Letter Health Consultation

SHERWIN-WILLIAMS/HILLIARDS CREEK SUPERFUND SITE

GIBBSBORO, CAMDEN COUNTY, NEW JERSEY

Prepared by
New Jersey Department of Health

SEPTEMBER 15, 2017

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

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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September 15, 2017

Ray Klimcsak
Remedial Project Manager
U.S. EPA, 290 Broadway 19th Floor
New York, New York, 10007-1866

Dear Mr. Klimcsak:

This Letter Health Consultation (LHC) has been completed by the New Jersey Department of Health (NJDOH) through a cooperative agreement with the federal Agency for Toxic Substances and Disease Registry (ATSDR), for the Sherwin-Williams/Hilliards Creek Superfund site located in a residential/commercial area of Gibbsboro, Camden County, New Jersey. The site includes the former facility buildings, Hilliards Creek, Kirkwood Lake and adjacent residential properties. The facility operated from 1849 to 1976 and manufactured primarily paint products. In 1981, the property was sold to a private developer. Contaminants including petroleum products and chlorinated organic compounds have been detected in the groundwater beneath the former facility.

The NJDOH prepared this LHC in response to a request by ATSDR to evaluate health impacts in historic sites with previously elevated levels of trichloroethylene (TCE). The indoor air data collection and analyses were conducted by the United States Environmental Protection Agency (USEPA) in July and December 2015. NJDOH evaluated the levels of contaminants detected at the on-site commercial buildings and concludes that, based on the levels of contaminants detected and an occupational exposure scenario, no harmful health effects are expected for workers and visitors.

The NJDOH recommends that the USEPA complete the investigation/remediation of the site as soon as feasible and monitor the indoor air. Site background and prior investigations conducted at the Sherwin-Williams/Hilliards Creek site may be found in the Public Health Assessment (ATSDR 2009) and Health Consultation (ATSDR 2010) prepared for this site.

Data from Recent USEPA Investigations

For the July and December 2015 sampling events, the USEPA collected 24-hour indoor air samples from several on-site commercial buildings[1]. The purpose of the investigation was to determine if site-related volatile organic compounds (VOCs) were impacting the interior of buildings, resulting in potential exposure to the employees. The buildings were identified for evaluation based on their location in relation to the seep area (ATSDR 2009).

The analytical results for indoor air sampling in the buildings located at 2 Foster Avenue, 4 Foster Avenue, and 3 US Avenue, Gibbsboro, New Jersey are summarized in Table A1, A2, and A3 of Appendix A, respectively[1]. The maximum concentration of most contaminants detected exceeded their respective environmental guideline comparison value.

2 Foster Avenue: The maximum concentration of 1,3-butadiene, 1,4-dioxane, acrolein, benzene, carbon tetrachloride, chloroform, chloromethane, naphthalene, tetrachloroethylene (PCE), and TCE detected in indoor air at 2 Foster Avenue exceeded their respective environmental guideline comparison values (CVs); they were considered as the contaminants of potential concern (COPC) for the building (see Table A1, Appendix A).

4 Foster Avenue: The maximum concentration of 1,4-dioxane, acrolein, benzene, carbon tetrachloride, chloroform, naphthalene, PCE, and TCE detected in indoor air at 4 Foster Avenue exceeded their respective environmental guideline CVs; they were considered as the COPCs for the building (see Table A2, Appendix A).

3 US Avenue: The maximum concentration of 1,3-butadiene, acrolein, benzene, carbon tetrachloride, chloroform, naphthalene, PCE, and TCE detected in indoor air at 3 US Avenue exceeded their respective environmental guideline CVs; they were considered as the COPCs for the building (see Table A3, Appendix A).

It should be noted that extremely elevated levels of methane were detected in sub-surface soil gas. Levels as high as 5% (i.e., 50,000 ppm) Lower Explosive Limit (LEL) were found throughout the sub slabs of buildings (2 and 4 Foster Avenue and 3 US Avenue). The USEPA's Removal Action Branch, in cooperation with the responsible party/building owner has implemented several emergency controls in the buildings to address the presence of indoor air contaminants including methane. The controls included installation of permanent LEL/methane monitors, sealing of sumps, sealing of floor cracks, modification of HVAC system and installation of passive sump vents with wind-vane type vent caps to minimize build-up of contaminants and pressure below the building slabs.

[1]Number of samples collected from 2 Foster Av., 4 Foster Av. and 3 US Av. were 6, 4 and 1, respectively. Sub-slab samples were collected but not presented in this LHC

Discussion

The method for assessing whether a health hazard exists to a community is to determine whether there is a completed exposure pathway from a contaminant source to a receptor population, and whether exposures to contamination are high enough to be of health concern (ATSDR 2005). As mentioned above, the elevated levels of contaminants in the indoor air of the occupied commercial buildings confirm the completed inhalation pathway. Exposed individuals include adults (including females of child-bearing age) working in the on-site commercial buildings. Based on the occupational exposure scenario, site-specific adjusted exposure concentrations can be calculated and compared with environmental guideline CVs.

