, year}{16\, kg \times 25550\, days} = 3.91\times10^{-5}\, mg/kg/day$

Using these two TCE slope factors, theoretical cancer risk estimates of 5.7 x 10^{-7} or 1.1 x 10^{-5} for an adult[10,11] and 7.8 x 10^{-6} or 1.6 x 10^{-5} for a child[12,13]. Thus, the exposure opportunities to TCE in indoor air do not present unusual cancer concerns

B. Gardening

The resident also expressed concerns regarding potential exposures to PCE from the soils at the Community Gardens located near the Capuano School properties. There are three gardens, one of which is directly adjacent to the school while the others are across a road to the north. According to MDEP, sampling was conducted at the community garden located near the school which is within the zone of the PCE plume. A hand auger was used to collect soil samples from about 2.5 feet below the soil surface, which is below the imported soil fill used as a growing layer. No PCE or other target compounds were detected in these soil samples [GEI 2007d]. Thus, exposure opportunities to PCE in the community gardens are not expected to result in health effects.

In addition, as described above, surface soil samples were collected from two locations in the yard of the residence in December of 2007 and analyzed for chlorinated volatile organic compounds and none were detected. Thus, exposure opportunities to PCE or other chlorinated volatile organic compounds in the soils near the residence are also not expected to result in health effects.

V. DISCUSSION

The levels of PCE measured in indoor air at the residence, both before and after installation of an SSDS, are below both short term (acute) and long term (chronic) EMEGs. This would indicate that non-cancer health effects are not expected from opportunities for exposure to the levels of

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[10] $CancerRisk = 2.84\times10^{-5}\, mg/kg/day \times 0.020 (mg/kg/day)^{-1} = 5.7\times10^{-7}$

[11] $CancerRisk = 2.84\times10^{-5}\, mg/kg/day \times 0.40 (mg/kg/day)^{-1} = 1.1\times10^{-5}$

[12] $CancerRisk = 3.91\times10^{-4}\, mg/kg/day \times 0.020 (mg/kg/day)^{-1} = 7.8\times10^{-6}$

[13] $CancerRisk = 3.91\times10^{-4}\, mg/kg/day \times 0.040 (mg/kg/day)^{-1} = 1.6\times10^{-5}$

PCE measured in indoor air. Based on theoretical cancer risk calculations performed using conservative assumptions and indoor air concentrations measured prior to SSDS installation, we do not expect unusual risks of cancer as a result of opportunities for PCE exposure.

The levels of TCE measured in the indoor air both before and after installation of the SSDS at the residence were below EMEGs for short term and intermediate exposure and below EPA Reference Concentration levels (RfCs) for chronic exposure. Calculations of theoretical cancer risk showed no unusual risk of cancer due to the indoor air exposure to this contaminant.

Although no adverse non-cancer health effects or unusual risk of cancer would be expected based on the levels of PCE and TCE in the home, the MDPH is providing the following general health information on possible health effects of exposure to these chemicals at higher levels.

Tetrachloroethylene is widely used for dry-cleaning and in metal degreasing, and is used in the manufacture of other chemicals and materials. It is known as PCE, perc, tetrachloroethene, perclene and perchlor. It is a nonflammable liquid at room temperature and evaporates easily into the air. PCE is said to have a sharp, sweet odor which many people can smell at a concentration of about 1 ppm in air [ATSDR 1997a].

PCE can be found in a variety of consumer products, including cleaners for fabric and wood, and is still used in dry cleaning of clothing. Studies have shown that homes where dry cleaned clothing is often brought in have higher levels of PCE than other similar homes [ATSDR 1997a]. People who work in dry cleaning businesses may be exposed to PCE. The Occupational Safety and Health Administration (OSHA) has set a limit for occupational exposures to PCE as 100 ppm as an 8-hour time weighted average in a 40-hour week [OSHA 1997].

Most PCE exits the human body through the lungs, whether the PCE was inhaled or ingested. The liver also converts some of the PCE into other chemicals which are then excreted in urine. Some of the inhaled or ingested PCE can be stored for a few days or weeks inside fatty tissues, and be released over that time. Women who are exposed to PCE can excrete some of the chemical in breast milk [ATSDR 1997a].

Short-term exposures to high levels of PCE have been shown to have an anesthetic effect; the compound had been used as a medical anesthetic in the past. In animal studies, concentrations of PCE higher than 1750 ppm were fatal to rats and mice when inhaled over the short term. At lower inhalation doses, the following short-term effects have been noted in humans: respiratory or eye irritation; neurological effects on vision; sleepiness; dizziness; mood changes and other intoxication effects. In human studies, the levels at which these effects were seen were 100 ppm or higher [ATSDR 1997a]. These levels are several thousand times greater than those found in the living space the residence. Other effects have been noted for short-term inhalation exposures to PCE in animals including changes to the kidney, liver or in body weight [ATSDR 1997a].

