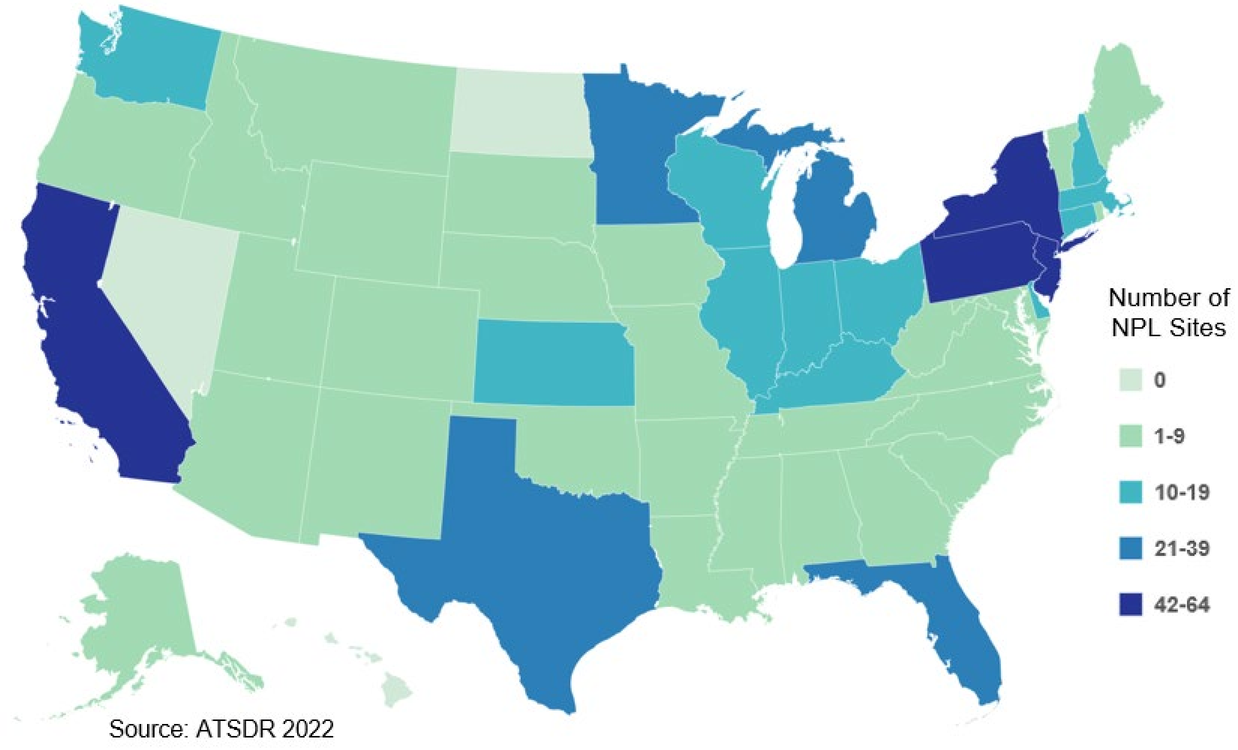
CHAPTER 5. POTENTIAL FOR HUMAN EXPOSURE

5.1 OVERVIEW

1,2-Dichloroethane has been identified in at least 593 of the 1,868 hazardous waste sites that have been proposed for inclusion on the EPA National Priorities List (NPL) (ATSDR 2022). However, the number of sites in which 1,2-dichloroethane has been evaluated is not known. The number of sites in each state is shown in Figure 5-1. Of these sites, 591 are located within the United States, and 2 are located in Puerto Rico (not shown).

Figure 5-1. Number of NPL Sites with 1,2-Dichloroethane Contamination



Source: ATSDR 2022

- The most likely route of exposure for 1,2-dichloroethane is inhalation of ambient or workplace air.
- 1,2-Dichloroethane has been detected in ambient air, surface water, groundwater, drinking water, human breath, urine, adipose tissue, and milk samples.
- The largest releases of 1,2-dichloroethane are to air.

- 1,2-Dichloroethane is expected to volatilize rapidly in surface water in a vigorous water flow scenario, moderately in a moderate water flow scenario, and relatively slowly in quiescent water scenarios. 1,2-Dichloroethane in soil is expected to volatilize to the atmosphere or leach into groundwater. The half-life of 1,2-dichloroethane in air is 73 days, and its atmospheric lifetime is >5 months.
- The primary degradation process for 1,2-dichloroethane in soil and water is biodegradation.

1,2-Dichloroethane's production, storage, and use as a synthetic feedstock (CMR 1998; EPA 1985), and as a solvent in closed systems (Budavari et al. 2013) may result in its release to the environment. The use of 1,2-dichloroethane as a lead scavenger in gasoline has been discontinued in the United States since 2018. The largest environmental releases of 1,2-dichloroethane occur to air. 1,2-Dichloroethane released to surface water and soil is expected to volatilize rapidly to the atmosphere where it will be degraded by photochemically produced hydroxyl radicals. The half-life for this reaction in air is about 73 days, calculated from its measured rate constant (Arnts et al. 1989; Atkinson 1986), and the overall atmospheric lifetime of 1,2-dichloroethane is >5 months (EPA 1993). Hydrolysis and photolysis do not appear to be significant in determining the environmental fate of 1,2-dichloroethane. Although biodegradation occurs slowly, it is the primary degradation process for 1,2-dichloroethane in soils and waters. 1,2-Dichloroethane has been detected in ambient air, surface water, groundwater, drinking water, human breath, urine, adipose tissue, and milk samples. Concentrations in environmental media are generally greatest near source areas (e.g., industrial point sources, hazardous waste sites).

Inhalation of 1,2-dichloroethane in ambient or workplace air is generally the main route of human exposure to the compound. The 2016 Toxic Substances Control Act (TSCA) Inventory Update Reporting data details a range from <10 workers to 500–999 workers that may be occupationally exposed to 1,2-dichloroethane for each of the 17 reporting plants (EPA 2016). The estimated size of the general population potentially exposed to low levels of the compound through inhalation of polluted ambient air around industrial sites was 150,000 people (Kellam and Dusetzina 1980). Ingestion of contaminated drinking water and food may also be important routes of exposure.

5.2 PRODUCTION, IMPORT/EXPORT, USE, AND DISPOSAL

5.2.1 Production

1,2-Dichloroethane is an industrially produced chlorinated aliphatic hydrocarbon that is not naturally occurring (NCI 2021). It is produced by chlorination of ethylene, by direct vapor- or liquid-phase chlorination or oxychlorination (Snedecor 2004). Direct chlorination of ethylene occurs at 40–50°C, usually using small amounts of ferric chloride as a catalyst, and less often aluminum chloride, antinomy pentachloride, and cupric chloride (Snedecor 2004). Oxychlorination of ethylene occurs at temperatures exceeding 200°C in fixed or fluidized bed reactors in the presence of oxygen and copper chloride catalyst (Al-Zahrani et al. 2001; Snedecor 2004).

The 2016 EPA Chemical Data Reporting dataset (CDR), which contains production and use information by chemical manufacturers and importers, reports that six companies domestically manufactured 1,2-dichloroethane at 11 facilities in the United States, and six facilities withheld whether they import or domestically manufacture 1,2-dichloroethane. The national aggregate production volume of 1,2-dichloroethane has been reported between 20 billion and 30 billion pounds annually from 2011 to 2015 (EPA 2016).

Table 5-1 summarizes information on facilities by state that reported manufacturing or processing of 1,2-dichloroethane to TRI in 2021. TRI data should be used with caution since only certain types of industrial facilities are required to report. This is not an exhaustive list.