The indoor air samples were collected over a 24-hour period. In an occupational setting, people work either full or part-time. Full-time workers are assumed to be in the building for eight hours per day for five days a week. Part-time workers and visitors are assumed to be on-site for two hours per day for four days per week, or four hours per day for five days per week. All workers and visitors are assumed to take two weeks of vacation per year, so the exposure was also adjusted to 50 weeks per year. Therefore, to evaluate the potential health effects of the COPCs, the adjusted exposure concentrations were calculated using a range of site-specific exposure scenarios.

The adjusted concentrations were calculated by multiplying the maximum concentration of the chemical by adjustment factors (see Table 1). The adjusted 24-hour concentrations of 1,4-dioxane, acrolein, benzene, carbon tetrachloride, chloroform and TCE in 2 Foster Avenue, acrolein, benzene, chloroform, naphthalene and TCE in 4 Foster Avenue and, acrolein, benzene, chloroform and TCE in 3 US Avenue exceeded the environmental guideline CVs (see Table 1); they were considered as the contaminant of concern (COC) for the buildings.

Non-Cancer Health Effects – To assess the possibility of non-cancer health effects, ATSDR has developed Minimal Risk Levels (MRLs) for contaminants that are commonly found at hazardous waste sites (ATSDR 2005). An MRL is an estimate of the daily human exposure to a hazardous substance at or below which that substance is unlikely to pose a measurable risk of adverse, non-cancer health effects over a specified duration of exposure. MRLs are usually extrapolated from observed effect levels in animal toxicological studies or occupational studies, and are adjusted by a series of uncertainty (or safety) factors or through the use of statistical models. In toxicological literature, effect levels include:

- no-observed-adverse-effect-level (NOAEL); and
- lowest-observed-adverse-effect-level (LOAEL).

NOAEL is the highest tested dose/concentration of a substance that has been reported to have no harmful (adverse) health effects on people or animals. LOAEL is the lowest tested dose/concentration of a substance that has been reported to cause harmful (adverse) health effects in people or animals. To provide additional perspective on these health effects,

Table 1: Adjusted 24-hour indoor air concentrations

Contaminant	Concentration (µg/m³)					COC[a]
	Max.	Adjusted 24-hour			Environmental Guideline CV[e]	
		8-hrs.[b]	4-hrs.[c]	2-hrs.[d]		
2 Foster Avenue						
1,3-Butadiene	0.056	0.013	0.0061	0.0022	0.033 (CREG[f])	No
1,4-Dioxane	9.2	2.116	1.012	0.368	0.2 (CREG)	**Yes**
Acrolein	2.2	0.506	0.242	0.088	0.02 (RfC[g])	**Yes**
Benzene	1.1	0.253	0.121	0.044	0.13 (CREG)	**Yes**
Carbon Tetrachloride	9.6	2.208	1.056	0.384	0.17 (CREG)	**Yes**
Chloroform	0.98	0.225	0.1078	0.039	0.043 (CREG)	**Yes**
Chloromethane	3	0.69	0.33	0.12	94 (RSL[h])	No
Naphthalene	11	2.53	1.21	0.44	3.7 (EMEG[i]/MRL[j])	No
PCE[k]	5	1.15	0.55	0.2	3.8 (CREG)	No
TCE[l]	4.3	0.989	0.473	0.172	0.22 (CREG)	**Yes**
4 Foster Avenue						
1,3-Butadiene	0.055	0.01265	0.006	0.0022	0.033 (CREG)	No
1,4-Dioxane	0.85	0.1955	0.0935	0.034	0.2 (CREG)	No
Acrolein	2.4	0.55	0.264	0.096	0.02 (RfC)	**Yes**
Benzene	1.7	0.391	0.187	0.068	0.13 (CREG)	**Yes**
Carbon Tetrachloride	0.45	0.1035	0.0495	0.018	0.17 (CREG)	No
Chloroform	2.4	0.552	0.264	0.096	0.043 (CREG)	**Yes**
Naphthalene	42	9.66	4.62	1.68	3.7 (EMEG/MRL)	**Yes**
PCE	6.3	1.449	0.693	0.252	3.8 (CREG)	No
TCE	6.6	1.518	0.726	0.264	0.22 (CREG)	**Yes**
3 US Avenue						
1,3-Butadiene	0.041	0.00943	0.0045	0.0016	0.033 (CREG)	No
Acrolein	2.9	0.667	0.32	0.116	0.02 (RfC)	**Yes**
Benzene	1.6	0.368	0.176	0.064	0.13 (CREG)	**Yes**
Carbon Tetrachloride	0.43	0.099	0.047	0.017	0.17 (CREG)	No
Chloroform	0.76	0.1748	0.083	0.03	0.043 (CREG)	**Yes**
Naphthalene	13	2.99	1.43	0.52	3.7 (EMEG/MRL)	No
PCE	2.9	0.67	0.32	0.116	3.8 (CREG)	No
TCE	2.9	0.67	0.32	0.116	0.22 (CREG)	**Yes**

[a]contaminant of concern; [b]Adjustment factor = 0.23 (based on 8 hr/day, 5 days/wk and 50 wks/yr); [c]Adjustment factor = 0.11 (based on 4 hr/day, 5 days/wk and 50 wks/yr); [d]Adjustment factor = 0.04 (based on 2 hr/day, 4 days/wk and 50 wks/year); [e]comparison value; [f]ATSDR's cancer risk evaluation guide; [g]USEPA's reference concentration; [h]USEPA's regional vapor intrusion screening level for residential indoor air; [i]ATSDR's environmental media evaluation guide; [j]ATSDR's minimum risk level; [k]tetrachloroethylene; [l]trichloroethylene

the calculated exposure dose/concentrations were then compared to observed effect levels (e.g., NOAEL, LOAEL). As the exposure dose/concentrations increase beyond the MRL to the level of the NOAEL and/or LOAEL, the likelihood of adverse health effects increases.

