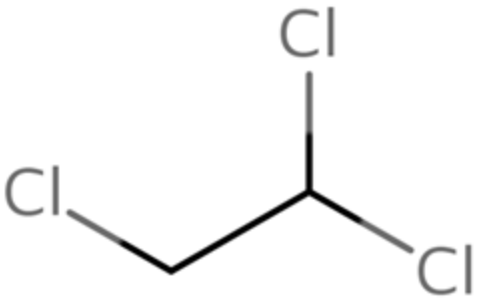
United States
Environmental Protection Agency

EPA Document# EPA-740D-26-026
July 2026
Office of Chemical Safety and
Pollution Prevention

Draft Risk Evaluation for 1,1,2-Trichloroethane

CASRN 79-00-5



July 2026

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDIX TABLES

ACKNOWLEDGEMENTS

The Assessment Team gratefully acknowledges the participation, input, and review comments from U.S. Environmental Protection Agency (EPA or the Agency) Office of Pollution Prevention and Toxics (OPPT) and Office of Chemical Safety and Pollution Prevention (OCSPP) senior managers and science advisors as well as the Office of General Council. The Agency is also grateful for assistance from the following EPA contractors: Abt Associates, Inc. (Contract Number EP-W-16-009); Eastern Research Group (Contract Nos. GS-00F-979CA and 68HERC23D0006); General Dynamics Information Technology, Inc. (Contract Nos. HHSN316201200013W and 68HERD24A0001); ICF (Contract Nos. 68HERC23D0007 and 68HERC19D0003); Spec Professional Services, LLC (Contract No. 68HERC20D0021); SpecPro Sustainable and Environmental, Inc. (Contract No. 68HERC25D0004); SRC, Inc. (Contract Nos. 68HERH19D0022 and 68HERC25D0001); and Versar (Contract No. EO-W-17-006).

Docket

Supporting information can be found in the public docket, Docket IDs EPA-HQ-OPPT-2026-2246 and EPA-HQ-OPPT-2018-0421.

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EXECUTIVE SUMMARY

Background

EPA evaluated the human health and environmental risks of the chemical 1,1,2-trichloroethane across its conditions of use (COUs) under section 6 of the Toxic Substances Control Act (TSCA), ranging from manufacture to disposal (see Table 1-1). In this draft risk evaluation, 10 of 12 assessed COUs for 1,1,2-trichloroethane significantly contribute to a preliminary determination of unreasonable risk of injury to human health. As shown in Table ES-1, of these 10 COUs for 1,1,2-trichloroethane that significantly contribute to a preliminary determination of unreasonable risk, all 10 COUs significantly contribute to dermal and/or inhalation risk to workers whereas 4 COUs significantly contribute to inhalation risk to occupational non-users (ONUs[1]). EPA has preliminarily determined that no COUs for 1,1,2-trichloroethane significantly contribute to unreasonable risk to consumers, the general population, or the environment.

1,1,2-Trichloroethane is a volatile, colorless, and oily liquid with a chloroform-like odor that is primarily used in the synthesis of other organic chemicals. Although volatile, it is also soluble in water (up to its solubility limit of 4,580 mg/L) and is miscible in most organic solvents. 1,1,2-Trichloroethane is persistent in the environment and slowly degrades over months to years if released to air, water, soil, and sediment. Estimated bioconcentration and bioaccumulation factors indicate that 1,1,2-trichloroethane is not likely to bioaccumulate in aquatic or terrestrial organisms.

