Letter Health Consultation

Evaluation of 2016–2018 Workplace Indoor Air Trichloroethylene

CHEM-FAB

DOYLESTOWN, BUCKS COUNTY, PENNSYLVANIA

EPA FACILITY ID: PAD002323848

Prepared by the
Pennsylvania Department of Health

May 2, 2019

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

Health Consultation: A Note of Explanation

A health consultation is a verbal or written response from ATSDR or ATSDR's Cooperative Agreement Partners to a specific request for information about health risks related to a specific site, a chemical release, or the presence of hazardous material. In order to prevent or mitigate exposures, a consultation may lead to specific actions, such as restricting use of or replacing water supplies; intensifying environmental sampling; restricting site access; or removing the contaminated material.

In addition, consultations may recommend additional public health actions, such as conducting health surveillance activities to evaluate exposure or trends in adverse health outcomes; conducting biological indicators of exposure studies to assess exposure; and providing health education for health care providers and community members. This concludes the health consultation process for this site, unless additional information is obtained by ATSDR or ATSDR's Cooperative Agreement Partner which, in the Agency's opinion, indicates a need to revise or append the conclusions previously issued.

The Pennsylvania Department of Health (PADOH) prepared this Letter Health Consultation (LHC) for the Chem-Fab site, located in Doylestown, Bucks County, Pennsylvania. This publication was made possible by grant number CDC-RFA-TS17-170103CONT19 under a cooperative agreement with the Agency for Toxic Substances Disease Registry (ATSDR). The PADOH evaluated data of known quality using approved methods, policies, and procedures existing at the date of publication. ATSDR reviewed this document and concurs with its findings based on the information presented by the PADOH.

You may contact

PADOH at 717-787-3350 or Env.health.concern@pa.gov
or visit https://www.health.pa.gov/topics/envirohealth/Pages/Assessment.aspx
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Chem-Fab

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To: Eduardo Rovira, On-Scene Coordinator, U.S. Environmental Protection Agency Region 3

From: Sasidevi Arunachalam, Epidemiology Program Specialist, Health Assessment Program, Division of Environmental Health Epidemiology, Pennsylvania Department of Health

Subject: Evaluation of 2016–2018 workplace indoor air trichloroethylene concentrations after installation of sub-slab vapor intrusion mitigation system at the Chem-Fab site, follow-up and recommendations

Date: May 2, 2019

The Environmental Protection Agency (EPA) Region 3 requested the Agency for Toxic Substances and Disease Registry (ATSDR) and the Pennsylvania Department of Health (PADOH) to determine whether the remedial actions implemented by EPA at the Chem-Fab site (the site) protect commercial office workers from exposure to trichloroethylene (TCE). Based on recommendations made in the previous letter health consultation (LHC) for the site [ATSDR 2015], EPA Region 3 installed a vapor intrusion mitigation system to remove TCE from sub-slab soil gas and to prevent migration into indoor air [EPA 2017]. EPA Region 3 collected air data before and after the system installation and shared April 2015 through March 2018 data with ATSDR and PADOH and requested to evaluate for any adverse health effects. Based on evaluation of the post installation (January 2016 through March 2018) data, PADOH concludes that breathing indoor air containing the detected levels of TCE is not expected to harm people's health. Based on our evaluation there is no further recommendation for the site, provided that the air quality inside the office locations remain below the levels of health concern.

The remainder of this LHC presents detailed information in support of PADOH's data analysis and conclusion.

Background

The site is located on North Broad Street in Bucks County, Doylestown, PA. An electroplating and metal processing facility operated on-site from 1965–1994. The facility stored and disposed of waste chemicals on the property contaminating the soil and groundwater underlying the site. In 1970s, Pennsylvania Department of Environmental Protection (PADEP) received several odor complaints from property owners adjacent to the site. In 1972, PADEP conducted inspections at the site and identified and removed 9,500-gallon tanks of acid and sludge. In 1986, PADEP completed a preliminary assessment and reported contamination of TCE, chromium, caustics and electroplating wastes at the site. In August 1987, EPA performed a site inspection and found that private wells in the surrounding area were contaminated with volatile organic compounds such as TCE and tetrachloroethylene. In October 1987, EPA provided bottled water and carbon filtration units to the affected residences and then connected affected residences to the public water system. As a remedial action in 1994, EPA removed 117 drums of chemicals and 8,400 gallons of liquid waste buried at the site. In 1999, the site underwent renovations and on-site soil was removed and covered with pavement and concrete. The site has been used as commercial