To ensure that MRLs are sufficiently protective, the extrapolated values can be several hundred times lower than the observed or no-observed adverse effect levels in experimental studies. When MRLs for specific contaminants are unavailable, other health-based comparison values such as the USEPA Reference Concentration (RfC) may be used. The RfC is an estimate of a daily exposure concentration to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime.

<u>Noncancer Health Effects – Inhalation of Indoor Air</u>: Adults (including females of child-bearing age) working at the on-site commercial buildings are exposed to indoor air contaminants. Based on the occupational exposure scenario, site-specific adjusted exposure concentrations were calculated and compared with health guideline comparison values (see Table 2). The adjusted concentration of acrolein in 2 Foster Avenue, acrolein and naphthalene in 4 Foster Avenue, and acrolein in 3 US Avenue exceeded the corresponding health guideline CVs. The adjusted TCE concentrations did not exceed the reference concentration (RfC) for non-cancer adverse effects. An evaluation of acrolein and naphthalene is presented below:

Acrolein: Acrolein[2] has been detected in the indoor air of all three buildings (see Table 2). Acrolein is a clear or yellow liquid with a disagreeable odor (ATSDR 1990). It is used as a pesticide to control algae, weeds, bacteria, and mollusks. Toxicological information on human health effects associated with chronic exposure to acrolein is inadequate. Animal studies show that breathing acrolein causes irritation to the nasal cavity, lowers the breathing rate, and damages the lining of the lungs. The LOAEL and the uncertainty factor for acrolein are 20 $\mu g/m^3$ and 1,000, respectively. The LOAEL is based on the development of nasal lesions in a subchronic rat inhalation study. The adjusted acrolein concentrations in the three buildings (i.e., 0.5 $\mu g/m^3$, 0.55 $\mu g/m^3$, and 0.667 $\mu g/m^3$) exceeded the RfC (0.02 $\mu g/m^3$). However, the adjusted exposure concentrations were about 30 to 40 times lower than the LOAEL. Therefore, although the acrolein has been identified to have potential for non-cancer health effect (see Table 2), such effects are not expected.

Naphthalene: Naphthalene is a white solid that evaporates easily (ATSDR 1995). Fuels such as petroleum and coal contain naphthalene. It is used to manufacture polyvinyl chloride (PVC) plastics; consumer use includes moth repellents and toilet deodorant blocks. Exposure to large amounts of naphthalene may damage or destroy red blood cells. Naphthalene has caused cancer in animals. The LOAEL and the uncertainty factor for naphthalene are 9,300 $\mu g/m^3$ and 3,000, respectively. The LOAEL is based on hyperplasia and metaplasia in respiratory and olfactory epithelium, respectively. The adjusted naphthalene concentration (9.66 $\mu g/m^3$) detected in one of the buildings (4 Foster Avenue) exceeded the RfC (3.7 $\mu g/m^3$). However the adjusted exposure concentration was about 960 times lower than the LOAEL. Therefore, although

[2]It should be noted that acrolein is not currently thought to be a site related contaminant (based on the fact that the chemical can be found in many common products, e.g., perfumes, cigarette smoke and automobile exhaust, see Appendix B).

naphthalene has been identified to have potential for non-cancer health effects (see Table 2), no chronic adverse health effects are likely from naphthalene exposures.

Table 2: Comparison of adjusted (8-hour workday) exposure concentration with the noncancer health guidelines

COC[a]	Adjusted (8-hour workday) concentration (μg/m³)			ATSDR[b] MRL[c]/ USEPA[d] RfC[e] (μg/m³)	Retained for Further Evaluation		
	2 Foster	4 Foster	3 US		2 Foster	4 Foster	3 US
1,4-Dioxane	2.11	0.195	-	30 (RfC)	No	No	No
Acrolein	0.5	0.55	0.667	0.02 (RfC)	**Yes**	**Yes**	**Yes**
Benzene	0.25	0.39	0.368	9.6 (MRL)	No	No	No
Carbon Tetrachloride	2.2	0.1035	0.099	100 (RfC)	No	No	No
Chloroform	0.22	0.55	0.175	98 (MRL)	No	No	No
Naphthalene	2.5	9.6	2.99	3.7 (MRL)	No	**Yes**	No
TCE[f]	0.99	1.518	0.667	2 (RfC)	No	No	No