Table 5-1. Facilities that Produce, Process, or Use 1.2-Dichloroethane

State[a]	Number of facilities	Minimum amount on site in pounds[b]	Maximum amount on site in pounds[b]	Activities and uses[c]
AR	4	10,000	999,999	6, 9, 10, 12
CA	1	0	99	1, 13
IA	1	1,000	9,999	1, 13, 14
IL	2	1,000	999,999	10, 12
KS	2	100	9,999	10, 12
KY	2	10,000	49,999,999	1, 3, 5, 6, 14
LA	10	10,000	499,999,999	1, 3, 4, 5, 6, 9, 10, 12, 13, 14
MI	2	10,000	999,999	9, 10, 12
MO	2	100,000	9,999,999	6, 7, 10
MS	1	100,000	999,999	6
NC	1	10,000	99,999	10
NE	1	10,000	99,999	9, 12
NY	1	0	99	12
OH	2	1,000	99,999	12
SC	2	1,000	9,999,999	1, 5, 9, 12
TX	15	0	499,999,999	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 13, 14
UT	1	10,000	99,999	9, 12

Table 5-1. Facilities that Produce, Process, or Use 1.2-Dichloroethane

State[a]	Number of facilities	Minimum amount on site in pounds[b]	Maximum amount on site in pounds[b]	Activities and uses[c]
WI	1	1,000	9,999	10
AR	4	10,000	999,999	6, 9, 10, 12

[a]Post office state abbreviations used.
[b]Amounts on site reported by facilities in each state.
[c]Activities/Uses:

1. Produce
2. Import
3. Used Processing
4. Sale/Distribution
5. Byproduct
6. Reactant
7. Formulation Component
8. Article Component
9. Repackaging
10. Chemical Processing Aid
11. Manufacture Aid
12. Ancillary
13. Manufacture Impurity
14. Process Impurity

Source: TRI21 2022 (Data are from 2021)

5.2.2 Import/Export

In the period from 2014 to 2018, general imports[1] and imports for consumption[2] of 1,2-dichloroethane were equal. U.S. imports of 1,2-dichloroethane fluctuated widely in the period from 2014 to 2018, ranging from 0 kg in 2014 and 2018, to 113,482 kg in 2017 (USITC 2019).

From 2014 to 2018, domestic exports[3] and total exports[4] of 1,2-dichloroethane were equal. Exports increased from 1.143 billion kg in 2014 to 1.366 billion kg in 2017, and then decreased to 1.073 billion kg in 2018 (USITC 2019).

5.2.3 Use

About 95% of produced 1,2-dichloroethane is used as an intermediate in the production of vinyl chloride (OECD 2002), and less often in the production of chlorinated solvents, including 1,1,1-trichloroethane

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[1] General imports are total physical arrivals of 1,2-dichloroethane to the United States from other countries that either enter consumption channels immediately or enter into bonded warehouses or Foreign Trade Zones (FTZs) (US Census 2018). A bonded warehouse is an approved private warehouse used to store imports until duties or taxes are paid (US Census 2018). FTZs are specially licensed commercial and industrial areas in or near ports of entry where goods may be brought in without paying customs duties. Imports brought to FTZs can be manipulated (i.e., sold, stored, exhibited, repacked, cleaned, manufactured, etc.) prior to re-export or entry (US Census 2018).

[2] Imports for consumption are the total amount of merchandise that has physically cleared through customs by either entering consumption channels immediately or leaving bonded warehouses or FTZs (US Census 2018).

[3] Domestic exports are goods that are grown, produced, or manufactured in the United States, or goods of foreign origin that have been changed, enhanced in value, or improved in condition in the United States (US Census 2018).

[4] Total exports are the sum of domestic exports and foreign exports, which are goods of foreign origin that are in the same condition at the time of export as they were in when imported (US Census 2018).

and tetrachloroethane (De Wildeman et al. 2001; Dreher et al. 2014). The chemical is also used in the synthesis of ethylenediamines (Dreher et al. 2014). As a solvent, 1,2-dichloroethane is used for fats, oils, waxes, gums, and resins, and in paint, varnish, and finish removers (Budavari et al. 2013). It is also reportedly used as a degreaser in engineering, textile, and petroleum industries (Larranaga et al. 2016).

Up until the ban of leaded gasoline in the 1990s, 1,2-dichloroethane was used as a lead scavenger (Henderson et al. 2009). Even after the ban of leaded gasoline, 1,2-dichloroethane was used in leaded fuel for aviation, racing cars, marine engines, and farm equipment (API 2008). This use was fully discontinued in 2018, and since 2019, 1,2-dichloroethane has seen no use in leaded gasoline. 1,2-Dichloroethane was formerly registered as a fumigant, including as an insect and soil fumigant for grains and orchards (Budavari et al. 2013; IARC 1999); however, the use of 1,2-dichloroethane as a fumigant for post-harvest grain and soil was discontinued in the late 1980s and early 1990s. The chemical was formerly registered as an ingredient in 15 pesticide products in the state of California (CDPR 2019). Other former uses include as a fumigant/cleaner for upholstery and carpet, solvent in textile cleaning and metal degreasing, spices extractant in certain food processes, and in cosmetic nail lacquers (NTP 2021).

5.2.4 Disposal

1,2-Dichloroethane is identified as hazardous waste by the EPA and its disposal is regulated under the Resource Conservation and Recovery Act (RCRA). Therefore, 1,2-dichloroethane falls under EPA regulations for storage, transportation, treatment, and disposal (EPA 2021c). The 2016 CDR reports that 1,2-dichloroethane was recycled at 3 facilities that domestically manufacture the chemical (EPA 2016).

Incineration is a recommended method of disposal for 1,2-dichloroethane, as it was considered a candidate for liquid injection incineration, rotary kiln incineration, and fluidized bed incineration (EPA 1981). 1,2-Dichloroethane should be burned by a licensed professional waste disposal service in a chemical incinerator with an afterburner and scrubber (Sigma-Aldrich 2020). 1,2-Dichloroethane is restricted from land disposal (EPA 2021b). 1,2-Dichloroethane is defined as a hazardous waste by EPA and generators of waste containing 1,2-dichloroethane must abide by EPA regulations to dispose of the contaminant (EPA 2021a, 2021c).

1,2-Dichloroethane can be removed from wastewater by treatment with granulated activated carbon, by aeration (air stripping), and by boiling. A drawback of granulated activated carbon is the further processing of the carbon spent by desorbing the chemical with steam or thermal carbon regeneration and concomitant incineration of the desorbed chemicals (Stucki and Thuer 1994). Boiling is an effective treatment on a short-term emergency basis when low concentrations are spilled in water. However, these processes should be used with caution, as they result in the transfer of the contaminant directly to air (EPA 1985, 1987).

5.3 RELEASES TO THE ENVIRONMENT

The Toxics Release Inventory (TRI) data should be used with caution because only certain types of facilities are required to report (EPA 2005). This is not an exhaustive list. Manufacturing and processing facilities are required to report information to the TRI only if they employ ≥10 full-time employees; if their facility is included in Standard Industrial Classification (SIC) Codes 10 (except 1011, 1081, and 1094), 12 (except 1241), 20–39, 4911 (limited to facilities that combust coal and/or oil for the purpose of generating electricity for distribution in commerce), 4931 (limited to facilities that combust coal and/or oil for the purpose of generating electricity for distribution in commerce), 4939 (limited to facilities that combust coal and/or oil for the purpose of generating electricity for distribution in commerce), 4953 (limited to facilities regulated under RCRA Subtitle C, 42 U.S.C. section 6921 et seq.), 5169, 5171, and 7389 (limited S.C. section 6921 et seq.), 5169, 5171, and 7389 (limited to facilities primarily engaged in solvents recovery services on a contract or fee basis); and if their facility produces, imports, or processes ≥25,000 pounds of any TRI chemical or otherwise uses >10,000 pounds of a TRI chemical in a calendar year (EPA 2018a).

There are no known natural sources of 1,2-dichloroethane. Releases of this compound to the environment may result from the manufacture, use, storage, distribution, and disposal of 1,2-dichloroethane. Older consumer goods containing 1,2-dichloroethane that are still in use or have been discarded as waste also represent potential emission sources. 1,2-Dichloroethane may also be released to the environment from the microbial degradation of other chlorinated alkanes. For example, 1,2-dichloroethane is a known product of the anaerobic biodegradation of 1,1,2,2-tetrachloroethane (Chen et al. 1996; Lorah and Olsen 1999).

