5. POTENTIAL FOR HUMAN EXPOSURE

5.1 OVERVIEW

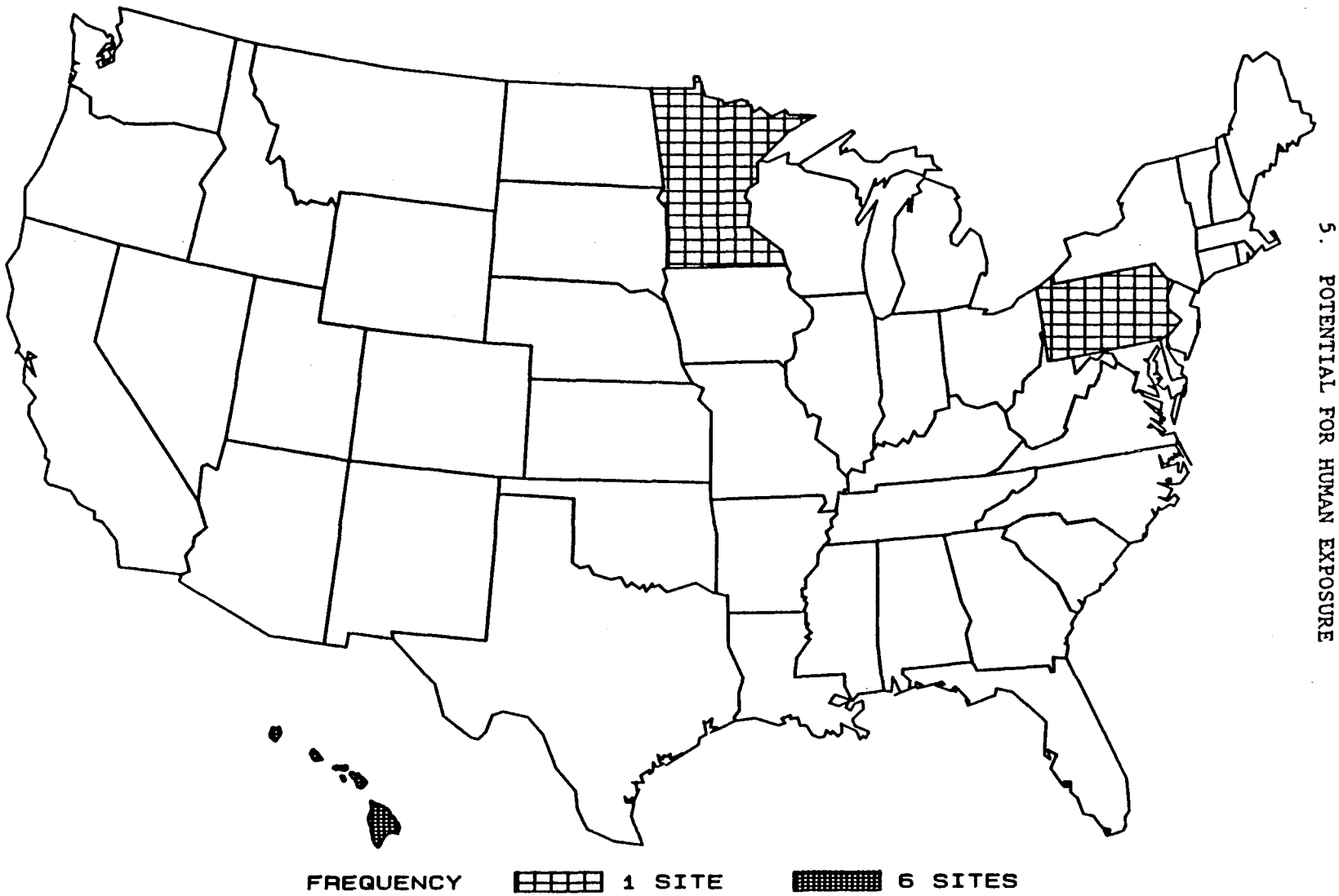
1,2,3-Trichloropropane is a man-made chemical that is present in the environment as a result of anthropogenic activity. Releases to the environment are likely to occur as a result of its manufacture, formulation, and use as a solvent and extractive agent, paint- and varnish-remover, cleaning and degreasing agent, cleaning and maintenance reagent, and chemical intermediate (HSDB 1989). Releases may occur as a result of the disposal of wastes from production of 1,2,3-trichloropropane and disposal of products that contain the chemical, especially at hazardous waste sites that received 1,2,3-trichloropropane-containing wastes. Release to soil can occur through the use of certain soil fumigants and nematocides that are known to contain 1,2,3-trichloropropane as an impurity and through the disposal of 1,2,3-trichloropropane-containing sewage sludge from municipal sewage treatment plants.