[a]Contaminant of Concern; [b]Agency for Toxic Substances and Disease Registry; [c]ATSDR Minimum Risk Level; [d]United States Environmental Protection Agency; [e]USEPA reference concentration; [f]Trichloroethylene

Cancer Health Effects – Inhalation of Indoor Air: The site-specific lifetime excess cancer risk (LECR) indicates the cancer potential of contaminants. LECR estimates are usually expressed in terms of excess cancer cases in an exposed population in addition to the background rate of cancer (ATSDR 2005). For perspective, the lifetime risk of being diagnosed with cancer in the United States is 42 per 100 individuals for males and 38 per 100 for females; the lifetime risk of being diagnosed with any of several common types of cancer ranges between 1 in 10 and 1 in 100 (ACS 2016). Typically, health guideline CVs (i.e,, ATSDR Cancer Risk Evaluation Guide, or CREG) developed for carcinogens are based on one excess cancer case per one million individuals (10^{-6}).

The U.S. Department of Health and Human Services (USDHHS) cancer classes for the site contaminants are presented in Table 3. The cancer classes are defined as follows:

1 = Known human carcinogen
2 = Reasonably anticipated to be a human carcinogen
3 = Not classified

Based on exposure assumptions, the LECRs were calculated by multiplying the exposure concentration by the inhalation unit risk (IUR) and adjusting for duration (see Table 3). The IUR is an estimate of the increased cancer risk from inhalation exposure to a concentration for a lifetime. The cancer risks associated with exposure to contaminants detected at on-site buildings were evaluated in an earlier health consultation (ATSDR 2009). Assuming an exposure duration of 30 years (1980 to 2010) and based on the mean concentration of contaminants detected in the indoor air, the calculated LECRs (in the 2009 ATSDR health consultation) ranged from 2 in 1,000,000 to 2 in 100,000,000 for the exposed population (ATSDR 2009).

Using maximum adjusted (8-hour workday) indoor air concentrations and an exposure duration of six years (2010 to 2016), the estimated LECRs were as high as 2 in 100,000 (i.e., in the building located at 4 Foster Avenue) which is considered to pose a very low increase in cancer risk (see Table 3). It should be noted that the calculated LECRs (based on six-year exposure duration) are much higher than the LECRs calculated in the earlier health consultation (using 30 year as exposure duration). This is because naphthalene was not detected in earlier sampling events, naphthalene has a high IUR and adjusted maximum concentration of naphthalene detected were used to calculate the LECR.

Table 3: Estimated LECR associated with potential exposure to contaminants detected in the buildings

COC[a]	Adjusted (8-hour workday) concentration (μg/m^3)			DHHS[b] Cancer class	IUR[c] (μg/m^3)$^{-1}$	LECR[d]		
	2 Foster	4 Foster	3 US			2 Foster[e]	4 Foster	3 US
1,4-Dioxane	2.11	0.195	ND[e]	2	5 x10^{-6}	8.1 x10^{-7f}	7.7 x10^{-8}	ND
Acrolein	0.5	0.55	0.067	3	-	-	-	-
Benzene	0.25	0.39	0.37	1	7.8 x10^{-6}	1.5 x10^{-7}	2.3 x10^{-7}	2.2 x10^{-7}
Carbon Tetrachloride	2.2	0.1	0.1	2	6 x10^{-6}	1 x10^{-6}	4.6 x10^{-8}	4.6 x10^{-8}
Chloroform	0.22	0.55	0.17	2	2.3 x10^{-5}	3.9 x10^{-7}	9.7 x10^{-7}	3 x10^{-7}
Naphthalene	2.5	9.6	2.99	2	3.4 x10^{-5}	6.5 x10^{-6}	2.5 x10^{-5}	7.8 x10^{-6}
TCE[g]	0.99	1.51	0.67	1	4.1 x10^{-6}	3.12 x10^{-7}	4.7 x10^{-7}	2.1 x10^{-7}

[a]Contaminant of Concern; [b]Department of Health and Human Services; [c]inhalation unit risk; [d]lifetime excess cancer risk, adjusted for 6 years (2010 to 2016); [e]No Data; [f]Example LECR calculation=(8-hour adjusted exposure concentration × IUR × Exposure Duration)/(Averaging Time) = [2.11 μg/m^3 × 5x10^{-6} (μg/m^3)$^{-1}$ × 6 years]/78 years = 8.11 x10^{-7}; [g]Trichloroethylene

<u>Conclusions</u>

The NJDOH concludes that based on an occupational exposure scenario, exposure to the measured levels of indoor air contaminants is not expected to harm the health of workers or visitors. Adjusted indoor air concentrations were well below concentrations that may result in noncancer health effects for the scenario examined. The cancer risk associated with estimated exposures is considered to be a very low increased cancer risk.

Recommendations

Currently, various operable units (i.e., seep area, groundwater, off-site areas, and residences) are being investigated/remediated by the Principal Responsible Party (PRP) with USEPA's oversight. It is recommended that EPA complete the investigation/remediation as soon as feasible and monitor the indoor air regularly.