5.3.1 Air

Estimated releases of 410,308 pounds (~186.1 metric tons) of 1,2-dichloroethane to the atmosphere from 51 domestic manufacturing and processing facilities in 2021, accounted for about 90.2% of the estimated total environmental releases from facilities required to report to the TRI (TRI21 2022). These releases are summarized in Table 5-2.

Table 5-2. Releases to the Environment from Facilities that Produce, Process, or Use 1,2-Dichloroethane[a]

		Reported amounts released in pounds per year[b]							
							Total release		
State[c]	RF[d]	Air[e]	Water[f]	UI[g]	Land[h]	Other[i]	On-site[j]	Off-site[k]	On- and off-site
AR	4	2,379	0	632	44	0	3,011	44	3,055
CA	1	0	0	0	0	0	0	0	0
GA	1	0	0	0	0	0	0	0	0
IL	2	5,001	65	0	2	0	5,001	67	5,068
IA	1	2,340	32	0	0	0	2,372	0	2,372
KS	2	44	0	3	3	1	47	4	51
KY	2	53,413	1,783	0	0	2,265	55,196	2,265	57,461
LA	10	232,348	520	0	286	12,692	232,934	12,912	245,846
MI	2	555	0	0	0	0	555	0	555
MS	1	271	0	0	0	0	271	0	271
MO	2	8,360	27	0	0	0	8,365	22	8,387
NE	1	144	0	0	23	0	144	23	167
NY	1	0	0	0	0	0	0	0	0
NC	1	7,870	0	0	0	52	7,870	52	7,922
OH	2	1	0	0	0	0	1	0	1
SC	2	20,148	16	0	0	0	20,148	16	20,164
TX	14	77,435	1,682	24,320	145	88	103,440	230	103,670
UT	1	0	0	0	0	10	0	10	10

Table 5-2. Releases to the Environment from Facilities that Produce, Process, or Use 1,2-Dichloroethane[a]

		Reported amounts released in pounds per year[b]							
							Total release		
State[c]	RF[d]	Air[e]	Water[f]	UI[g]	Land[h]	Other[i]	On-site[j]	Off-site[k]	On- and off-site
WI	1	0	0	0	0	0	0	0	0
Total	51	410,308	4,125	24,955	503	15,108	439,355	15,645	455,000

[a] The TRI data should be used with caution since only certain types of facilities are required to report. This is not an exhaustive list. Data are rounded to nearest whole number.
[b] Data in TRI are maximum amounts released by each facility.
[c] Post office state abbreviations are used.
[d] Number of reporting facilities.
[e] The sum of fugitive and point source releases are included in releases to air by a given facility.
[f] Surface water discharges, wastewater treatment (metals only), and publicly owned treatment works (POTWs) (metal and metal compounds).
[g] Class I wells, Class II-V wells, and underground injection.
[h] Resource Conservation and Recovery Act (RCRA) subtitle C landfills; other onsite landfills, land treatment, surface impoundments, other land disposal, other landfills.
[i] Storage only, solidification/stabilization (metals only), other off-site management, transfers to waste broker for disposal, unknown.
[j] The sum of all releases of the chemical to air, land, water, and underground injection wells.
[k] Total amount of chemical transferred off-site, including to POTWs.

RF = reporting facilities; UI = underground injection

Source: TRI21 2022 (Data are from 2021)

5.3.2 Water

Estimated releases of 4,125 pounds (~1.9 metric tons) of 1,2-dichloroethane to surface water from 51 domestic manufacturing and processing facilities in 2021, accounted for about <1% of the estimated total environmental releases from facilities required to report to the TRI (TRI21 2022). This estimate includes releases to wastewater treatment and publicly owned treatment works (POTWs) (TRI21 2022). These releases are summarized in Table 5-2.

In England and Wales, 1,2-dichloroethane was detected in 17% of industrial wastewater effluent samples at an average concentration of 117 μg/L, and in 9.5% of treated sewage at an average concentration of 1.39 μg/L (Stangroom et al. 1998).

5.3.3 Soil

Estimated releases of 503 pounds (~0.2 metric tons) of 1,2-dichloroethane to soil from 51 domestic manufacturing and processing facilities in 2021, accounted for <1% of the estimated total environmental releases from facilities required to report to the TRI (TRI21 2022). An additional 24,955 pounds (~11.3 metric tons), accounted for about 5.5% of the total environmental emissions, were released via underground injection (TRI21 2022). These releases are summarized in Table 5-2.

5.4 ENVIRONMENTAL FATE

1,2-Dichloroethane released to the environment partitions to the atmosphere. Reaction with photochemically produced hydroxyl radicals is the primary degradation mechanism of 1,2-dichloroethane in the atmosphere. 1,2-Dichloroethane released to water surfaces is expected to volatilize quickly in vigorous water flow scenarios, moderately in moderate water flow scenarios, and relatively slowly in quiescent water scenarios. 1,2-Dichloroethane released to soil surfaces is expected to volatilize to the atmosphere or leach into groundwater. Biodegradation occurs slowly in water and soil surfaces. Hydrolysis and photolysis are not expected to be important environmental fate processes for 1,2-dichloroethane.

5.4.1 Transport and Partitioning

Air. Releases of 1,2-dichloroethane to the environment as a result of industrial activity are primarily to the atmosphere (see Section 5.3). 1,2-Dichloroethane released to the atmosphere may be transported long distances before being washed out in precipitation or degraded. For example, Pearson and McConnell (1975) attributed the presence of chlorinated organic compounds, including 1,2-dichloroethane, in upland waters to long-range aerial transport and deposition in precipitation.

Water. Based on a Henry's law constant of 0.14 kPa-m^3/mol at 25°C (Haynes et al. 2015), 1,2-dichloroethane is expected to volatilize from water surfaces, with the rate of volatilization depending on water flow, depth, and temperature. An estimated volatilization half-life of 28–29 minutes was reported for 1,2-dichloroethane present at a concentration of 1 mg/L in an open water column held at 25°C and stirred at 200 revolutions/minute (Dilling 1977; Dilling et al. 1975). Removal of 90% of the compound under the same conditions occurred in 96 minutes. However, an evaporation half-life of 10 days was estimated using the EXAMS model for a eutrophic lake. Volatilization losses were shown to be the dominant fate process following a chemical spill in the Rhine River in Germany (Brüggemann et al. 1991).

Physical properties indicate that 1,2-dichloroethane will be mobile in groundwater but will not partition out of groundwater into air and soil to a great degree (Henderson et al. 2009). Based on the solubility and gasoline-water partition constant of 1,2-dichloroethane, it can be expected in concentrations up to 3,700 μg/L in groundwater near the source area of a leaded gasoline release (Henderson et al. 2009).