In December 2019, EPA designated 1,1,2-trichloroethane as a high-priority substance for TSCA evaluation and in August 2020 released the final scope document (U.S. EPA, 2020b). Manufacturers, based on the 2024 Chemical Data Reporting (CDR) (U.S. EPA, 2026b), report that 1,1,2-trichloroethane annual production volumes, which also include imports, are between 10 million and 50 million pounds (lb). CDR provides data from domestic manufacturers (including importers) of 1,1,2-trichloroethane. EPA's assessment of manufacturing was specific to manufacturing of 1,1,2-trichloroethane as an unintended byproduct. The Agency's current understanding based on CDR data, the test order process, and other sources, is that manufacture of 1,1,2-trichloroethane occurs primarily or predominantly as an unintentional byproduct during the production of other chemicals—as opposed to intentional manufacturing of 1,1,2-trichloroethane. Chemical manufacturers will seek to reclaim value from byproduct streams and information supports the understanding that 1,1,2-trichloroethane in byproduct streams is used as a reactant in the production of other chemicals. Information from non-CDR data sources—including facility reported data to the Toxics Release Inventory (TRI), Discharge Monitoring Reports (DMR), National Emissions Inventory (NEI), safety data sheets (SDS), and import landings data from Datamyne (Descartes Systems Group, 2018)—indicated several downstream industrial and commercial COUs.

This draft risk evaluation assesses risks to both human health and the environment, including fenceline communities and potentially exposed or susceptible subpopulations (PESS). All supporting files are being released for public comment; the human health and environmental hazard technical support document (TSD) (U.S. EPA, 2026w) and the chemistry, fate, release, and exposure TSD (U.S. EPA, 2026g) will undergo independent, expert peer review through the Science Advisory Committee on Chemicals (SACC). Following public comment and expert peer review, EPA will consider all comments and recommendations and issue a final risk evaluation, which will include the Agency's determination as to whether 1,1,2-trichloroethane presents unreasonable risk to human health or the environment based on identified risk of injury from COUs.

[1] ONUs do not directly handle 1,1,2-trichloroethane but may be indirectly exposed to it in the workplace as part of their employment.

Laboratory animal studies were previously conducted to determine whether exposure to 1,1,2-trichloroethane can cause a range of non-cancer and cancer health effects and suggest that 1,1,2-trichloroethane can be harmful to people if they are exposed at sufficient levels, as described in the hazard technical support document (U.S. EPA, 2026w). The selected hazard endpoints for the oral and dermal routes are neurotoxicity for acute durations and immunological effects for intermediate and chronic durations. For the inhalation route, the hazard endpoint was respiratory (olfactory) effects for all durations. 1,1,2-Trichloroethane is genotoxic and carcinogenic. The cancer slope factor was based on liver tumors. The inhalation unit risk was derived via route-to-route extrapolation using a physiologically based pharmacokinetic (PBPK) model initially developed by the Sapphire Group (2002) under the Final Enforceable Consent Agreement for 1,1,2-Trichloroethane and Accompanying Testing Consent Order, signed by EPA on June 7, 2000, which was subsequently revalidated by EPA for this assessment. See the *Draft Human Health and Environmental Hazard Assessment for 1,1,2-Trichloroethane* (U.S. EPA, 2026w) for more information.

In this draft risk evaluation, EPA utilized personal breathing zone (PBZ) monitoring data obtained through TSCA section 4's test order authority for the COU, Manufacturing – Domestic manufacture – Domestic manufacture (see also Table 1-1). Exposures to sediment-dwelling organisms were also based on hazard data obtained through EPA's test order authority. EPA also evaluated whether manufacturing, processing, distribution in commerce, use, or disposal of 1,1,2-trichloroethane contributes to unreasonable risk of injury to human health or the environment under the COUs evaluated. Human or environmental exposure to 1,1,2-trichloroethane through uses that are not subject to TSCA (*e.g.,* tobacco smoke) were not evaluated by the Agency in this evaluation because such uses are excluded from TSCA's definition of "chemical substance."

In this draft risk evaluation, EPA assessed human health risk to workers and ONUs, consumers, and the general population, including fenceline communities and PESS exposed to environmental releases of 1,1,2-trichloroethane. This draft risk evaluation also assessed risk to the environment. Specifically, EPA evaluated acute, intermediate, chronic and cancer risks to workers and ONUs exposed to 1,1,2-trichloroethane in and near the workplace. The Agency also assessed acute and chronic non-cancer risk to consumers from 1,1,2-trichloroethane-containing products or articles. However, the Agency acknowledges consumer exposure may not be chronic in nature for the adhesive product identified and evaluated for 1,1,2-trichloroethane based on rapid elimination of 1,1,2-trichloroethane from the body (<1 day) and use profile for the product. Rather, consumer exposure may be better represented as repeat acute exposures for the one product evaluated over the course of a year.