business office locations and as a warehouse storage facility since 1999 [EPA 2016]. In March 2008, the site was added to the National Priorities List. In 2009, as an early remedial action plan, EPA conducted vapor intrusion investigation inside the commercial office buildings to determine the extent of contamination at the site. In 2010, EPA detected TCE concentrations in indoor air at the site that were determined to be associated with on-site vapor intrusion from subsurface water and soil contamination beneath the structures. Vapor intrusion occurs when volatile chemicals in soil and groundwater volatilize and enter a structure through its foundation and build up inside. In 2010, EPA initiated vapor intrusion mitigation at the site [EPA 2016]. Sampling events prior to activation of mitigation showed a maximum indoor air TCE concentration of 225 micrograms per cubic meter ($\mu g/m^3$) (see Appendix, Table A). Following the activation of vapor intrusion mitigation in August 2012, the maximum detected TCE level was 17 $\mu g/m^3$, but this was elevated in comparison to the available screening levels such as EPA's Reference Concentration (RfC) of 2 $\mu g/m^3$, ATSDR's Chronic Minimum Risk Level (cMRL) of 2.1 $\mu g/m^3$ and the Cancer Risk Evaluation Guide (CREG) of 0.21 $\mu g/m^3$ [ATSDR 2013]. Hence, temporary air filtration units were installed at each office location to further reduce TCE levels. Follow-up sampling in January 2013 showed a decrease in TCE levels; however, levels were still elevated ranging from non-detect (ND) to 5 $\mu g/m^3$. Since the filtration units were not operated continuously, TCE levels fluctuated (ND–27 $\mu g/m^3$) over time from 2013–2015 (see Appendix, Table A) and posed non-cancer health concerns for sensitive populations such as pregnant women [ATSDR 2015]. Based on the April 2015 results, PADOH and ATSDR recommended that EPA implement a permanent remedy to reduce TCE exposure. In October 2015, EPA installed a permanent active sub-slab vapor intrusion mitigation system (a new depressurization/active venting system similar to radon mitigation systems) and monitored the indoor air to determine the effectiveness of the new system. EPA shared the indoor air sampling results, conducted in April 2015, June 2015 (pre-installation), January 2016, March 2016, January 2017, December 2017 and March 2018 (post-installation) with ATSDR and PADOH.

Environmental Data and Screening

Table 1 summarizes maximum indoor air TCE concentrations detected in office locations 300, 310, 314, 322, 324, 328 and 330 as well as ambient air behind 300 on April 2015, June 2015, January 2016, March 2016, January 2017, December 2017 and March 2018. In January 2017 there was slight increase in indoor TCE levels. This may be because a portion of the mitigation system had been turned off, as noted by EPA during one of their reconnaissance site visits. Table 1 also has the adjusted values for the maximum indoor air TCE concentration detected at each of those office locations after the installation of the permanent sub-slab vapor intrusion mitigation system (see Appendix for calculations). A few other office locations (320, 327, 329, 334, 338, and 360) were also monitored during the December 2017 and March 2018 monitoring periods. In those locations, the TCE levels were mostly non-detects and below the screening levels. A summary of sub-slab TCE levels monitored before and after the installation of permanent active sub-slab vapor intrusion mitigation system is given in Table B in Appendix. Higher levels of TCE in sub-slab before the mitigation indicates a potential source of varying indoor air contamination of TCE measured prior to permanent mitigation. However, TCE levels in sub-slab/indoor air has been substantially reduced/mitigated after the installation of permanent sub-slab vapor intrusion mitigation system. The active vapor mitigation system creates negative

pressure in sub-slab and by use of fan-powered vent keeps the vapors out from beneath the slab. The substantial decrease in sub-slab concentration may be due to indoor air drawn down through the slab or ambient air drawn from the edge of the foundation [McHugh et al 2017]. This substantial decrease in sub-slab concentration is a strong sign that the vapor mitigation system is working [EPA 2016a]. A significant reduction in sub-slab TCE concentration has been reported in other studies of vapor mitigation systems [MassDEP 2016].