Sediment and Soil. No information was found regarding partitioning of 1,2-dichloroethane from the water column onto sediments. However, structural analogs of the compound (i.e., dichloromethane, trichloromethane, and 1,1,1-trichloroethane) do not concentrate selectively onto sediments (Dilling et al. 1975; Pearson and McConnell 1975). Based on log K_{oc} values of 1.28–1.62 (Borisover and Graber 1997; Chiou et al. 1980; Sabljić et al. 1995), 1,2-dichloroethane is not expected to adsorb to suspended solids and sediment in the water column. An experimental bioconcentration factor (BCF) of 2 indicates that 1,2-dichloroethane will not bioconcentrate in fish and aquatic organisms (Banerjee and Baughman 1991) and is not expected to bioaccumulate in the food chain (Farrington 1991). 1,2-Dichloroethane released to land surfaces is expected to volatilize to the atmosphere or leach into groundwater. Volatilization losses occur at a much slower rate for 1,2-dichloroethane present in subsurface soil. Jury et al. (1990) modeled the rate of volatilization of 1,2-dichloroethane from soil at a depth of 1 m to mimic the type of contamination that may occur from landfill leachate. When water evaporation was not considered, the yearly loss of 1,2-dichloroethane amounted to 7.1% from a sandy soil. Yearly volatilization losses increased to 30% when water evaporation was considered. Based on log K_{oc} values of 1.28–1.62 (Borisover and Graber 1997; Chiou et al. 1980; Sabljić et al. 1995), 1,2-dichloroethane is expected to have very high mobility in soil surfaces and should be available for transport into groundwater. In a laboratory experiment conducted with a sandy loam, approximately 50% of an initial concentration of 0.81 mg/L of 1,2-dichloroethane applied to the soil surface was volatilized. The remainder percolated through the soil column to a depth of 140 cm, suggesting that leaching into groundwater may occur (Wilson et al. 1981). Environmental surveys conducted by EPA have detected 1,2-dichloroethane in groundwater sources in the vicinity of contaminated sites (EPA 1985). Large spills of 1,2-dichloroethane may contaminate groundwater because of the high density of this compound, which makes it sink into the aquifer in a vertical gravity-driven process (Corapcioglu and Hossain 1990).

5.4.2 Transformation and Degradation

Air. In the atmosphere, 1,2-dichloroethane is degraded by reaction with photochemically produced hydroxyl radicals. An experimental rate constant of 2.2×10^{-13} cm^3/molecule-second at 25°C (Arnts et al. 1989; Atkinson 1986) corresponds to a half-life of 73 days using an average atmospheric hydroxyl radical concentration of 5×10^5 molecule/cm^3. The estimated atmospheric lifetime of 1,2-dichloroethane was reported to be >5 months with formyl chloride, chloroacetyl chloride, hydrogen chloride, and chloroethanol reported as degradation products (EPA 1993). 1,2-Dichloroethane is not expected to undergo significant atmospheric removal by oxidation with ozone or nitrate radicals, and it will not undergo removal by direct photolysis.

A recent study shows that the observed mixing ratio and the initial mixing ratio during the day of 1,2-dichloroethane are equal (0.30 ppbv), indicating that 1,2-dichloroethane is not very reactive with radicals during transport from their sources to sampling sites (Gao et al. 2018). The observed mixing ratio of 1,2-dichloroethane at night was measured to be 0.34 ppbv (Gao et al. 2018).

Water. Due to 1,2-dichloroethane's solubility in water, low sorption coefficient, and low Henry's law coefficient, it remains in the water phase in groundwater under average environmental conditions (De Wildeman et al. 2001); however, 1,2-dichloroethane has been found to volatilize into building structures at some contaminated sites (Kurtz et al. 2010; Ma et al. 2016). In groundwater and surface water, biodegradation is the primary degradation process for the removal of 1,2-dichloroethane. Abiotic degradation processes, such as oxidation and hydrolysis, are too slow to be environmentally significant.

1,2-Dichloroethane biodegrades under aerobic and anaerobic conditions. Under aerobic conditions, 1,2-dichloroethane is thought to biodegrade via enzymatically initiated hydrolytic dehalogenation to 2-chloroethanol or oxidation reactions to 1,2-dichloroethanol; biodegradation has been demonstrated anaerobically via a reductive dechlorination reaction to chloroethane, dihaloelimination reaction to ethane, and mineralization to CO_2 (Hirschorn et al. 2007). Bacteria isolated from a mixture of activated sludge from wastewater treatment plants and 1,2-dichloroethane-polluted soils have used 1,2-dichloroethane as a sole carbon source (Janssen et al. 1984; Stucki et al. 1983). Approximately 14% degradation of 5 mg/L 1,2-dichloroethane occurred after 14 days incubation in laboratory experiments using a domestic wastewater inoculum (Tabak et al. 1981). The reported loss was corrected for 27% volatilization loss in 10 days from control flasks. Reported degradation losses (corrected for volatilization) for 10 mg/L of the compound were 15% at 7 days and 30% at 14 days. Following a 24-hour incubation at 25 °C under aerobic conditions, 1,2-dichloroethane was degraded (approximately 10%) by a strain of *Pseudomonas fluorescens* bacteria isolated from soil and water contaminated with various chlorinated hydrocarbons, including 1,2-dichloroethane (Vandenbergh and Kunka 1988). 1,2-Dichloroethane was not biodegraded after 35 days under anaerobic conditions in sediment-water test systems (Jafvert and Wolfe 1987) and was not biodegraded by bacteria isolated from groundwater after 8–16 weeks of incubation (Wilson et al. 1983). The biodegradation half-life of 1,2-dichloroethane in aerobic water was reported as 100 days and the half-life in anaerobic water was reported as 400 days, but no details on the kinetic experiments used to establish these half-lives were reported (Capel and Larson 1995). The half-life represents the calculated time for loss of the first 50% of the substance, but the time required for the loss of half of that which remains may be substantially longer, and the rate of disappearance may decline further as time progresses. 1,2-Dichloroethane was 97% biodegraded in laboratory studies using aerobic groundwater microcosms obtained from a Superfund site in California over a 6-day incubation period (Cox et al. 1998). In the field, however, the biodegradation half-life of 1,2-dichloroethane in groundwater can range from <1 to 30 years depending on the conditions (Bosma et al. 1998).

A growing body of evidence indicates that the co-metabolism of 1,2-dichloroethane (the biodegradation of 1,2-dichloroethane from which the degrading organism gains no energetic benefit) occurs under aerobic conditions (see Sediment and Soil). Pure cultures of methanotrophic (methane using) bacteria obtained from both polluted and non-polluted sources degraded 1,2-dichloroethane in the presence of methane and oxygen (Oldenhuis et al. 1989). Aquifer solids obtained at an *in situ* biorestoration field study mineralized 1,2-dichloroethane to carbon dioxide in the presence of dissolved oxygen and methane (Lanzarone and McCarty 1990). Concentrated cell suspensions of methanogenic bacteria incubated at 37 or 55°C for 24–96 hours reductively dechlorinated 1,2-dichloroethane to ethene, chloroethane, and ethane (Holliger et al. 1990). One study examined the ability of upflow anaerobic sludge blanket (UASB) technology to dehalogenate 1,2-dichloroethane at high volumetric rates and demonstrates that UASB technology under optimal dechlorination conditions can be used to treat 1,2-dichloroethane contaminated waters (De Wildeman et al. 2001). De Wildeman et al. (2001) found that living methanogenic granular sludge grown in UASB reactors is able to degrade 1,2-dichloroethane.

The experimental first-order rate constants for the hydrolysis of 1,2-dichloroethane under neutral conditions were reported as 2.1×10^{-8} and 1.8×10^{-8} second^{-1} at 25°C (Barbash and Reinhard 1989; Jeffers et al. 1989). These values correspond to half-lives of 65 and 72 years. A more recent study determined that the hydrolysis half-life of 1,2-dichloroethane was 4.9×10^{4} years at pH 9 and 15°C (Miyamoto and Urano 1996). Barbash and Reinhard (1989) found that the presence of 5.1×10^{-4} molar (16 ppm) solution of hydrogen sulfide anion decreased the hydrolytic half-life to 6 years. Although still a slow process, this latter reaction may occur in hypoxic groundwater where hydrogen sulfide occurs naturally.

Sediment and Soil. As in surface water, direct photolysis of 1,2-dichloroethane on soil surfaces and hydrolysis in moist soil and sediment are not expected to be important environmental fate processes. The primary transformation process for 1,2-dichloroethane in sediment and soil is biodegradation. Incubation of 1,2-dichloroethane at a starting concentration of 100 ppb with an unsaturated calcareous soil resulted in 15–23% mineralization to carbon dioxide after 4 weeks, under aerobic conditions, and 3.3–3.4% mineralization under anaerobic conditions (Watwood et al. 1991). Over a 2-week incubation period, 2 μmol of 1,2-dichloroethane completely dechlorinated to ethane by anaerobic microcosms and enrichment cultures derived from river sediment (Loffler et al. 1997). A first-order biodegradation rate constant of 0.013 day^{-1} was determined for 1,2-dichloroethane in an anaerobic sediment slurry (Peijnenburg et al. 1998). This rate constant corresponds to a biodegradation half-life of about 52 days. It was noted that degradation followed first-order kinetics for at least two successive half-lives in this study.