The Agency did not assess cancer risk to consumers based on the consumer use patterns of the product identified and because the scientific evidence that does not indicate a single, acute exposure would lead to cancer effects. Specifically, for cancer the consumer use pattern for the adhesive product identified has a 5-minute use window and 5 to 20 minutes of inhalation exposure when used to repair items. This use profile does not align with a daily, weekly, or monthly use pattern every year for a consumer's entire lifetime. Additionally, findings from the National Cancer Institute mouse study (NCI, 1978) found it took 55 weeks at the low dose of 195 mg/kg-day for 5 days per week to develop the first tumors in the liver. A later study (Milman et al., 1988) showed it took 7 weeks of exposure at a dose of 70 mg/kg/day to develop precancerous lesions in the liver when also pre-treated with a potent tumor initiator. Since these continuous, longer term, high doses do not align with the consumer use profile for the product evaluated or the relative inhaled concentration from the consumer product, the Agency determined there are no single consumer exposure scenarios expected that could lead to cancer effects identified for 1,1,2-trichloroethane and therefore did not evaluate cancer risk to consumers in this assessment.

EPA evaluated facility-specific and modeled releases to air, water, and land for each COU scenario and estimated exposures and associated risks to the general population and environment. The general population assessed in this draft risk evaluation includes fenceline communities and PESS that can be exposed when facilities release 1,1,2-trichloroethane into the environment. EPA used chemical-specific data where available; however, surrogate data and modeling were used to characterize certain scenarios that lacked monitoring data. Human or environmental exposure to 1,1,2-trichloroethane through uses that are not subject to TSCA (*e.g.,* use in cosmetics, medical devices, food additives) were not specifically evaluated by the Agency in reaching its preliminary determination. This is because these uses are excluded from TSCA's definition of a chemical substance (under TSCA section 3(2)(B)). Thus, conclusions in this draft evaluation cannot be extrapolated to form conclusions about uses of 1,1,2-trichloroethane that are not subject to TSCA and that EPA did not evaluate.

Determining Unreasonable Risk to Human Health

In TSCA existing chemical risk evaluations, EPA must determine whether a chemical substance under the COUs, does or does not present unreasonable risk of injury to human health or the environment. The unreasonable risk must be consistent with the best available science. The Agency, in determining whether 1,1,2-trichloroethane presents unreasonable risk to human health and the environment, considered risk-related factors as described in its risk evaluation framework rule and as required under TSCA (see TSCA section 6(b)(4)(F); 89 FR 37028, 37037 [May 3, 2024]). Risk-related factors beyond the levels of 1,1,2-trichloroethane that can impact the unreasonable risk determination include but are not limited to the type of health effect under consideration; the reversibility of the health effect being evaluated; exposure-related considerations (*e.g.,* duration, magnitude, frequency of exposure); population exposed (including any PESS); as well as EPA's confidence in the information used to inform the hazard and exposure values. These considerations are included as part of the evaluation of hazard and exposure to 1,1,2-trichloroethane. If an estimate of risk for a specific scenario exceeds the standard risk benchmarks, then the determination of whether those risks significantly contribute to the unreasonable risk of 1,1,2-trichloroethane under TSCA is both case-by-case and context-driven. EPA considers all risk-related factors when making a determination of whether a COU under TSCA significantly contributes to unreasonable risk.