In ambient air, the primary removal process is expected to be the vaporphase reaction with photochemically generated hydroxyl radicals. In surface waters, the primary removal process is likely to be volatilization. In soil, the primary removal processes are volatilization from near-surface soil and leaching to groundwater. Aerobic biodegradation is probably a slow process in natural waters and soil. It may persist in groundwater for a relatively long time.

Data regarding the concentrations of 1,2,3-trichloropropane in the environment are limited, but concentrations should not be large except in case of an accidental spill. It has been found at low levels in the United States in a few rivers and bays, drinking water, groundwater, and hazardous waste sites. The EPA has identified 1,177 NPL sites. 1,2,3-Trichloropropane has been found at eight of the sites evaluated for the presence of this chemical. However, we do not know how many of the 1,177 NPL sites have been evaluated for this chemical. As more sites are evaluated by EPA, the number may change. The frequency of these sites within the United States can be seen in Figure 5.1.

The general population can be exposed to low levels of 1,2,3-trichloropropane mainly by ingesting contaminated water. Members of the general population living near waste sites that contain 1,2,3-trichloropropane may be exposed to low levels of 1,2,3-trichloropropane in their drinking water if they obtain their household water from a well. Additional exposure may occur through the inhalation of contaminated air, especially for those who live near facilities that manufacture or use 1,2,3-trichloropropane or at treatment or disposal facilities. Inhalation and dermal exposure may occur during the use of consumer products containing 1,2,3-trichloropropane, such as certain paint removers. It is difficult to assess the extent of general population and occupational exposure because data are lacking. However, significant exposure to 1,2,3-trichloropropane may be unlikely because the compound may no longer be used for purposes other than a chemical intermediate, and current

FIGURE 5-1. FREQUENCY OF NPL SITES WITH 1,2,3-TRICHLOROPROPANE CONTAMINATION *



* Derived from View 1989

manufacturing processes generally occur in closed and tightly sealed systems (NIOSH 1981). The National Occupational Exposure Survey (NOES) conducted by NIOSH from 1981 to 1983 statistically estimated that 492 workers are potentially exposed to 1,2,3-trichloropropane in the United States. The NOES database does not contain information on the frequency, concentration, or duration of exposure of workers to any of the chemicals listed therein. This summary provides only estimates of the number of workers potentially exposed to chemicals in the workplace. Occupational exposure probably results from inhalation and dermal contact.

5.2 RELEASES TO THE ENVIRONMENT

5.2.1 Air

Data on releases of 1,2,3-trichloropropane to the atmosphere are lacking. Based on the few data available, current releases to the air are expected to be relatively small. Minor releases may have occurred as exhaust, stack, and fugitive emissions from its manufacture, formulation, and use as a solvent (HSDB 1989). 1,2,3-Trichloropropane may have been released in the past into the air as a result of its use as a paint- and varnish-remover, a degreasing agent, and a cleaning and maintenance reagent (Hawley 1981; NIOSH 1981). No information was found that indicates that 1,2,3-trichloropropane is still used for these purposes today. Very small amounts may be released during its use as a chemical intermediate and as a result of its formation during the synthesis of other organic chemicals (see Section 4.1). Volatilization from contaminated surface waters, effluent waters, and near-surface soils may also be minor atmospheric sources of this compound. This includes volatilization from identified and unidentified hazardous waste dumps that contain 1,2,3-trichloropropane and from farmland treated with 1,2,3-trichloropropane-contaminated fumigants and nematocides (no information is available to determine whether or not the soil fumigants and nematocides currently manufactured contain 1,2,3-trichloropropane). Small amounts may be released *to* the air during treatment of water containing 1,2,3-trichloropropane, because some of the chemical may be removed via evaporative stripping from the water.