If you have any questions, please contact me at (609) 826-4984, or by e-mail at tariq.ahmed@doh.nj.gov. Alternately, please contact Ms. Leah Graziano, Senior Regional Representative, ATSDR Region II at (732) 906-6932, or Leah.Graziano@cdc.hhs.gov.

Sincerely,

Tariq Ahmed, PhD, PE
Environmental and Occupational Health Surveillance Program

c: Eva McLanahan, PhD, Technical Project Officer, ATSDR
Leah Graziano, Senior Regional Representative, ATSDR Region II
Katharine McGreevy, MPH, PhD, Program Manager, NJDOH

References

[ACS] American Cancer Society: Cancer Facts and Figures. 2016. [accessed 2016 June 6]. Available from: http://www.cancer.org/acs/groups/content/@research/documents/document/acspc-047079.pdf

[ATSDR] Agency for Toxic Substances and Disease Registry. 1990. Toxicological profile for Acrolein. US Department of Health and Human Services, Atlanta, Georgia.

[ATSDR] Agency for Toxic Substances and Disease Registry. 1995. Toxicological profile for Polycyclic Aromatic Hydrocarbons. US Department of Health and Human Services, Atlanta, Georgia.

[ATSDR] Agency for Toxic Substances and Disease Registry. 2005. Public health assessment guidance manual (update). Atlanta: US Department of Health and Human Services.

[ATSDR] Agency for Toxic Substances and Disease Registry. 2009. Public Health Assessment Sherwin-Williams/Hilliards Creek Site, Gibbsboro, Camden County, New Jersey, Atlanta: US Department of Health and Human Services.

[ATSDR] Agency for Toxic Substances and Disease Registry. 2010. Health Consultation Sherwin-Williams/Hilliards Creek Site: Review of Soil Gas, Indoor Air and Potable Well Data, Gibbsboro, Camden County, New Jersey, Atlanta: US Department of Health and Human Services.

[USEPA] United States Environmental Protection Agency. 2011. Toxicological Profile for Trichloroethylene Appendix D. Integrated Risk Information System. Washington, DC. [updated 2011 September; accessed 2016 June 6]. Available from: https://cfpub.epa.gov/ncea/iris/iris_documents/documents/toxreviews/0199tr/Appendix_D_0199t r.pdf

Appendix A

Indoor air sampling results

Table A1: Indoor air sampling results (2 Foster Avenue)

Contaminant	No. of Samples	Concentration (µg/m³)			COPC[b]
		Range	Mean	Environmental Guideline CV[a]	
1,1,2-Trichlorotrifluoroethane	6	0.4 - 0.61	0.50	NA[c]	**Yes**
1,2,4-Trimethylbenzene	5	0.72 - 1.9	0.90	7.3 (EPA RSL[d])	No
1,2-Dichloroethane	6	0.37 - 0.7	0.53	2,400 (EMEG[e]/MRL[f])	No
1,2-Dichloropropane	2	0.067 - 0.76	0.14	4 (RfC[g])	No
1,3-Butadiene	6	0.034 - 0.056	0.04	0.033 (CREG[h])	**Yes**
1,4-Dichlorobenzene	6	0.064 - 0.084	0.07	60 (EMEG/MRL)	No
1,4-Dioxane	2	0.15 - 9.2	1.56	0.2 (CREG[i])	**Yes**
1-Butanol	4	4.1 - 220	42.67	NA	**Yes**
2,2,4-Trimethylpentane (Isooctane)	3	0.59 - 2	0.55	NA	**Yes**
2,3-Dimethylpentane	6	1.1 - 3.3	1.67	NA	**Yes**
2-Methylbutane	6	1.5 - 7.5	3.87	NA	**Yes**
2-Methylpentane	6	0.91 - 1.6	1.27	NA	**Yes**
2-Propanol (Isopropyl Alcohol)	2	8.8 - 9.7	3.08	NA	**Yes**
3-Ethyltoluene	1	1.2	0.20	NA	**Yes**
4-Methyl-2-pentanone	4	0.797 - 1.7	0.73	3,100 (NJDEP VISL)	No
Acetone	6	17 - 36	25.83	31,000 (EMEG/MRL)	No
Acrolein	5	1.4 - 2.2	1.38	0.02 (RfC)	**Yes**
alpha-Pinene	6	0.94 - 13	6.84	NA	**Yes**
Benzene	6	0.43 - 1.1	0.76	0.13 (CREG)	**Yes**
Carbon Tetrachloride	6	0.38 - 9.6	1.97	0.17 (CREG)	**Yes**
Chlorodifluoromethane (CFC 22)	6	2.3 - 10	7.17	50,000 (RfC)	No
Chloroform	6	0.35 - 0.98	0.60	0.043 (CREG)	**Yes**
Chloromethane	6	0.26 - 3	0.74	0.94 (EPA RSL)	**Yes**
Cyclohexane	6	1.6 - 2.6	1.89	6,000 (RfC)	No
Cyclohexanone	6	0.038 - 4.1	1.75	730 (EPA RSL)	No

Table A1: Cont'd.