Table 1: Maximum indoor air TCE concentrations detected before and after installation of sub-slab vapor intrusion mitigation system and adjusted exposure concentration at each office locations from January 2016–March 2018

Office location	Pre-installation of permanent sub-slab vapor intrusion mitigation system µg/m^3		Post-installation of permanent sub-slab vapor intrusion mitigation system µg/m^3					Adjusted exposure concentration calculated from maximum detected value from 2016–2018 period* µg/m^3
	April 2015	June 2015	January 2016	March 2016	January 2017	December 2017	March 2018	
300	7.00	1.00	1.00	1.00	**3.00**	NA	1.70	1.00
310	3.00	2.00	ND	ND	**1.00**	ND	ND	0.34
314	5.00	3.00	NA	NA	NA	NA	NA	NA
322	NA	10.00	**1.00**	0.30	ND	NA	NA	0.34
324	9.00	12.00	ND	ND	**0.20**	NA	NA	0.07
328	11.00	12.00	ND	ND	**0.50**	NA	NA	0.17
330	18.00	14.00	ND	0.2	**0.50**	NA	NA	0.17
Ambient Air (behind 330)	ND	ND	ND	ND	ND	NA	NA	ND

NA: not available/not tested; ND: not detected, level of detection 0. 13 µg/m^3; Bolded value indicates 24-hour maximum value detected at each office location after the installation of permanent sub-slab vapor intrusion mitigation system; * the bolded 24-hour maximum indoor air TCE concentrations detected were adjusted for a 10-hour work day assuming exposure for 10 hours per day, 6 days per week, 50 weeks per year (see Appendix for calculations).

Public Health Implications of TCE in Indoor Air

The 24-hour maximum indoor air TCE concentrations detected (2016–2018) after the installation of the permanent sub-slab vapor intrusion mitigation system were below non-cancer screening levels (ATSDR's cMRL of 2.1 µg/m^3 and the EPA's RfC of 2 µg/m^3) for all office locations except office location 300 (3 µg/m^3). For more information on adverse non-cancer health effects associated with TCE exposure, refer to our previous health consultation [ATSDR 2015]. The 24-hour maximum indoor air TCE concentrations at office locations 300, 310, 322, 328, and 330 exceeded the CREG level of 0.22 µg/m^3. However, in an occupational setting, 24 hours of

continuous exposure to a given worker is unlikely. To evaluate potential health effects for workers, PADOH calculated an adjusted exposure concentration based on site-specific exposure assumptions [ATSDR 2005]. Adjusted exposure concentrations were calculated by multiplying an exposure factor by the maximum concentration detected at each office location after the installation of the permanent sub-slab vapor intrusion mitigation system. The exposure factor is an expression of how often and how long a person may be exposed to a contaminant. The exposure factor is calculated by multiplying exposure time with the frequency of exposure and the exposure duration (see Appendix). For this site, full-time workers are assumed to be at the facility for ten hours per day, six days per week and fifty weeks per year. The adjusted exposure concentration is then compared to the available screening levels (cMRL or RfC and CREG) to estimate potential health risks.

The adjusted exposure concentration at office location 300 (assuming a full-time worker's maximum exposure of 10-hours per day, 6 days per week and 50 weeks per year—see Appendix for calculations) was 1.0 $\mu g/m^3$ and was below ATSDR's cMRL (2.1 $\mu g/m^3$) and EPA's RfC (2 $\mu g/m^3$). Therefore, non-cancer health effects such as hepatic, renal, neurological, immunological, reproductive, and developmental effects are not expected from exposure to detected TCE levels. The adjusted exposure concentration at office locations 328 and 330 (0.17 $\mu g/m^3$ for both locations) were below the CREG value of 0.21 $\mu g/m^3$. However, the adjusted exposure concentration at office locations 300, 310 and 324 (1.0 $\mu g/m^3$, 0.34 $\mu g/m^3$, 0.34 $\mu g/m^3$ respectively) exceeded the CREG value and were further evaluated to determine potential cancer risk.

Cancer Risk Evaluation

The US Department of Health and Human Services has classified TCE as "known to be a human carcinogen" [DHHS 2016]. Background indoor air TCE concentrations in the United States are 1.0 $\mu g/m^3$ or less when a local, external TCE source is not present [EPA 2011]. EPA has characterized TCE as "carcinogenic to humans" by all routes of exposure and has estimated an inhalation unit risk (IUR) of 4.1×10^{-6} per $\mu g/m^3$ of daily exposure over a lifetime [EPA 2011a].

PADOH estimated the excess cancer risk by multiplying the highest exposure concentration of 1.0 $\mu g/m^3$ with EPA's IUR, and the number of years exposed. Based on occupational inhalation exposure scenario, PADOH assumed the number of years exposed to be 20 years since the office locations have been in operation at the site since 1999. The estimated cancer risk at all locations (300, 310, and 324) was very low i.e., approximately one in a million (1.1×10^{-6}) or less based on a 20-year exposure duration (see Appendix). All the uncertainties and the conservative exposure assumptions associated with the dose calculations were included in the risk estimation [ATSDR 2005]. In addition, the adjusted exposure concentrations at all locations were similar to or less than background indoor air TCE concentrations (1.0 $\mu g/m^3$) and do not pose significant cancer risk to workers at the site.