The presence of methane or increasing the proportion of methanotrophs can increase the rate of aerobic biodegradation of 1,2-dichloroethane in soil. In laboratory experiments conducted with different soil types (sand, sandy clay, silty loam, clay, and Lincoln fine sand), soils exposed to methane biodegraded 1,2-dichloroethane to carbon dioxide (Henson et al. 1988; Speitel and Closmann 1991). Based on these results, it was estimated that the bioremediation of soil contaminated with 100 ppm 1,2-dichloroethane could be complete within several months if methane is present (Speitel and Closmann 1991). Methane oxidizing cultures from soil of a California landfill readily biodegraded 1,2-dichloroethane, but toluene and phenol oxidizing cultures were not able to degrade this compound (Chang and Alvarez-Cohen 1996).

As the concentration of 1,2-dichloroethane increases in a soil surface, the degree of biodegradation that takes place may decrease due to microbial toxicity at the enhanced contaminant level. In a respirometer study of microbial toxicity to an agricultural soil, it was determined that a concentration of 0.51 mg 1,2-dichloroethane/g of soil resulted in a 50% respiratory inhibition (Regno et al. 1998).

5.5 LEVELS IN THE ENVIRONMENT

Reliable evaluation of the potential for human exposure to 1,2-dichloroethane depends, in part, on the reliability of supporting analytical data from environmental samples and biological specimens.

Concentrations of 1,2-dichloroethane in unpolluted atmospheres and in pristine surface waters are often so low as to be near the limits of current analytical methods. In reviewing data on 1,2-dichloroethane levels monitored or estimated in the environment, it should also be noted that the amount of chemical identified analytically is not necessarily equivalent to the amount that is bioavailable.

Table 5-3 shows the limits of detection typically achieved by analytical analysis in environmental media. Presented in Table 5-4 is a summary of the range of concentrations detected in environmental media.

Table 5-3. Lowest Limit of Detection for 1,2-Dichloroethane Based on Standards[a]

Media	Detection limit	Reference
Air	11.2 pptv (0.00005 mg/m^3)	Gao et al. 2018
Workplace air	0.014 mg/m^3	NIOSH 1994
Drinking water	0.03–0.07 μg/L	Kessels et al. 1992
Water and wastewater	0.002 μg/L	EPA 1994b
Water, wastewater, and solid waste	5 μg/kg (soil/sediment); 0.5 μg/kg (wastes); 5 μg/L (water)	EPA 1994c
Fish	10 μg/kg (wet weight)	Easley et al. 1981
Table ready foods	6 ppb (6 μg/kg)	Heikes 1987; Heikes and Hopper 1986
Sediment	20 pg/g (0.02 μg/kg)	Roose et al. 2001
Breath	0.12 μg/m^3 (0.00012 mg/m^3)	Wallace et al. 1984
Human erythrocytes	No data	Ansari et al. 1987
Blood/urine	No data	Barkley et al. 1980
Blood	0.010 ng/mL (0.001 μg/dL)	Blount et al. 2006

[a] Detection limits based on using appropriate preparation and analytics. These limits may not be possible in all situations.

Table 5-4. 1,2-Dichloroethane Levels in Water, Soil, and Air of National Priorities List (NPL) Sites

Medium	Median	Geometric mean	Geometric standard deviation[a]	Number of quantitative measures	NPL sites
Water (μg/L)	18	46.4	26.0	402	232
Soil (μg/kg)	3,300	1,990	114	70	49
Air (ppbv)	1.95	2.62	36.3	46	35

[a] Concentrations found in ATSDR site documents from 1981 to 2022 for 1,868 NPL sites (ATSDR 2022). Maximum concentrations were abstracted for types of environmental media for which exposure is likely. Pathways do not necessarily involve exposure or levels of concern.

5.5.1 Air

1,2-Dichloroethane has been detected in ambient air samples taken over the north Atlantic Ocean at concentrations of 0.061–0.12 μg/m^3 (0.015–0.030 ppb) (Class and Ballschmiter 1986) and in trace amounts in the southern Black Forest in southwestern Germany (concentration unspecified) (Jüttner 1986). The reported average surface level background concentration of the compound in ambient air at mid-latitudes is 0.168 μg/m^3 (Singh et al. 1982). Mean percentile distributions of 1,2-dichloroethane concentrations in ambient air in the United States available from EPA's Air Quality System database are presented in Table 5-5. Approximately 40% of sites tested had zero detections in 2021. According to the 2014 National Air Toxics Assessment, the mean 1,2-dichloroethane concentration in the United States was 0.000409 μg/m^3 (EPA 2018b). Concentrations ranged from undetectable in Northwest Arctic and Prince of Wales-Hyder, Alaska; Monroe, Florida; and Sanoval, New Mexico to 0.424 μg/m^3 in Iberville, Louisiana (EPA 2018b).

Table 5-5. Percentile Distribution of Annual Mean 1,2-Dichloroethane Concentrations (ppbC) Measured in Ambient Air at Locations Across the United States

Year	Number of U.S. locations	25th	50th	75th	95th	Maximum
2022	30	0	0	0	0	0.1
2021	142	0	0	0	0.1	95
2020	142	0	0	0.04	0.1	111.4
2019	148	0	0	0	0.10	31.8
2018	190	0	0.01	0.04	0.08	58
2017	199	0	0	0.03	0.05	52.6
2016	203	0	0.01	0.03	0.12	22.6
2015	200	0	0	0.03	0.07	11.9
2014	251	0	0.02	0.03	0.08	15.3