Contaminant	No. of Samples	Concentration (µg/m³)			COPC
		Range	Mean	Environmental Guideline CV	
Dichlorodifluoromethane (CFC 12)	6	1.5 - 2.3	1.93	100 (NJDEP VISL)	No
d-Limonene	6	1.5 - 74	13.98	NA	**Yes**
Ethanol	6	2 - 230	90.50	NA	**Yes**
Ethyl Acetate	5	5.2 - 45	15.53	73 (EPA RSL)	No
Ethylbenzene	6	1 - 8.9	2.80	260 (EMEG/MRL)	No
m,p-Xylenes	6	0.85 - 11	5.13	220 (EMEG/MRL)	No
Methyl Acetate	5	0.79 - 21	4.07	NA	**Yes**
Methylcyclohexane	6	9.1 - 17	12.68	NA	**Yes**
Naphthalene	6	2 - 11	6.45	0.083 (EPA RSL)	**Yes**
n-Decane	6	1 - 2	1.42	NA	**Yes**
n-Dodecane	6	0.78 - 2.5	1.29	NA	**Yes**
n-Heptane	6	1.1 - 2.5	1.53	NA	**Yes**
n-Hexane	6	0.78 - 1.6	1.16	30 (RfC)	No
n-Nonane	2	0.7 - 1.6	0.38	21 (EPA RSL)	No
n-Octane	1	0.77	0.13	NA	**Yes**
n-Undecane	6	0.8 - 3	1.46	NA	**Yes**
o-Xylene	6	1.2 - 3.4	1.88	100 (EPA RSL)	No
Propene	6	0.76 - 3.5	2.33	NA	**Yes**
Styrene	1	3.1	0.52	850 (EMEG/MRL)	No
Tetrachloroethene	6	1.5 - 5	2.98	3.8 (CREG)	**Yes**
Tetrahydrofuran (THF)	6	2.5 - 6.4	4.58	2,000 (RfC)	No
Trichloroethene (TCE)	6	1 - 4.3	2.02	0.22 (CREG)	**Yes**
Trichlorofluoromethane (CFC 11)	5	1 - 1.4	1.02	730 (NJDEP VISL)	No

[a]Comparison Value; [b]Contaminant of Potential Concern; [c]Not Available; [d]Regional Screening Level; [e]ATSDR Environmental Media Evaluation Guide; [f]Minimum Risk Level; [g]Reference Concentration; [h]ATSDR Cancer Risk Evaluation Guide; [i]Vapor Intrusion Screening Level

Table A2: Indoor air sampling results (4 Foster Avenue)

Contaminant	No. of Detections	Concentration (µg/m³)			COPC[b]
		Range	Mean	Environmental Guideline CV[a]	
1,1,1,2-Tetrafluoroethane (HFC 134a)	1	0.7	0.17	NA[c]	**Yes**
1,1,2-Trichlorotrifluoroethane	3	0.48 - 0.58	0.387	NA	**Yes**
1,1-Difluoroethane	3	1.4 - 2.7	1.4	NA	**Yes**
1,2,3-Trimethylbenzene	1	0.73 - 0.73	0.18	NA	**Yes**
1,2,4-Trimethylbenzene	3	1 - 1.9	1.05	7.3 (EPA RSL[d])	No
1,2-Dichloroethane	2	3.9 - 4.4	2.07	2,400 (EMEG[e]/MRL[f])	No
1,2-Dichloropropane	3	0.036 - 0.094	0.042	4 (RfC[g])	No
1,3,5-Trimethylbenzene	1	0.73	0.182	NA	**Yes**
1,3-Butadiene	2	0.042 - 0.055	0.0242	0.033 (CREG[h])	**Yes**
1,4-Dichlorobenzene	3	0.06 - 0.095	0.062	60 (EPA RSL)	No
1,4-Dioxane	2	0.15 - 0.85	0.25	0.2 (CREG)	**Yes**
1-Butanol	3	13 - 15	10.5	NA	**Yes**
2,3-Dimethylpentane	3	3.4 - 5.6	3.37	NA	**Yes**
2-Methyl-2-propanol (tert-Butyl Alcohol)	1	2.5	0.62	3,100 (NJDEP VISL[i])	No
2-Methylbutane	2	3.7 - 4.2	1.97	NA	**Yes**
2-Methylpentane	3	1.4 - 2.2	1.27	NA	**Yes**
2-Propanol (Isopropyl Alcohol)	1	14	3.5	NA	**Yes**
3-Ethyltoluene	1	0.9 0.9	0.22	NA	**Yes**
4-Methyl-2-pentanone	3	0.92 - 2.6	1.2	NA	**Yes**
Acetone	3	32 - 59	32.2	31,000 (EMEG/MRL)	No
Acrolein	1	2.4	0.6	0.02 (RfC)	**Yes**
alpha-Pinene	3	8.6 - 17	8.6	NA	**Yes**

Table A2: Cont'd.