5.2.2 Water

Data on the release of 1,2,3-trichloropropane to environmental waters are lacking. Based on the few data available, current releases to environmental waters are expected to be relatively small. Releases to surface water may have occurred through runoff of waste water from hazardous waste sites containing 1,2,3-trichloropropane and runoff from farmland treated with certain soil fumigants and nematocides that contain 1,2,3-trichloropropane. Releases to surface and groundwater may have occurred as a result of the improper disposal of 1,2,3-trichloropropane-containing industrial wastes or wastes from its use in paint- and varnish-removers, cleaning and degreasing agents, and maintenance reagents. Releases to groundwater may have occurred

as a result of the chemical leaching through soil at waste sites and agricultural soil treated with fumigants that contain the chemical. Small amounts of the chemical may have entered surface waters as a result of washout from 1,2,3-trichloropropane-contaminated air; however, some of the 1,2,3-trichloropropane removed from the atmosphere by washout is likely to have re-entered the atmosphere by volatilization. The chemical was found in groundwater at 0.71% of the sites in the Contract Laboratory Program Statistical Database (CLPSD) at a geometric mean concentration of 57.3 µg/L (CLPSD 1989). Note that the CLPSD includes data from both NPL and non-NPL sites.

5.2.3 Soil

Data on releases of 1,2,3-trichloropropane to soils are sparse, which makes a quantitative estimation of the magnitude of such releases impossible. However, releases to soils are expected to be relatively small based upon the available data. Releases to farmland soil have occurred as a result of the use of certain soil fumigants and nematocides known to contain 1,2,3-trichloropropane as an impurity. No current information is available, however, that indicates that these soil fumigants and nematocides still contain 1,2,3-trichloropropane. Releases of the chemical to soil may have occurred as a result of disposal of 1,2,3-trichloropropane-containing sewage sludge from municipal sewage treatment plants (Jacobs and Zabik 1983). Very small amounts of the chemical may be brought to the surface of the earth as a result of washout from 1,2,3-trichloropropane-containing air; however, much of the 1,2,3-trichloropropane removed from the atmosphere by washout may re-enter the atmosphere by volatilization from near-surface soil. Land disposal of wastes from its use in paint- and varnish-removers, cleaning and degreasing agents, and cleaning and maintenance reagents may have released 1,2,3-trichloropropane to soil. The chemical was found in soil at 0.71% of the sites in the CLPSD at a geometric mean concentration of 204 µg/kg (CLPSD 1989). Note that the CLPSD includes data from both NPL and non-NPL sites.

5.3 ENVIRONMENTAL FATE

5.3.1 Transport and Partitioning

No experimental or predictive data were located in the literature regarding the transport of 1,2,3-trichloropropane in the atmosphere. 1,2,3-Trichloropropane is expected to exist in the atmosphere predominantly in the vapor phase, based on its vapor pressure (Table 3-2) (Eisenreich et al. 1981; MacKay et al. 1982). The speculation that substantial amounts of 1,2,3-trichloropropane are not likely to be present in the particulate phase indicates that dry deposition to the earth's surface will not be an important removal process. Based upon its low water solubility and moderate vapor pressure (Table 3-2), very small amounts of 1,2,3-trichloropropane present in

air may be removed by wet deposition; however, much of the 1,2,3-trichloropropane removed from the atmosphere by washout is likely to re-enter the atmosphere by volatilization.

Based upon an estimated soil organic carbon partition coefficient (K_{oc}) of 98 (calculated from water solubility) (Lyman et al. 1982; Riddick et al. 1986), 1,2,3-trichloropropane is expected to display high mobility in soil (Swann et al. 1983); therefore, it has the potential to leach into groundwater. This predicted mobility is confirmed by the detection of 1,2,3-trichloropropane in groundwater from various locations (see Section 5.4.2). The vapor pressure of 1,2,3-trichloropropane (3.1 mmHg at 25°C) (MacKay et al. 1982), and the calculated Henry's law constant (3.17×10^{-4} atm-m^3/mol at 25°C) (Lyman et al. 1982) suggest that volatilization from either dry or moist soil to the atmosphere will be a significant environmental process.