Source: EPA 2022

1,2-Dichloroethane has been found at higher concentrations in ambient air samples from urban areas of the United States. In a review of 950 potential papers on VOCs in air published from 1970 to 1987, a database of median daily atmospheric concentrations by site type was compiled (EPA 1988). The median daily atmospheric concentration of 1,2-dichloroethane in urban sites was 0.049 μg/m^3 (0.012 ppb) (1,214 samples) and 1.0 μg/m^3 (0.26 ppb) (182 samples) for source-dominated samples; it was not detected in 648 samples from suburban, rural, or remote sites. 1,2-Dichloroethane was detected at 83 urban locations across the United States at a median concentration of 0.04 μg/m^3 (0.01 ppb) (Kelly et al. 1994). The average concentration of 1,2-dichloroethane in seven urban locations in 1980–1981 ranged from 0.405 to 6.07 μg/m^3 (0.100–1.50 ppb) (Singh et al. 1982). The mean concentrations of 1,2-dichloroethane in 1,412 samples of ambient air from 23 sites in 12 Canadian cities from 1988 to 1990 ranged from 0.070 to 0.28 μg/m^3 (0.017–0.069 ppb) with an overall mean of 0.13 μg/m^3 (0.032 ppb) (WHO 1995). Mean urban air concentrations of 1,2-dichloroethane measured during field experiments in March 1984 in Downey, California, Houston, Texas, and Denver, Colorado were 0.40 μg/m^3 (0.010 ppb), 1.82 μg/m^3 (0.45 ppb), and 0.089 μg/m^3 (0.022 ppb), respectively (Singh et al. 1992). Air samples collected in Izmir, Turkey showed that concentrations of 1,2-dichloroethane were nearly the same in summer and winter at the urban site sampled, and concentrations were higher at the urban site than at the suburban site (Elbir et al. 2007). In a 1987 survey of 35 homes in the Kanawha Valley, West Virginia, the mean concentration of 1,2-dichloroethane was 20.8 μg/m^3 (5.15 ppb), with a maximum concentration of 140 μg/m^3 (34.6 ppb) (Cohen et al. 1989). A component of the Total Exposure Assessment Methodology (TEAM) compared the outdoor concentration of toxic substances to the corresponding overnight indoor concentration. The results of this monitoring study indicated that 1,2-dichloroethane was detected in 30% of the indoor samples (median concentration: 0.025 μg/m^3) and 37% of the outdoor samples (median concentration: 0.025 μg/m^3) in Greensboro, North Carolina (fall, 1980); 89% of the indoor samples (3.6 μg/m^3) and 100% of the outdoor samples (2.2 μg/m^3) in Baton Rouge, Louisiana (winter, 1981); 18% of the indoor (0.04 μg/m^3) and 40% of the outdoor samples (0.045 μg/m^3) in Houston, Texas (summer, 1981); 64% of the indoor (0.22 μg/m^3) and 54% of the outdoor samples (0.21 μg/m^3) in Los Angeles, California (winter, 1984); 4.3% of the indoor samples (0.03 μg/m^3) and none of the outdoor samples in Los Angeles, California (summer, 1984); 20% of the indoor (0.12 μg/m^3) and none of the outdoor samples in Antioch/Pittsburgh, California (summer, 1984) (Pellizzari et al. 1986). 1,2-Dichloroethane was detected in only 1 of the 349 samples drawn from 11 cities in the 1990 Urban Air Toxics Monitoring Program (UATMP) at a concentration of 0.32 μg/m^3 (0.080 ppb) (EPA 1991). In a survey of homes in North Carolina, 1,2-dichloroethane was detected at a concentration of 0.40 μg/m^3 (0.10 ppb) in 1 out of 25 homes of smokers and was not detected in the homes of nonsmokers (Heavner et al. 1995). In a survey of New Jersey and Pennsylvania residences, 1,2-dichloroethane was detected in the homes of nonsmokers at a mean concentration of 0.03 μg/m^3 (0.007 ppb) and in the homes of smokers at a mean concentration of 0.32 μg/m^3 (0.079 ppb) (Heavner et al. 1996). The maximum concentration of 1,2-dichloroethane reported in nonsmoking households was 0.54 μg/m^3 (0.13 ppb), while the maximum concentration in households where at least one family member smoked was 9.72 μg/m^3 (2.40 ppb).

1,2-Dichloroethane has also been evaluated in samples of ambient air collected in the vicinity of hazardous waste disposal sites. 1,2-Dichloroethane was not detected in 6 air samples at Ogden Railyard in

EPA Region 8 in 2000 (WQP 2020). 1,2-Dichloroethane was detected at concentrations ranging from 0.039 to 0.049 μg/m^3 in 24 ambient air samples from Palermo Wellfield Superfund Site between 2013 and 2014; the concentration in 4 samples of indoor air ranged from 0.039 to 0.041 μg/m^3 (WQP 2020). At Superfund Intermountain Waste Oil Refinery in 2004, 1,2-dichloroethane was not detected in ambient air (WQP 2020). Trace amounts of 1,2-dichloroethane were found in samples of outdoor ambient air from two of nine residences in the Love Canal area of Niagara, New York (Barkley et al. 1980). It was also detected in indoor ambient air samples from two of the nine residences surveyed, at concentrations of 0.10 μg/m^3 (0.025 ppb) and 0.13 μg/m^3 (0.032 ppb). In addition, it has been found in ambient air samples from three of five hazardous waste sites surveyed in New Jersey at average concentrations of 0.04, 1.1, and 0.12 μg/m^3 (0.01, 0.28, and 0.030 ppb) (LaRegina et al. 1986). In an analysis of VOCs in five hair salons, 1,2-dichloroethane was detected in 100% of sites, with values between 63 and 99 ppb (Kaikiti, et al. 2022).

Other possible sources of indoor air pollution by 1,2-dichloroethane include volatilization from contaminated potable water in domestic shower and bath systems (Andelman 1985) and vapor intrusion from contaminated groundwater and soil gas A review of indoor air measurements from ATSDR public health assessment reports found concentrations of 1,2-dichloroethane to be below ATSDR's media-specific noncancer comparison values for indoor air and vapor intrusion (Burk and Zarus 2013). 1,2-Dichloroethane was detected in indoor air at 8 of 148 vapor intrusion sites and ranged from 0.0049 ppb (0.02 μg/m^3) to 6.7 ppb (27 μg/m^3). 1,2-Dichloroethane groundwater concentrations detected at nine of the vapor intrusion sites ranged from 0.987 to 150 μg/L. In a survey conducted by the Association of State and Territorial Solid Waste Management Officials in 2014, lead scavengers, including 1,2-dichloroethane, were a contaminant of concern in 20% of underground storage tank sites (ASTSWMO 2014).

1,2-Dichloroethane was detected at concentrations of 146 μg/m^3 (36 ppb) and 81 μg/m^3 (20 ppb) in the ambient air at municipal landfill sites in Canada (Brosseau and Heitz 1994). 1,2-Dichloroethane was detected in 11.4% of the vented air samples obtained from the Fresh Kills landfill in New York at an average concentration of 0.77 mg/m^3 (0.19 ppm) (EPA 1996). 1,2-Dichloroethane has been detected in samples of indoor air taken from newly renovated homes in Shanghai at a mean concentration of 33.83 μg/L (8,364 ppb), which is noticeably higher than concentrations reported in previous studies in Hong Kong, Japan, and Canada (Dai et al. 2017). In this study, 1,2-dichloroethane presented the highest median and mean cancer risks (Dai et al. 2017). Dai et al. (2017) note that renovated homes have higher

VOC concentrations, like 1,2-dichloroethane, than non-renovated homes have, and that this is due to emissions from building materials, furniture, paint, glue, floor coverings, and other materials.

A study monitoring VOC concentrations at an industrial area, traffic zone, residential zone, development zone, and background zone in Hefei city in China found that concentrations of 1,2-dichloroethane ranged from 0.68 μg/L in the industrial area to 1.51 μg/L in the background zone (Hu et al. 2018).

5.5.2 Water

In a survey of 14 heavily industrialized river basins in the United States, 1,2-dichloroethane was detected at a frequency of 53% in 204 surface water samples collected (EPA 1977); reported concentrations in domestic surface waters used as drinking water sources ranged from trace amounts to 4.8 μg/L (Brown et al. 1984). 1,2-Dichloroethane has also been found in samples of urban runoff from Eugene, Oregon, at a concentration of 4 μg/L (Cole et al. 1984). 1,2-Dichloroethane was detected in 26% of the river samples obtained from Osaka, Japan, at a mean concentration of 0.09 μg/L (Yamamoto et al. 1997). 1,2-Dichloroethane was detected in the Tees estuary in England in 1992 at concentrations of 0.72–4.02 μg/L, with the highest levels measured near an industrialized area where 1,2-dichloroethane and vinyl chloride monomer were produced (Dawes and Waldock 1994).

1,2-Dichloroethane is reported to be one of the predominant organohalogen pollutants in groundwater and industrial effluents, ranging from μg to g/L levels (De Wildeman et al. 2001; Hirschorn et al. 2007). Groundwater samples taken from 178 hazardous waste disposal sites contained 1,2-dichloroethane at 29.1% frequency (Plumb 1987). 1,2-Dichloroethane was detected in the groundwater of the Du Pont Necco Park Landfill in Niagara Falls, New York at concentrations of 14–4,250 μg/L (Lee et al. 1995). Reported concentrations of 1,2-dichloroethane in domestic groundwater supplies used for drinking water ranged from trace amounts to 400 μg/L (Brown et al. 1984). 1,2-Dichloroethane was detected in 10 of 943 groundwater samples across the United States at concentrations that ranged from 0.95 to 9.80 μg/L with median concentrations ranging from 0.57 to 2.9 μg/L (Westrick et al. 1984).