For chronic exposure to PCE, in human studies, liver changes were observed in a study where the average inhalation exposure was approximately 15 ppm for about 20 years. Kidney changes and problems were observed for occupational exposures of 10-15 ppm over several years. At similar levels, human occupational studies have also shown some neurological effects, such as headache, dizziness, color vision loss and increased reaction times. The levels in these studies are based on occupational exposures, for example an 8-hour workday, 40-hour workweek, for adults [ATSDR 1997a]. This leaves some uncertainty in extrapolating risk for infants and children, and in people who are exposed in the home rather than at work, but these levels, which represent the lowest levels at which adverse effects were seen, are about a thousand times higher than the levels seen inside the residence evaluated in this health consultation.

Other effects are seen in experiments performed on rodents such as mice or rats, including liver or kidney damage at exposure levels similar to the human studies. In rats, endocrine and stomach problems were also seen, and in mice there were also respiratory problems observed. [ATSDR 1997a]

No studies are available showing effects of chronic PCE exposure on the immune system in humans; increased susceptibility to bacterial infections of the lungs was seen in mice exposed to PCE levels of 50 ppm over a short term [ATSDR 1997a].

In occupational studies, some adverse reproductive effects in women have been reported, including menstrual problems and spontaneous abortions. The ATSDR considers these reports to be limited because the studies were small, didn't have associated exposure data, and/or didn't control for other factors, such as smoking and alcohol. Other studies of occupationally-exposed women did not show this correlation. In rats, reproductive effects were seen in studies where the exposures were high enough to also cause sedation in the pregnant rats. Lower levels, at or below 300 ppm, had no observable effect on pup size and survival [ATSDR 1997a].

No human studies are available regarding developmental effects. For animals, including mice, rats and guinea pigs, developmental changes and problems were observed with exposure levels of 100 ppm or higher to the pregnant animals [ATSDR 1997a].

Trichloroethylene, also known as Triclene and Vitran, is a nonflammable colorless liquid with a sweet odor and sweet burning taste. It is now mainly used as a degreasing solvent and is present in some household products [ATSDR 1997b]. About half of the TCE that is inhaled is exhaled from the body quickly while the other half may enter the blood or other organs. The liver changes the TCE into other compounds which are excreted in urine. Most of the TCE is excreted in breath or urine within about a day, although some amount can be briefly stored in body fat [ATSDR 1997b].

At high concentrations, TCE is an anesthetic, causing sleepiness and potentially, death when inhaled. Other lung damage has been reported with short-term inhalation doses on the order of 500 ppm. Similarly high levels have also been shown to cause heart arrhythmias. There is less information available on the effects of TCE on the kidneys. Some effects on the liver are seen with chronic inhalation exposure to levels significantly above those found in the residence [ATSDR 1997b].

Chronic exposure to TCE at levels over 35 ppm has been shown to decrease body weight. The lowest observable neurological effects were found at or above 100 ppm for short-term effects and at or above 10 ppm for chronic effects [ATSDR 1997b]

Occupational exposures to TCE may be associated with reproductive and developmental effects such as spontaneous abortions and abnormal sperm, but the specific effects of TCE in these studies is hard to determine

The indoor air data for the subject residence evaluated above is limited to two samples prior to the installation of the SSDS, one each from the basement and first floor. This, therefore, represents a snapshot of conditions in the house at the time of sampling. Indoor air sampling results can also be affected by various conditions inside the house, including temperature, ventilation rates, activities of the residents, and other sources of chemicals. Current information does not allow us to precisely know the duration of time that the residents may have been exposed to chemicals from this release; if additional information about this, such as a model of groundwater contaminant flow, becomes available, upon request, the MDPH will evaluate it.

VI. CONCLUSIONS

Based on the evaluation and analysis above, there are several conclusions that can be drawn:

- An evaluation of sampling results does not appear to suggest that acute or chronic exposure to the detected concentrations would be expected to result in non-cancer health impacts.
- Using conservative exposure assumptions, MDPH evaluated whether short- or long-term exposures to PCE measured in indoor air may result in an increased risk of adverse health effects. Based on this analysis, chronic exposures to the concentrations of PCE measured in indoor air do not suggest unusual risks of cancer to the child or the adult.
- Using conservative exposure assumptions, MDPH evaluated whether short- or long-term exposures to TCE measured in indoor air may result in an increased risk of adverse health effects. Based on this analysis, chronic exposures to the concentrations of TCE measured in indoor air do not suggest unusual risks of cancer to the child or the adult.
- Based on the information evaluated by MDPH, adverse health effects are unlikely to result from exposure opportunities during gardening activities at the community garden locations evaluated, or in surface soils in the residential yard since no contamination was found at these locations.