To determine whether 1,1,2-trichloroethane presents an unreasonable risk of injury to human health, EPA considered the following PESS in its assessment: pregnant women; infants; children; people who frequently use consumer products and/or articles containing high concentrations of 1,1,2-trichloroethane; people exposed to 1,1,2-trichloroethane in the workplace; and people in close proximity to releasing facilities, including fenceline communities. These subpopulations are PESS because some have greater exposure to 1,1,2-trichloroethane per body weight (*e.g.,* infants, children, adolescents) while others can experience exposure from multiple sources, higher exposures than others, or exhibit greater biological susceptibility than the general population. Although variability in susceptibility across the human population is likely, EPA did not identify specific human groups that are expected to be more susceptible to cancer or non-cancer effects following 1,1,2-trichloroethane exposure; however, it should be noted that the Agency used an uncertainty factor (UF) of 10 to account for human variability that would include the PESS identified above.

EPA considered the weight of scientific evidence to determine confidence levels in underlying datasets and risk estimates of 1,1,2-trichloroethane for human health (Section 4.3). Workers with the greatest potential for exposure are those who work directly with the chemical in environments where 1,1,2-trichloroethane is manufactured, processed, used, or disposed of. For the general population, the Agency has robust confidence in inhalation risk estimates from ambient air. EPA has robust confidence in the modeling methods used for estimating inhalation risks to the general population and robust confidence

that these methods resulted in the best available modeling estimates based on the inputs used. In general, for inhalation risk estimates to the general population, the Agency has robust confidence that the risk estimates are representative of high-end exposures to actual exposed populations when there are facility-reported release data from multiple reporting databases (TRI and NEI), moderate confidence where there was data from only one database, and low confidence for the occupational exposure scenario (OES) where only EPA-estimated releases from generic facilities/sites were available. The Agency has robust confidence in oral and dermal risk estimates from other pathways (drinking water intake and incidental dermal and ingestion via swimming; Sections 4.3.4.2, 4.3.4.3, and 4.3.4.4) and that these estimates represent the high-end risk and are protective of highly exposed populations.

For workers, EPA has slight-to-robust confidence in the risk estimates calculated for inhalation exposure scenarios, moderate confidence in the risk estimates for non-cancer dermal scenarios, and moderate confidence in the risk estimates for cancer dermal exposure (Section 4.3.2.3). Two OESs—Repackaging for Laboratory Chemical Use as well as Disposal to Landfill—have confidence ratings of slight-to-moderate, with moderate confidence for workers and slight confidence for ONUs. For consumers, EPA has robust confidence in the risk estimates calculated for inhalation and dermal exposure scenarios and robust confidence that the consumer exposure scenarios represent a conservative upper bound on exposure (Section 4.3.3).

Determining Unreasonable Risk to the Environment

In preliminarily determining whether 1,1,2-trichloroethane presents an unreasonable risk of injury to the environment, EPA considered the following groups of organisms in its assessment: aquatic vertebrates, invertebrates, plants, and algae; sediment-dwelling invertebrates; terrestrial mammals and plants; and soil invertebrates. Specifically, the Agency assessed 1,1,2-trichloroethane exposures to the environment through the manufacturing, processing, use, or disposal of 1,1,2-trichloroethane. For aquatic organisms inhabiting the water column and benthic zone, EPA estimated exposures from surface water and sediment (including pore water). EPA also estimated exposure to algae from surface water. Inhalation exposure of terrestrial mammals to 1,1,2-trichloroethane was assessed using releases estimated from inputs within EPA's Integrated Indoor/Outdoor Air Calculator Model.

The Agency weighed the scientific evidence to determine confidence levels in underlying datasets and risk estimates for the environment (Section 5.3). EPA has robust confidence that its environmental risk estimates represent levels of exposure at which ecologically relevant effects will occur (Section 5.3.5). The Agency did not identify significant contributions to unreasonable risk to the environment for 1,1,2-trichloroethane for any COU.

Summary and Considerations

Table ES-1 shows the 10 COUs, of 12 total assessed, for 1,1,2-trichloroethane that significantly contribute to a preliminary determination of risk of injury to human health due to non-cancer and cancer risks driven by inhalation and/or dermal exposures. All 10 of those COUs are driven by risk to workers, and of those, 4 COUs also indicate inhalation risk to ONUs.