1,2,3-Trichloropropane in surface water is expected to volatilize rapidly to the atmosphere. An experimental half-life of 56.1 minutes has been measured for evaporation of 1,2,3-trichloropropane from a 1 ppm solution, with a depth of 6.5 cm, stirred with a shallow pitch propeller at 200 rpm at 25°C under still air (less than 0.2 mph air currents) (Dilling 1977). Using the Henry's law constant, a half-life of 6.9 hours was calculated for evaporation from a model river 1 m deep, flowing at 1 m/set, with a wind velocity of 3 m/set, and neglecting adsorption to sediment (Lyman et al. 1982). A volatilization half-life of 3.5 days from a model pond can be estimated (EPA 1985). 1,2,3-Trichloropropane is not expected to significantly adsorb to sediment and suspended organic matter based upon the estimated K_{oc} of 98 (calculated from water solubility) (Lyman et al. 1982; Riddick et al. 1986). It is also not expected to significantly bioconcentrate in fish and aquatic organisms based upon an estimated bioconcentration factor (BCF) of 9.2 (calculated from log octanol-water partition coefficient (K_{ow}) (EPA 1988b; Lyman et al. 1982). No data were located to indicate a potential for 1,2,3-trichloropropane to biomagnify from lower to higher trophic states of the food chain, but based upon the estimated BCF, this is not likely.

5.3.2 Transformation and Degradation

5.3.2.1 Air

The primary degradation process for 1,2,3-trichloropropane in the atmosphere is expected to occur via gas-phase reaction with photochemically produced hydroxyl radicals. The rate constant for this process is an estimated 1.0475×10^{-12} cm^3/molecule-sec (Atkinson 1987). This corresponds to a half-life of 15.3 days at an estimated atmospheric concentration of 5×10^5 hydroxyl radicals/cm^3. Direct photolysis of 1,2,3-trichloropropane is not

expected to occur in the atmosphere because the chemical lacks a chromophore that absorbs light at environmentally significant wavelengths (greater than 290 nm) (Silverstein et al. 1974).

5.3.2.2 Water

Degradation of 1,2,3-trichloropropane in natural waters is expected to be a slow process. The chemical should volatilize from surface waters before significant degradation can occur. Hydrolysis of 1,2,3-trichloropropane in natural waters is not expected to be a significant removal process. The measured neutral and base hydrolysis rate constants at 25°C are 1.8×10^{-6} $hour^{-1}$ and 9.9×10^{-4} M^{-1} $hour^{-1}$, respectively (EPA 1988c). These rate constants correspond to a hydrolysis half-life of 44 years over a pH range of 5-9. Direct photolysis of 1,2,3-trichloropropane is not expected to occur in environmental waters because the chemical lacks a chromophore that absorbs light at environmentally significant wavelengths (greater than 290 nm) (Silverstein et al. 1974).

No studies were located regarding the biodegradation of 1,2,3-trichloropropane in natural waters. An aqueous screening study with activated sewage sludge has indicated that 1,2,3-trichloropropane can be removed by biological treatment processes and that at least part of the removal was due to volatilization. However, this study cannot be used to predict the biodegradability of this compound under natural conditions. Other authors have observed that halogenated hydrocarbons, in general, and especially those with multiple chlorine substitution, such as 1,1,2-trichloroethane and 1,1,2,2-tetrachloroethane, are recalcitrant towards biodegradation (Kawasaki 1980; Tabak et al. 1981). No data concerning the potential for anaerobic aqueous biodegradation of 1,2,3-trichloropropane were found.

5.3.2.3 Soil

No data specifically regarding the degradation of 1,2,3-trichloropropane in soil were found. However, it has been observed that 1,2-dichloropropane will not significantly biodegrade in soil (Roberts and Stoydin 1976). Therefore, 1,2,3-trichloropropane is expected to be even less biodegradable because it contains an additional chlorine. The rate of 1,2,3-trichloropropane loss from soil due to biodegradation may not be significant when compared with its loss by volatilization and leaching from soil. 1,2,3-Trichloropropane will be lost from the soil by evaporation (from both moist and dry near-surface soil) and by leaching to groundwater before 1,2,3-trichloropropane will hydrolyze in soil. Direct photolysis on the surface of soil will not occur.