ATSDR requires that one of five conclusion categories be used to summarize findings of a health consultation. These categories are as follows: (1) Urgent Public Health Hazard; (2) Public Health Hazard; (3) Indeterminate Public Health Hazard; (4) No Apparent Public Health Hazard; (5) No Public Health Hazard. A category is selected on the basis of site-specific conditions, such as the degree of public health hazard based on the presence and duration of human exposure, contaminant concentration, the nature of toxic effects associated with site-related contaminants, the presence of physical hazards, and community health concerns. Based on the evaluation of potential exposure to indoor air contaminants described above, ATSDR would conclude that exposures pose "no apparent public health hazard" presently and in the future provided the SSDS remains in use. Because no indoor air data were available prior to 2007, ATSDR would classify past exposures as posing an "indeterminate public health hazard". ATSDR would classify exposures to contaminants in garden or residential soils as posing "no public health hazard" due to the lack of exposure to PCE, TCE or the other chlorinated volatile organic compounds in these soils.

VII. RECOMMENDATIONS

Based on this evaluation, the following actions are recommended for the residents:

- Ensure that the SSDS at the residence continues to be operational. Consultants should be asked to operate and test the system as well as test the indoor air to ensure correct functioning. Keep records of any sampling, maintenance or other activities performed on this system. As long as this system is functioning properly, the indoor air exposures to any contaminants from the plume in the nearby groundwater would be expected to be mitigated.
- The residents should continue to work with their personal physicians about any health concerns they may have. MDPH staff are available for consultation with medical providers.

VIII. PUBLIC HEALTH ACTION PLAN

The purpose of the Public Health Action Plan is to ensure that this health consultation not only identifies potential public health hazards, but also provides a plan of action designed to mitigate

and prevent adverse health effects resulting from exposure to hazardous substances in the environment. Included is a commitment on the part of ATSDR/MDPH to follow up on this plan and ensure that it is implemented. The public health actions to be implemented by ATSDR/MDPH are as follows:

- Upon request, MDPH is available to assist residents in interpretation of any medical test results related to past exposures.
- Upon request, MDPH will review additional environmental data provided by concerned residents of this area.

IX. REFERENCES

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PREPARER

This document was prepared by the Bureau of Environmental Health of the Massachusetts Department of Public Health. If you have any questions about this document, please contact Suzanne K. Condon, Director of BEH/MDPH at 250 Washington Street, 7th Floor, Boston, MA 02108.

CERTIFICATION

The Health Consultation, *Evaluation of Community Health Concerns Related to a Tetrachloroethylene (PCE) Release Site 50 Tufts Street Somerville, Massachusetts Middlesex County,* was prepared by the Massachusetts Department of Public Health under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with approved methodology and procedures existing at the time the Health Consultation was initiated. Editorial review was completed by the cooperative agreement partner.

Technical Project Officer, CAT, SPAB, DHAC, ATSDR

The Division of Health Assessment and Consultation, ATSDR, has reviewed this Health Consultation and concurs with its findings.