The disposal of organic chemicals in trenches at a waste disposal site near Ottawa, Canada resulted in 1,2-dichloroethane groundwater concentrations ranging from 3.9 to 58.0 μg/L in 30% of samples taken from a 37-well monitoring network in 1988 (Lesage et al. 1990). The concentration of 1,2-dichloroethane in the leachate samples from hazardous waste landfills in Germany ranged from 40 to 830 μg/L (Först et al. 1989). 1,2-Dichloroethane was identified, not quantified, in groundwater wells of Eau Claire, Wisconsin (Canter and Sabatini 1994). 1,2-Dichloroethane was detected in 17% of groundwater samples obtained from 479 waste disposal sites in the United States (Barbee 1994). 1,2-Dichloroethane was detected in 27 of 82 samples of groundwater at the Darling Hill Dump, Vermont at an average concentration of 3.7 μg/L and a maximum concentration of 240 μg/L (EPA 1992a). The maximum concentration of 1,2-dichloroethane in groundwater at the Fallon Naval Air Station, Fallon, Nevada was 1,400 μg/L (Kelley et al. 1998). Groundwater from a former petro-chemical refinery in California contained 1,2-dichloroethane at concentrations ranging from 1 to 9 μg/L (EPA 1992b). 1,2-Dichloroethane was detected at concentrations of 0.8–32.8 μg/L in groundwater near the Lower Llobregat aquifer in Spain (Ventura et al. 1997). 1,2-Dichloroethane was determined to be one of two main contaminants in the groundwater at an organic chemical plant site in Chongqing, China, with concentrations ranging from 0.6 to 8,160 μg/L (Liu et al. 2016). The concentrations were much higher than the <1.45 μg/L concentration of 1,2-dichloroethane in the Yangtze River (Liu et al. 2016). In samples of shallow groundwater in new residential/commercial areas of the United States, 1,2-dichloroethane was measured at a concentration of 5 μg/L (Squillace et al. 2004).

In EPA's 3rd six-year review of drinking water contaminants (EPA 2006–2011), only 13 of 375,022 sites detected 1,2-dichlororethane above the regulated threshold of 5 μg/L (EPA 2016). 1,2-Dichloroethane was detected above the limit of detection (LOD) in 2,457 sites, with a median value of 0.89 μg/L.

5.5.3 Sediment and Soil

The concentration of 1,2-dichloroethane in sediment samples obtained from the Southampton Water estuary, England over an 18-month period ranged from 0.070 to 11 ppb (0.070 to 11 μg/kg) (Bianchi et al. 1991). 1,2-Dichloroethane was not detected in sediment downstream from two facilities in Canada that manufactured this compound (Oliver and Pugsley 1986). The mean concentration of 1,2-dichloroethane in soil near 20 homes in the Netherlands was 11 mg/kg, while samples in the vicinity of a garage and waste site contained <5 and 30 mg/kg, respectively (WHO 1995). 1,2-Dichloroethane was detected in soil from Claire, Michigan near seven industrial facilities at concentrations of 6–19 μg/kg (EPA 1992c). 1,2-Dichloroethane was also detected in sediments from the Scheldt Estuary in the Southern North Sea at concentrations between 0.28 and 0.58 ng/g (Roose et al. 2001). 1,2-Dichloroethane is among the 10 most prevalent chemicals found in Superfund sites in North Carolina (Tilley et al. 2017).

5.5.4 Other Media

Historically, 1,2-dichloroethane was used as a lead scavenger in leaded aviation gasoline, and its approximate concentration in gasoline was 0.07 g/L (Henderson et al. 2009).

In a market basket survey of over 500 samples of table-ready and prepared foods (including cereals, oils/dressings, vegetables, baked goods, nuts, dairy products, jams/candy, meats/meat dishes, fruits, infant/toddler blends, and beverages), 1,2-dichloroethane was detected in a whiskey sample at a concentration of 30 ng/g (Daft 1988, 1991). 1,2-Dichloroethane has been detected in plain granola samples at 0.31 and 12 ng/g, shredded wheat cereal samples at 8.2 ng/g (Heikes 1987), wheat grain samples at 0–180 ng/g, and bleached flour samples at 0–6.5 ng/g (Heikes and Hopper 1986). 1,2-Dichloroethane has also been qualitatively detected as a volatile component in chickpeas (Rembold et al. 1989).

1,2-Dichloroethane was formerly used as a fumigant but is not currently registered for use in agricultural products in the United States, Canada, and the United Kingdom. 1,2-Dichloroethane was not detected in 24 samples of rice analyzed in 1992 (WHO 1995) and was not detected in a U.S. Food and Drug Administration (FDA) survey of 234 table-ready foods (Heikes et al. 1995). In a survey of foods from Tokyo, Japan, 1,2-dichloroethane was not detected in bean sprouts, colas, juice, rice, lactic beverages, plain yogurt, tofu, or ice milk (Miyahara et al. 1995). It was detected at mean concentrations of 1.3 ng/g in butter, 0.2 ng/g (ppb) in cake, 0.03 ng/g in ice cream, and 0.03 ng/g in store-bought milk (Miyahara et al. 1995).

5.6 GENERAL POPULATION EXPOSURE

The greatest source of exposure to 1,2-dichloroethane for most of the U.S. population is inhalation of the compound in contaminated air. Vapor intrusion may also be a potential source of 1,2-dichloroethane exposure, as vapor intrusion has been observed for several VOCs with similar properties. Using a numerical model, Ma et al. (2016) concluded that exposure to 1,2-dichloroethane could occur through vapor intrusion. The model predicted that indoor air concentration of 1,2-dichloroethane can exceed EPA screening levels of 0.011 $\mu g/m^3$ if there is a sufficiently high source concentration such as those found at leaking underground storage tank sites. However, despite concerns over vapor intrusion due to groundwater contamination at two former industrial facilities in Denver, Colorado, Kurtz et al. (2010) found no evidence of vapor intrusion significantly contributing to indoor air concentrations of

1,2-dichloroethane. EPA's compilation of eight studies of background indoor air concentrations found a 1–25% detection rate for 1,2-dichloroethane in 1,661 U.S. resident samples between 1984 and 2004 (EPA 2011). The background medians ranged from less than the reporting levels (0.02–2.02 μg/m^3) to 0.25 μg/m^3, 95th percentiles ranged from less than the reporting levels to 1.1 μg/m^3, and maximum values ranged from 0.43 to 51 μg/m^3.

About 50% of 1,2-dichloroethane volatilizes from water while showering. Volatility from other household uses of water range from 23% (sinks, toilets) to 70% (dishwashers). Thus, the potential for inhalation exposure exists during showering, bathing, and other household water uses, such as dishwashers, clothes washers, toilets, and sinks. ATSDR's three-compartment Shower and Household Water-Use Exposure (SHOWER) model predicts air concentrations in the shower stall, bathroom, and main house throughout the day for households with up to eight members. Using these concentrations and human activity patterns, the model estimates a daily time-weighted average exposure concentration from breathing indoor air. The model also estimates dermal uptake from skin contact while bathing and washing hands.

Other potential routes of human exposure include ingestion of 1,2-dichloroethane in contaminated drinking water or food items and dermal absorption (EPA 1985; Gold 1980). Since 1,2-dichloroethane is not currently registered for use in agricultural products in the United States, the potential exposure from ingesting contaminated food sources has likely decreased. However, for populations with drinking water supplies containing >6 μg/L of the compound, oral and dermal routes are expected to be more important than inhalation (EPA 1985). The estimated daily intake of 1,2-dichloroethane in Japan attributed to food ingestion is 0.004 mg/day (Miyahara et al. 1995).

1,2-Dichloroethane is believed to be a constituent of tobacco smoke (Rodgman and Perfetti 2013). 1,2-Dichloroethane was detected at a mean concentration of 0.09 μg/m^3 in workplaces where smoking is not permitted and at a mean concentration of 0.03 μg/m^3 in workplaces where smoking is permitted (Heavner et al. 1996). These data are in contrast with the findings from the same study that showed a significantly higher concentration of 1,2-dichloroethane in the air of homes in which at least one family member smoked (see Levels Monitored in the Environment). It may be that workplaces that permit smoking have better ventilation, and thus lower ambient air contaminant levels.