5.4 LEVELS MONITORED OR ESTIMATED IN THE ENVIRONMENT

5.4.1 Air

No data were located regarding the detection of 1,2,3-trichloropropane in ambient air in the United States. Therefore, no estimate of U.S. atmospheric levels of the chemical, including background levels, is possible.

5.4.2 Water

Limited data are available regarding the detection of 1,2,3-trichloropropane in environmental waters. It has been detected by one of the sampling techniques at less than 0.2 µg/L in drinking water from the Carrollton Water Plant in New Orleans, Louisiana, sampled during August, 1974; however, since two of the three sampling techniques failed to detect the compound, the significance of this detection is in question (Keith et al. 1976). 1,2,3-Trichloropropane has been qualitatively detected in the drinking water of Cincinnati, Ohio, sampled during 1978 (EPA 1984), and Ames, Iowa, on an unspecified date (EPA 1987). Data from the EPA STORET Data Base indicate that 1,2,3-trichloropropane was found in 39% of 941 samples of groundwater at a median concentration of 0.69 µg/L, at an average concentration of 1.0 µg/L, and a range of trace (below unspecified detection limit) to 2.5 µg/L (STORET 1989). It has been found at concentrations ranging from 0.1 to 5.0 µg/L in groundwater samples from California and Hawaii during small- and large-scale retrospective studies of farmlands possibly treated with fumigants and nematocides that contained 1,2,3-trichloropropane as an impurity (Cohen et al. 1986, 1987). The locations that had 1,2,3-trichloropropane-contaminated wells included the island of Oahu, Hawaii, and the Central Valley of California. Typical concentrations ranged from 0.2 to 2 µg/L. 1,2,3-Trichloropropane was found in water from nine of nine wells in Oahu, Hawaii, sampled in 1983 and 1984 at maximum concentrations ranging from 0.30 to 2.8 µg/L (Oki and Giambelluca 1987). The wells had been closed previously to drinking water use due to contamination with other halogenated hydrocarbons.1,2,3-Trichloropropane has been detected in groundwater from 2 of 10 sites in an agricultural community in Suffolk County, New York, at concentrations of 6 and 10 µg /L (Lykins and Baier 1985).

1,2,3-Trichloropropane was qualitatively found in 1 of 30 water samples from the Delaware, Schuylkill, and Lehigh Rivers, taken February 17-20, 1976 (DeWalle and Chian 1978). 1,2,3-Trichloropropane was qualitatively found in water from Narragansett Bay, Rhode Island, sampled during the summers of 1979 and 1980, and the winters of 1980 and 1981 (Wakeham et al. 1983). Some samples reportedly contained significant levels of the chemical. The chemical was qualitatively detected in effluent from an advanced waste treatment plant in Lake Tahoe, California, in 1974 (EPA 1984). The chemical was found in groundwater at 0.71% of the sites in the CLPSD, which includes data from both NPL and non-NPL sites, at a geometric mean concentration of 57.3 µg/L (CLPSD 1989). 1,2,3-Trichloropropane was found in 69 of 141 samples of sewage

sludges from municipal sewage treatment plants in Michigan in 1980 (Jacobs and Zabik 1983). The median and average concentrations of 1,2,3-trichloropropane in the sludges were 0.352 and 1.07 mg/kg, respectively, and the range was 0.00459-19.5 mg/kg on a dry-weight basis.

5.4.3 Soil

Limited data are available regarding the detection of 1,2,3-trichloropropane in soil samples. It has been found in soil samples from California and Hawaii during small- and large-scale retrospective studies at levels typically ranging from 0.2 to 2 ppb (Cohen et al. 1987). It was found at least 10 feet down in the soil profiles in Hawaii. 1,2,3-Trichloropropane may be present in these soils as a result of the use of dichloropropene (a soil fumigant and nematocide). 1,2,3-Trichloropropane is used in the preparation of this nematocide and is an impurity in the formulation of it (Baier et al. 1987). 1,2,3-Trichloropropane was not found in any of the soil samples from the sites in the CLPSD (1988). The detection of the chemical in the groundwater of hazardous waste sites, however, suggests that it is released to soil at these sites. The chemical was found in soil at 0.71% of the sites of the CLPSD at a geometric mean concentration of 204 pg/L (CLPSD 1989); the CLPSD includes data from both NPL and non-NPL sites.