Contaminant	No. of Detections	Concentration (µg/m³)			COPC
		Range	Mean	Environmental Guideline CV	
Benzene	3	0.84 - 1.7	0.93	0.13 (CREG)	**Yes**
Carbon Tetrachloride	3	0.42 - 0.45	0.32	0.17 (CREG)	**Yes**
Chlorodifluoromethane (CFC 22)	3	5.4 - 13	7.07	50,000 (RfC)	No
Chloroform	3	1.6 - 2.4	1.5	0.043 (CREG)	**Yes**
Chloromethane	2	0.31 - 0.38	0.172	NA	**Yes**
Cyclohexane	3	4.8 - 9	5.025	6,000 (RfC)	No
Cyclohexanone	3	1.8 - 2.2	1.45	730 (EPA RSL)	No
Dichlorodifluoromethane (CFC 12)	3	1.9 - 2.3	1.52	100 (NJDEP VISL)	No
d-Limonene	3	2.9 - 4.4	2.65	NA	**Yes**
Ethanol	3	81 - 200	107.75	NA	**Yes**
Ethylbenzene	3	1.7 - 3.3	1.85	260 (EMEG/MRL))	No
Indan	2	1.3 - 1.3	0.65	NA	**Yes**
m,p-Xylenes	3	5.5 - 11	6.35	220 (EMEG/MRL)	No
Methyl Acetate	3	1.1 - 1.8	1.1	NA	**Yes**
Methylcyclohexane	3	41 - 66	40.75	NA	**Yes**
Naphthalene	3	19 - 42	22.75	0.083 (EPA RSL)	**Yes**
n-Decane	3	1.3 - 2.6	1.6	NA	**Yes**
n-Dodecane	2	1.4 - 1.6	0.75	NA	**Yes**
n-Heptane	3	0.8 - 1.4	0.8	NA	**Yes**
n-Hexane	3	0.81 - 1.3	0.762	30 (RfC)	No
n-Nonane	3	0.81 - 1.1	0.727	21 (EPA RSL)	No
n-Octane	1	0.74	0.18	NA	**Yes**
n-Undecane	2	1.8 - 2.1	0.97	NA	**Yes**
o-Xylene	3	1.8 - 3.4	1.92	100 (EPA RSL)	No

Table A2: Cont'd.

Contaminant	No. of Detections	Concentration (µg/m³)			COPC
		Range	Mean	Environmental Guideline CV	
Propene	3	1.5 - 6.1	2.77	NA	**Yes**
Styrene	3	1.4 - 2	1.27	850 (EMEG/MRL)	No
Tetrachloroethene	2	3.3 - 6.3	2.4	3.8 (CREG)	**Yes**
Tetrahydrofuran (THF)	2	1.1 - 2.6	0.925	2,000 (RfC)	No
Toluene	1	18	4.5	300 (EMEG)	No
Trichloroethene (TCE)	3	4.9 - 6.6	4.25	0.22 (CREG)	**Yes**
Trichlorofluoromethane (CFC 11)	3	3.7 - 19	9.67	730 (NJDEP VISL)	No

[a]Comparison Value; [b]Contaminant of Potential Concern; [c]Not Available; [d]Regional Screening Level; [e]ATSDR Environmental Media Evaluation Guide; [f]Minimum Risk Level; [g]Reference Concentration; [h]ATSDR Cancer Risk Evaluation Guide; [i]Vapor Intrusion Screening Level

Table A3: Indoor air sampling results (3 US Avenue)

Contaminant	Concentration ($\mu g/m^3$)	Environmental Guideline CV[a] ($\mu g/m^3$)	COPC[b]
1,1,2-Trichlorotrifluoroethane	0.49	NA[c]	**Yes**
1,2,4-Trimethylbenzene	1.7	7.3 (EPA RSL[d])	No
1,2-Dichloroethane	0.69	2,400 (EMEG[e]/MRL[f])	No
1,2-Dichloropropane	0.044	4 (RfC[g])	No
1,3,5-Trimethylbenzene	0.87	NA	**Yes**
1,3-Butadiene	0.041	0.033 (CREG[h])	**Yes**
1,4-Dichlorobenzene	0.15	60 (EMEG/MRL)	No
1-Butanol	9.7	NA	**Yes**
2,2,4-Trimethylpentane (Isooctane)	0.79	NA	**Yes**
2,3-Dimethylpentane	2	NA	**Yes**
2-Methylbutane	4.4	NA	**Yes**
2-Methylpentane	1.9	NA	**Yes**
3-Ethyltoluene	0.74	NA	**Yes**
4-Methyl-2-pentanone	4.5	3,100 (NJDEP VISL[i])	No
Acetone	41	31,000 (EMEG/MRL)	No
Acrolein	2.9	0.02 (RfC)	**Yes**
alpha-Pinene	9.6	NA	**Yes**
Benzene	1.6	0.13 (CREG)	**Yes**
Carbon Tetrachloride	0.43	0.17	**Yes**
Chlorodifluoromethane (CFC 22)	47	50,000 (RfC)	No
Chloroform	0.76	0.043	**Yes**
cis-1,2-Dichloroethene	0.23	NA	**Yes**
Cyclohexane	3.1	6,000 (RfC)	No
Cyclohexanone	3.2	730 (EPA RSL)	No
Dibromochloromethane	0.041	NA	**Yes**
Dichlorodifluoromethane (CFC 12)	1.9	100 (NJDEP VISL)	No
d-Limonene	2.4	NA	**Yes**
Ethanol	36	NA	**Yes**
Ethylbenzene	4.5	260 (EMEG/MRL)	No
m,p-Xylenes	26	220 (EMEG/MRL)	No
Methyl Acetate	2.6	NA	**Yes**
Methylcyclohexane	22	NA	**Yes**
Naphthalene	13	0.083 (EPA RSL)	**Yes**
n-Butyl Acetate	1.9	NA	**Yes**
n-Decane	4.5	NA	**Yes**
n-Dodecane	2.1	NA	**Yes**

Table A3: Cont'd.