Exposure of the population to 1,2-dichloroethane through releases to ambient air from a number of specific emission sources has been estimated (Kellam and Dusetzina 1980). The estimates, which are probably too high because of the current limited use of leaded fuels, are presented in Table 5-6. The EPA TEAM studies measured personal and outdoor exposures of about 800 people to 25 VOCs, including 1,2-dichloroethane (Wallace 1991). The people were selected to represent more than one million residents in a wide variety of urban, suburban, and rural areas. The mean measured exposure to 1,2-dichloroethane, which was based on a 24-hour exposure of 750 people in 6 urban areas, was reported to be 0.5 μg/m^3. The outdoor air concentration based on backyard measurements in 175 homes in 6 urban areas was 7 μg/m^3 (Wallace 1991).

Table 5-6. Estimated Population Exposure to 1,2-Dichloroethane Through Releases to Ambient Air from a Number of Specific Emission Sources

Emission source	Estimated population exposed	Ambient air concentration (ppb)
1,2-Dichloroethane manufacturing plants	12,500,000	0.01–10
Chemical production facilities	2,621,000	0.01–0.99
Gasoline service stations[a]	1,000,000	0.01–0.029
Automobile emissions	13,000,000	0.01–0.029
Automobile refueling	30,000,000	<0.01

[a] Emissions from gasoline stations are in decline.

Source: Kellam and Dusetzina (1980)

In addition to industrial releases of 1,2-dichloroethane to ambient air, the general population may have been exposed to this compound in indoor air through volatilization from consumer products and from potable water (Andelman 1985). 1,2-Dichloroethane was detected in the volatile emissions of cleaning agents and pesticides, recently glued wallpaper, and recently glued carpet at concentrations of 236 μg/m^3 (58.2 ppb), 48±7.3 μg/m^3 (12±1.8 ppb), and 15±1 μg/m^3 (3.7±0.25 ppb), respectively (Wallace et al. 1987). Since 1,2-dichloroethane is no longer used in consumer products like cleaning agents and adhesives, this route of exposure is expected to be low today.

1,2-Dichloroethane has been detected in the expired breath and urine of humans in a number of studies, following exposure of the test subjects to the compound in ambient air and drinking water (Barkley et al. 1980; EPA 1982; Wallace et al. 1984).

1,2-Dichloroethane has been detected in child (aged 12–19 years) blood samples collected by the National Health and Nutrition Examination Survey (NHANES), although too many of the samples collected were below the LOD of 10 pg/mL to calculate selected percentiles (CDC 2018).

Inhalation of contaminated air likely represents the greatest route of potential exposure for children. 1,2-Dichloroethane has also been detected in drinking water, and therefore, ingestion of contaminated water is a possible source of exposure. 1,2-Dichloroethane was previously detected in human milk at concentrations ranging from 0.195 to 0.63 mg/100 mL of milk (EPA 1980; Urusova 1953). Current data on the concentration of 1,2-dichloroethane in breast milk are not available, and these historic data likely reflect exposures from former use patterns that are no longer relevant today. 1,2-Dichloroethane was formerly used in certain consumer household products such as cleaning agents and adhesives. The use of any household products that contained 1,2-dichloroethane to clean floors or glue carpets may result in exposure since children often crawl on floors and play on carpets. The potential for exposure is expected to diminish with time since 1,2-dichloroethane volatilizes fairly rapidly. This is expected to be a relatively minor route of exposure since most of these products have probably been used up or discarded from the majority of households. Differences from adults in susceptibility to hazardous substances are discussed in 3.2.1 Children's Susceptibility.

1,2-Dichloroethane has been detected in several food products, as discussed in Section 5.5.4, but consumption of these products should not disproportionately affect children. No data are available regarding the weight-adjusted intake of 1,2-dichloroethane. 1,2-Dichloroethane was formerly used as a fumigant but is not currently registered for use in agricultural products in the United States, Canada, or the United Kingdom. Therefore, it is expected that exposure to 1,2-dichloroethane through food sources will continue to decrease.

Children are unlikely to be exposed to 1,2-dichloroethane from parents' clothing or other objects removed from the workplace because of its volatility. It is possible that exposure may arise from the exhaled breath of parents who are occupationally exposed to 1,2-dichloroethane, but no quantitative data are available to confirm this. 1,2-Dichloroethane has been detected in humans in a number of studies, following exposure of the test subjects to the compound in ambient air and drinking water (Barkley et al. 1980; EPA 1982; Wallace et al. 1984).

There have been no documented exposures of children to 1,2-dichloroethane from pica. Children are unlikely to be exposed to 1,2-dichloroethane from pica since the majority of 1,2-dichloroethane released to the environment is emitted to the atmosphere. Furthermore, much of the 1,2-dichloroethane released to soil is expected to volatilize to air or leach into subsurface soil and groundwater.

5.7 POPULATIONS WITH POTENTIALLY HIGH EXPOSURES

Human exposure to 1,2-dichloroethane is expected to be highest among certain occupational groups and members of the general population living in the vicinity of industrial point emission sources (EPA 1985) and hazardous waste sites. 1,2-Dichloroethane has been detected in both ambient air and water in low concentrations (Fusillo et al. 1985; Isacson et al. 1985; Jüttner 1986; McDonald et al. 1988; Singh et al. 1982). No information was found regarding the number of people potentially exposed around hazardous waste sites. It was estimated that 150,000 people living in the vicinity of manufacturing and formulation plants were potentially exposed to concentrations ranging from 0.01 to 10 ppb 1,2-dichloroethane in ambient air in the late 1970s (Kellam and Dusetzina 1980). Hsu et al. (2018) found that concentrations of 1,2-dichloroethane were significantly high within a 5-km radius of a petrochemical complex in central Taiwan, with concentrations ranging from 0.028 to 0.432 ppb. In a study among workers in Lignite mines in India, workers were exposed to 1,2-dichloroethane at significantly high concentrations ranging from 1.52 to 2.85 ppb (Yao et al. 2021). In a study of several closed batch processes, levels of exposure to 1,2-dichloroethane were determined (Franken et al. 2020). The highest airborne concentrations were measured during rolling and handling of immersed objects, with geometric means of 437 and 324 ppm, and the lowest concentrations were measured during partially closed processes and closed processes, with geometric means of 5.3 and 10.2 ppm, respectively.

Concentrations of VOCs, including 1,2-dichloroethane, and risk levels of wastewater treatment plant employees' exposure to VOCs in Finland have been determined. The concentration of 1,2-dichloroethane was found to be elevated at one of the two plants studied, with a measured concentration of 955.8 μg/L in the trash rake (Lehtinen and Veijanen 2011). Employees at an organic chemical plant site in Chongqing, China were determined to be at elevated cancer risk due to the concentration of 1,2-dichloroethane in soil and groundwater samples (Liu et al. 2016).

Recent information on workplace exposures to 1,2-dichloroethane was not located. Information presented in this paragraph was obtained in the 1970s; thus, data are not likely to pertain to current occupational exposures. The National Occupational Hazard Survey (NOHS), conducted by NIOSH from 1972 to 1974, estimated that 1,909,530 workers in 148,165 plants were potentially exposed to 1,2-dichloroethane in the workplace in 1972–1974 (NIOSH 1976). These estimates were derived from observations of the actual use of 1,2-dichloroethane (5% of total estimate), the use of trade-name products known to contain 1,2-dichloroethane (3%), and the use of generic products suspected of containing the compound (92%).

Neither the NOHS database nor the NOES database contains information on the frequency, level, or duration of exposure of workers to any of the chemicals listed therein. They provide only estimates of workers potentially exposed to the chemicals. There was a large potential for exposure to 1,2-dichloroethane in the workplace during its previous use as a grain fumigant, solvent, and diluent in open-system operations (NIOSH 1978).