5.4.4 Other Environmental Media

1,2,3-Trichloropropane has been qualitatively identified as a component of ethylene dichloride-tar, a tarlike, oily waste byproduct of vinyl chloride production that had been disposed of by dumping into the sea (Jensen et al. 1975). The chemical has been found in the volatile products from the thermal oxidative degradation of the flame-retardant plasticizer, tris(dichloropropy1) phosphate (Christos et al. 1977). No information was found that indicated that 1,2,3-trichloropropane has been found in food. Because of the lack of recent comprehensive monitoring data, the average daily intake of i,2,3-trichloropropane and the relative significance of each source of exposure cannot be determined.

5.5 GENERAL POPULATION AND OCCUPATIONAL EXPOSURE

There are not enough measured data to assess the general population's exposure to this compound. The paucity of data may be the result of either a lack of 1,2,3-trichloropropane contamination in the environment or a lack of studies that attempt to identify and quantify the compound in the environment using sufficiently sensitive techniques. Based upon the few data available, the estimated transport and partitioning properties of the compound, and information on production and use, the following estimations concerning exposure can be made. A small part of the population may be exposed to very low levels of 1,2,3-trichloropropane through the ingestion of contaminated drinking water. Exposure to very low levels of 1,2,3-trichloropropane also may occur through the inhalation of contaminated air; however, no monitoring

data regarding the presence of 1,2,3-trichloropropane in the atmosphere in the United States were located. General exposure to air containing low levels may occur near chemical manufacturing facilities that produce 1,2,3-trichloropropane and certain other chemicals, near 1,2,3-trichloropropane-containing hazardous waste dumps, and farmlands treated with fumigants and nematocides that contain 1,2,3-trichloropropane. No current information is available, however, that indicates that 1,2,3-trichloropropane is still present in soil fumigant formulations, and commercial manufacturing processes generally occur in closed and tightly sealed systems (NIOSH 1981). Inhalation and dermal exposure may occur during the use of 1,2,3-trichloropropane as a solvent and extractive agent, in paint- and varnish-removers, in cleaning and degreasing agents, and in cleaning and maintenance reagents, although there is no current information that indicates that the compound is still used for these purposes (Hawley 1981; NIOSH 1981). No data regarding the detection of 1,2,3-trichloropropane in humans in the United States were located.

According to the NOES conducted by NIOSH from 1981 to 1983, 492 workers (of which 9 were women) were potentially exposed to 1,2,3-trichloropropane in the workplace in 1980 (NIOSH 1989); however, no report of actual measured exposure levels in any occupational situation in the United States was located. The NOES database does not contain information on the frequency, concentration, or duration of exposure of workers to any of the chemicals therein. This survey provides only an estimate of the number of workers potentially exposed to chemicals in the workplace. Occupational exposure to 1,2,3-trichloropropane is expected to be higher in facilities where the chemical or products containing the chemical are used than in facilities that produce 1,2,3-trichloropropane either directly or as a byproduct, since the commercial manufacturing processes generally occur in closed and tightly sealed systems (NIOSH 1981). Furthermore, exposure may result from procedures that require direct handling of the material; these include purification, formulation of products, sampling and quality control, packaging and storage, leakage of equipment, startup and shutdown procedures, maintenance, cleanup, spills, and other plant emergencies (NIOSH 1981).

5.6 POPULATIONS WITH POTENTIALLY HIGH EXPOSURES

Data regarding the presence of 1,2,3-trichloropropane in the environment are lacking, which prevents the thorough assessment of the potential for high exposure in various populations. Populations with potentially high exposure to 1,2,3-trichloropropane will generally include those that may be exposed to environmental contamination over long periods of time. These may include populations exposed to low levels of 1,2,3-trichloropropane via inhalation of contaminated air at or near both identified and unidentified 1,2,3-trichloropropane-containing waste disposal sites and landfills. Children playing in and around these sites may also be dermally exposed to soil containing 1,2,3-trichloropropane, although any 1,2,3-trichloropropane il surface soil would be expected to volatilize or leach through the soil.