Contaminant	Concentration (µg/m³)	Environmental Guideline CV (µg/m³)	COPC
n-Heptane	2.4	NA	**Yes**
n-Hexane	1.5	30 (RfC)	No
n-Nonane	1.5	21 (EPA RSL)	No
n-Octane	2.8	NA	**Yes**
n-Undecane	4.1	NA	**Yes**
o-Xylene	5.7	100 (EPA RSL)	No
Propene	1.6	NA	**Yes**
Styrene	1.1	850 (EMEG/MRL)	No
Tetrachloroethene	2.9	3.8 (CREG)	**Yes**
Tetrahydrofuran (THF)	2.6	2,000 (RfC)	No
Trichloroethene (TCE)	2.9	0.22 (CREG)	**Yes**
Trichlorofluoromethane (CFC 11)	35	730 (NJDEP VISL)	No

[a]Comparison Value; [b]Contaminant of Potential Concern; [c]Not Available; [d]Regional Screening Level; [e]ATSDR Environmental Media Evaluation Guide; [f]Minimum Risk Level; [g]Reference Concentration; [h]ATSDR Cancer Risk Evaluation Guide; [i]Vapor Intrusion Screening Level

Appendix B

SOURCES OF COMMON INDOOR AIR CHEMICALS

COMMON INDOOR AIR CHEMICAL SOURCES

CHEMICAL NAME	SOURCES
1,1,1-Trichloroethane	Used as a degreaser, in solvents, and as an aerosol propellant
1,2,4-Trimethylbenzene	Used to make drugs and dyes, in gasoline and certain paints and cleaners.
1,3,5-Trimethylbenzene	Component in diesel exhaust.
2-Butanone	Found in paints, coatings, glues, cleaning agents, and cigarette smoke. It occurs naturally in some fruit and trees. Also known as Methyl Ethyl Ketone or MEK.
4-Ethyltoluene	Used as a solvent, found in kerosene and light vapor oil.
Acetone	Used as a common solvent.
Acetonitrile	Found in certain lithium batteries. Used to make plastics, synthetic rubber, and acrylic fibers. Used as a common solvent in laboratories.
Acrolein	Used in plastics, perfumes, aquatic herbicides. Also found in cigarette smoke and automobile exhaust.
Benzene	Found in cigarette smoke, gasoline, crude oil, and used as a solvent. May be an ingredient of household products such as glues, paints, furniture wax, and detergents.
Carbon Disulfide	Used in the manufacturing of rayon, in soil disinfectants, and in solvents.
Chlorobenzene	Used as a solvent for paints, pesticides.
Chloroethane	Used as a refrigerant, solvent. Also used in making cellulose, dyes, medicinal drugs.
Chloromethane	Byproduct of burning grasses, wood, cigarettes, charcoal, or plastic. Found in styrofoam insulation, aerosol propellants, and chlorinated swimming pools.
cis-1,2-Dichloroethene	Found in perfumes, dyes, lacquers, solvents, and products made from natural rubber
Dichlorodifluoromethane	Used as a refrigerant, aerosol propellant, and solvent. Also known as Freon 12.
Ethylbenzene	Used as a common solvent, and found in gasoline, inks, insecticides, and paints. Also found in cigarette smoke.

CHEMICAL NAME	SOURCES
Heptane/Hexane	Found in petroleum products, is often mixed with other solvents, and is used as a filling for thermometers.
Isooctane	Found in petroleum, gasoline, solvents, and thinners. A component of the "odor" of gasoline.
Methyl t-Butyl Ether	Used as an additive in unleaded gasoline.
Pentane	Found in petroleum, gasoline.
Propene	A flammable propellant, produced from petroleum cracking.
Styrene	Found in synthetic rubbers, resins, insulators
tert-Butyl Alcohol	Found as flavors, in perfumes, in paint remover, as a gasoline booster, and in solvents.
Tetrachloroethene	Used in dry cleaning and as a degreaser. When clothes are brought home from the drycleaners, they often release small amounts of tetrachloroethylene into the air.
Toluene	Used as a common solvent, and found in gasoline, paints and lacquers. Also found in cigarette smoke.
Trichloroethene	Used as a degreasing agent. It is also a common ingredient in cleaning agents, paints, adhesives, varnishes, and inks.
Trichlorofluoromethane	Used as refrigerant, aerosol propellant, and solvent. Also known as Freon 11.
Xylenes	Used as a solvent, cleaning agent, and thinner for paints, and in fuels and gasoline.

Note: Gasoline components may be listed in the ingredients of household products as petroleum distillates or solvents.