Conclusions

PADOH concludes that breathing indoor air containing detected levels of TCE is not expected to harm people's health. The interpretation provided in this LHC is based on the 2016–2018 indoor air data.

Recommendations

Based on evaluation of current information available there is no further recommendation for the site, provided that the air quality inside the office locations remains below the levels of health concern, and the permanent sub-surface vapor intrusion remediation system is properly maintained and monitored.

Public Health Action Plan

PADOH will ensure that the community advisory group of Doylestown is aware of the findings of this consultation.

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Appendix

Calculations
Adjusted Exposure Concentration and Cancer Risk Calculations

EC = CA x Exposure Factor
Where:
EC ($\mu g/m^3$) = adjusted exposure concentration;
CA ($\mu g/m^3$) = contaminant concentration in air;

Exposure Factor = ET x EF x ED
Where:
ET (hours/day) = exposure time;
EF (days/week) = exposure frequency;
ED (weeks/year) = exposure duration

Exposure Factor for this site:

Assuming the employee works for 10 hours per day, 6 days per week, and 50 weeks per year:

ET = 10 hours/24 hours; EF = 6 days/7 days; ED = 50 weeks/52 weeks

$$\text{Exposure Factor} = \frac{10 \text{ hours}}{24 \text{ hours}} \times \frac{6 \text{ days}}{7 \text{ days}} \times \frac{50 \text{ weeks}}{52 \text{ weeks}} = 0.34$$

EC for maximum measured air concentration of 3 $\mu g/m^3$

EC = Exposure Factor x CA

$$= 0.34 \times 3 \ \mu g/m^3 = 1.0 \ \mu g/m^3$$

Estimating Excess Cancer Risk

CR = EC x IUR x EY/78 years
Where:
CR = cancer risk
IUR = inhalation unit risk = $0.0000041/\mu g/m^3$
EC = adjusted exposure concentration = 1.0 $\mu g/m^3$
EY = exposure years = 20 years

Example: Cancer risk calculation for 20 years of exposure for adjusted exposure concentration of 1.0 $\mu g/m^3$

$CR = 0.000004 \ (\mu g/m^3)^{-1} \times 1.0 \ \mu g/m^3 \times 20 \text{ years} / 78 \text{ years} = 1.1 \times 10^{-6}$

Table A: Summary of Maximum Indoor Air TCE Concentration Detected at Office Locations Before and After Installation of Various Mitigation Systems from October 2011 – March 2018

Office Locations	Pre-activation of Mitigation System $\mu g/m^3$		Post-activation of Mitigation System $\mu g/m^3$	Post-installation of Temporary Air Filtration Units $\mu g/m^3$					Permanent Sub-Slab Vapor intrusion mitigation System $\mu g/m^3$				
	Oct. 2011	Jan. 2012	Aug. 2012	Jan. 2013	Apr. 2014	Jan. 2015	Apr. 2015	Jun. 2015	Jan. 2016	Mar. 2016	Jan. 2017	Dec. 2017	Mar. 2018
300	81	78	6	5	20	19	7	1	1	1	3	NA	1.7
310	53	22	4	4	NA	3	3	2	ND	ND	1	ND	ND
314	225	6	5	1	NA	4	5	3	NA	NA	NA	NA	NA
322	26	18	15	ND	NA	11	13	10	1	0.3	ND	NA	NA
324	18	NA	15	ND	NA	ND	9	12	ND	ND	0.2	NA	NA
328	29	27	17	ND	12	ND	11	12	ND	ND	0.5	NA	NA
330	45	44	0.3	ND	25	27	18	14	ND	0.2	0.5	NA	NA
Ambient Air (behind 330)	NA	ND	6	3	NA	ND	ND	ND	ND	ND	ND	NA	NA

NA: not available /not tested; ND: not detected

Table B: Summary of Sub-slab TCE Concentrations in $\mu g/m^3$

Office Locations	Sub-slab Levels							
	Pre-installation of Sub-slab Vapor Mitigation System			Post-installation of Sub-Slab Vapor Mitigation System				
	Jan. 2013	Jan. 2015	Apr. 2015	Jan. 2016	Mar. 2016	Jan. 2017	Dec. 2017	Mar. 2018
300	4,120	6,500	5,500	10	24	207	NA	2.5
314	4.30	NA	NA	1.20	ND	ND	NA	NA
322	997	2,600	2,000	1.30	ND	2.10	NA	NA
324	24,700	58,000	50,000	19	11	8.60	NA	NA

NA: not available /not tested; ND: not detected