Persons whose drinking water is derived from 1,2,3-trichloropropanecontaminated groundwater or surface water for a long period of time may be exposed to relatively high levels of 1,2,3-trichloropropane. Workers involved in the manufacture or use of 1,2,3-trichloropropane or 1,2,3-trichloropropanecontaining products may have the highest potential for exposure to 1,2,3-trichloropropane. Potentially high general population exposure may occur during the use of 1,2,3-trichloropropane-containing products, such as paint- and varnish-removers and cleaners, especially when they are used in poorly ventilated areas such as in the cleaning of reactors. Exposure through the manufacture or use of 1,2,3-trichloropropane-containing products may not be significant, however, since current manufacturing processes generally occur in closed and tightly sealed systems (NIOSH 1981) and no current information indicates that 1,2,3-trichloropropane is still used for those purposes listed.

5.7 ADEQUACY OF THE DATABASE

Section 104(i)(5) of CERCLA as amended directs the Administrator of ATSDR (in consultation with the Administrator of EPA and agencies and programs of the Public Health Service) to assess whether adequate information on the health effects of 1,2,3-trichloropropane is available. Where adequate information is not available, ATSDR, in conjunction with the NTP, is required to assure the initiation of a program of research designed to determine the health effects (and techniques for developing methods to determine such health effects) of 1,2,3-trichloropropane. The following categories of possible data needs have been identified by a joint team of scientists from ATSDR, NTP, and EPA. They are defined as substance-specific informational needs that, if met, would reduce or eliminate the uncertainties of human health assessment. In the future, the identified data needs will be evaluated and prioritized, and a substance-specific research agenda will be proposed.

5.7.1 Data Needs

Physical and Chemical Properties. Physical and chemical property data are essential for estimating the transport and partitioning of a chemical in the environment. Many of the physical and chemical properties of 1,2,3-trichloropropane are available (Table 3-2) (Hawley 1981; HSDB 1989; Mackay et al. 1982; McNeil1 1979; Riddick et al. 1986; Ruth 1986; Weast 1985; Williams 1949). However, only estimated values are listed for the log K_{ow}, K_{oc}, and BCF (Lyman et al. 1982). Since the log K_{ow} was used to estimate the K_{oc} and BCF, an experimentally determined log K_{ow} would lead to less uncertainty in those estimated properties. Experimentally determined values would remove any doubt regarding the reliability of these data, although the techniques used for the estimations appear to be accurate.

Production, Import/Export, Use, and Disposal. Data regarding the production methods for 1,2,3-trichloropropane are available (Bauer et al.

1987; Hawley 1981; NIOSH 1981; SRI 1989; Williams 1949); however, data regarding current production, import, and export volumes, and use patterns are lacking. We do know that the chemical is currently produced (SRI 1989), but not in what quantities or whether future production levels will increase, We do not know if the chemical is widely used in the home, the environment, or in the workplace, but it does not appear that such widespread use is likely. It has not been found in food although foods may not have been tested for its presence. Use, release, and disposal information is useful for determining where environmental exposure to 1,2,3-trichloropropane may be high, and may help in estimating whether exposure is likely, and therefore may help to determine whether further toxicological studies are warranted. General data are available regarding the methods of disposal of 1,2,3-trichloropropane (HSDB 1989; Matsui et al. 1975), but information concerning the efficiencies of these methods, as well as the amount disposed of by each method is lacking. Specific disposal information, obtainable by polling industries or industry organizations, may be useful for determining environmental burden and potential concentrations where environmental exposures may be high. Rules and regulations governing land disposal of 1,2,3-trichloropropane are known (EPA 1988a).

Environmental Fate. The environmental fate of 1,2,3-trichloropropane remains unclear due to a lack of experimental data. We do not know where the chemical partitions in the environment. However, based upon estimated physical properties (Lyman et al. 1982), the chemical is expected to partition into the atmosphere and groundwater (Swann et al. 1983). It has been shown that the chemical leaches through soil (Cohen et al. 1986, 1987; Lykins and Baier 1985; Oki and Giamelluca 1987; STORET 1989). It is estimated that it can volatilize ,through near-surface soil and water to the atmosphere (EPA 1985; Lyman et al. 1982). Nothing definitive is known about the biodegradability of the compound. The rate constant for reaction with hydroxyl radicals in the atmosphere is an estimated value (Atkinson 1987), as are significant partition coefficient values used in predicting the environmental fate of the compound (EPA 1988b). Experimental data in these areas would aid in assessing the ultimate environmental fate of 1,2,3-trichloropropane, which would, in turn aid in assessing its background levels in the environment and levels of human exposure.