Team Lead, CAT, SPAB, DHAC

TABLES AND FIGURES

TABLE 1. INDOOR AIR SAMPLING RESULTS AND APPLICABLE COMPARISON VALUES

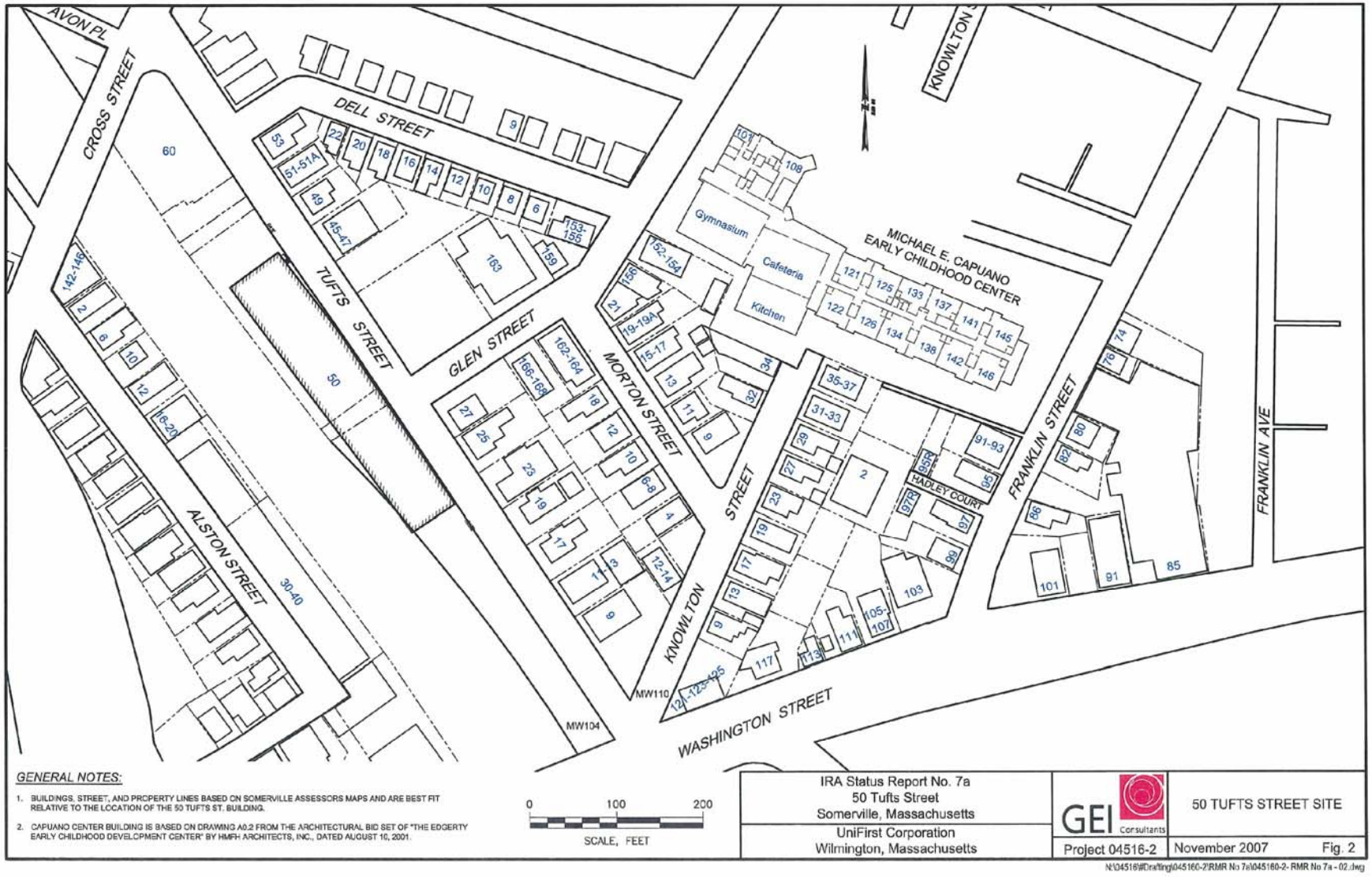
Date/location	Units	4/18/07 (initial)[1]		6/5/07 (1st confirmatory)[2]		8/23/07 (2nd confirmatory)[3]		Comparison value
		Basement	1st floor	Basement	1st floor	Basement	1st floor	
Carbon tetrachloride	µg/m^3	<1.3	0.75 J	<6.3	0.88 J	0.69 J	0.69 J	CREG = 0.01 ppb Chronic EMEG/MRL = 30 ppb Intermed. EMEG/MRL = 30 ppb
	ppbV	<0.02	0.12 J	<1.0	0.14 J	0.11 J	0.11 J	
Tetrachloroethylene (PCE)	µg/m^3	106	35	8.1	19	3.5	2.3	Chronic EMEG/MRL = 40 ppb Acute EMEG/MRL = 200 ppb
	ppbV	15.6	5.1	1.2	2.8	0.52	0.34	
1,1,1-trichloroethane	µg/m^3	0.98 J	<1.1	<5.5	<1.1	<1.1	<1.1	Intermed. EMEG/MRL = 700 ppb Acute EMEG/MRL = 2,000 ppb
	ppbV	0.18 J	<0.20	<1.0	<0.20	<0.20	<0.20	
Trichloroethylene (TCE)	µg/m^3	2.7	1.1	<5.4	0.75 J	<1.1	<1.1	Chronic RfC = 40 µg/m^3 (7.6 ppbV) Intermed. EMEG/MRL = 100 ppb Acute EMEG/MRL = 2,000 ppb
	ppbV	0.51	0.20	<1.0	0.14 J	<0.20	<0.20	

Notes:
1. This sampling was conducted prior to the installation of an SSDS
2. This sampling was conducted after installation of an SSDS
3. this sampling was conducted following the installation of a second extraction point for the SSDS along with other basement modifications

µg/m^3 = micrograms per cubic meter. A microgram is 10^{-6} grams.
ppbV = parts per billion volume.
The ratio between µg/m^3 and ppmV is a function of the molecular weight of the compound
Values flagged with a "J" are estimated values between the method detection limit and the method quantification limit
Values with a "<" were not detected in the sample at the quantification limit shown after the ":<"
Values marked in bold are the maximum detected in the units as the relevant comparison values.
CREG = Cancer risk Evaluation Guide used to determine if cancer risks may be above 10^{-6}
EMEG = Environmental Media Evaluation Guide
RfC = Reference Concentration from USEPA

[GEI 2007a, GEI 2007d, ATSDR 2007, USEPA 2001]

Figure 1. Area Map



[GEI 2007d]