Bioavailability from Environmental Media. Studies have shown that 1,2,3-trichloropropane is absorbed through the lungs, gastrointestinal tract, and skin of animals (see Section 2.3.1) (Alpert 1982; Clark 1977; Johannsen et al. 1988; Sipes et al. 1982; Union Carbide 1958; Volp et al. 1984). This indicates that it may be absorbed through the inhalation of contaminated air, ingestion of contaminated water, food, and soil, and through dermal contact. The amount of 1,2,3-trichloropropane that is bioavailable from each route is not well documented, and no data were found for humans. Data on the bioavailability of 1,2,3-trichloropropane would be helpful in assessing the importance of environmental exposure levels.

Food Chain Bioaccumulation. The estimated BCF for 1,2,3-trichloropropane (EPA 1988b; Lyman et al. 1982) indicates that this compound would not significantly bioconcentrate in plants, aquatic organisms, or animals. No experimental data were found to support this conclusion. Information was unavailable on the biomagnification of 1,2,3-trichloropropane in food chains. Additional information on bioconcentration by plants, aquatic organisms, and animals and biomagnification in terrestrial and aquatic food chains could be helpful because it might help to indicate whether the chemical biomagnifies in food chains and thereby poses a potential for significant exposure. Biomagnification is not likely, however, based upon the estimated BCF.

Exposure Levels in Environmental Media. Limited data were available regarding the levels of 1,2,3-trichloropropane in the environment (Baier et al. 1987; CLPSD 1989; Cohen et al. 1986, 1987; Dewalle and Chian 1978; EPA 1984, 1987; Jacobs and Zabik 1983; Keith et al. 1976; Lykins and Baier 1985; Oki and Giambelluca 1987; STORET 1989; Wakeham et al. 1983). Information on exposure to 1,2,3-trichloropropane from environmental media would be useful, especially from drinking water derived from groundwater downgradient from 1,2,3-trichloropropane-containing hazardous waste disposal sites and other contaminated surface waters, air near facilities that make or use products containing the compound, and soil at waste disposal sites. Data concerning the presence of 1,2,3-trichloropropane in foods would also be useful in assessing potential exposure.

Exposure Levels in Humans. No data have been found that indicate that 1,2,3-trichloropropane has been found in human samples of blood, urine, fat, or breast milk. Furthermore, no biomarkers of exposure or effect have been identified. Data on both workplace exposure and ambient environmental exposure are sparse and outdated (NIOSH 1981; 1989). A detailed, recent database of exposure would be helpful in determining the current exposure levels, thus allowing estimation of the average daily dose associated with various scenarios such as living near a hazardous waste disposal site, drinking contaminated drinking water, or working in a contaminated workplace. This database of exposure may be very useful if current use patterns, for which information is not available, warrant it.

Exposure Registries. No exposure registries for 1,2,3-trichloropropane were located. This compound is not currently one of the compounds for which a subregistry has been established in the National Exposure Registry. The compound will be considered in the future when chemical selection is made for subregistries to be established. The information that is amassed in the National Exposure Registry facilitates the epidemiological research needed to assess adverse health outcomes that may be related to the exposure to this compound.

5.7.2 On-going Studies

Remedial investigations and feasibility studies conducted at the eight NPL sites known to be contaminated with 1,2,3-trichloropropane will add to the available database on exposure levels in environmental media, exposure levels in humans, and exposure registries and will increase the current knowledge regarding transport and transformation of 1,2,3-trichloropropane in the environment.

As part of the Third National Health and Nutrition Evaluation Survey (NHANES III), the Environmental Health Laboratory Sciences Division of the Center for Environmental Health and Injury Control, Centers for Disease Control, will be analyzing human blood samples for 1,2,3-trichloropropane and other volatile organic compounds. These data will indicate the frequency of occurrence and background levels of these compounds in the general population.

No other on-going studies were located.