Table ES-1. Conditions of Use of 1,1,2-Trichloroethane That Significantly Contribute to a Preliminary Determination of Unreasonable Risk to Human Health

Condition of Use	Workers								ONUs			
	Inhalation				Dermal[a]				Inhalation			
	Non-Cancer			Lifetime Cancer	Non-Cancer			Lifetime Cancer	Non-Cancer			Lifetime Cancer
	A	I	C		A	I	C		A	I	C	
Manufacturing – Domestic manufacture	×	×	×			×	×					
Manufacturing – Import	×	×	×	×		×	×	×	×	×	×	×
Processing – As a reactant – Intermediate in: Plastic manufacturing; Petrochemical manufacturing; All other chemical product manufacturing	×	×	×			×	×	×				
Processing – Repackaging	×	×	×	×		×	×	×	×	×	×	×
Processing – Recycling	×	×	×			×	×	×				
Processing – Incorporation into a formulation, mixture, or reaction product – Formulation of adhesives and sealants	×	×	×			×	×					
Industrial use – Solvents	×	×	×	×		×	×	×	×	×	×	×
Distribution in commerce												
Industrial and commercial use – Adhesives and sealants	×	×	×	×					×	×	×	×
Commercial use – Other use – Laboratory chemical						×	×	×				
Consumer use – Adhesives and sealants												
Disposal	×	×	×	×		×	×	×				

A = acute; I = intermediate; C = chronic; ONU = occupational non-user
[a] Dermal exposure was not assessed for ONUs.
Shaded cells with × are COUs that significantly contribute to a preliminary determination of unreasonable risk of injury 1,1,2-trichloroethane for workers and/or ONUs.

EPA has preliminarily determined that the following two COUs do not significantly contribute to unreasonable risk of injury to human health (Table ES-1):

- Distribution in commerce; and
- Consumer use – Adhesives and sealants.

No 1,1,2-trichloroethane COUs significantly contribute to unreasonable risk for consumers, the general population, or the environment.

Next Steps and Public Input

This draft risk evaluation, including EPA's preliminary determination that 10 of 12 assessed COUs for 1,1,2-trichloroethane significantly contribute to unreasonable risk of injury to human health as well as the accompanying technical support documents (TSDs) and supplemental files (see Appendix C), have been released for public comment. The *Draft Human Health and Environmental Hazard Assessment for 1,1,2-Trichloroethane* TSD (U.S. EPA, 2026w) as well as the *Draft Chemistry, Fate, Release, and Exposure Assessment for 1,1,2-Trichloroethane* TSD (U.S. EPA, 2026g) will undergo independent, expert scientific peer review by the SACC.

Recommendations from the SACC, as well as public comments on the draft risk evaluation package, will inform the final risk evaluation of 1,1,2-trichloroethane—including the Agency's determination of whether 1,1,2-trichloroethane presents unreasonable risk of injury to human health or the environment, under the COUs. If, in the final risk evaluation, the Agency determines that 1,1,2-trichloroethane presents unreasonable risk of injury to human health or the environment, EPA will initiate regulatory action under TSCA section 6(a) to the extent necessary so that 1,1,2-trichloroethane no longer presents such risk.

The Agency seeks public comment on all aspects of this draft risk evaluation and seeks additional information on the following topics:

- Importation by whom and what quantities.
- Whether 1,1,2-trichloroethane is manufactured as a primary product in the United States and in what quantities, as well as information on the chemical manufacturing process and potential for occupational exposure or airborne releases.
- As described in Section 3.1.1.1, EPA identified Manufacturing as a Byproduct in the Pulp and Paper Industry as an OES for 1,1,2-trichloroethane. EPA seeks more information as to how 1,1,2-trichloroethane produced as a byproduct at pulp and paper manufacturing facilities is further used/disposed/distributed by the producing facility. Additionally, EPA seeks information on process description, airborne exposure concentrations of 1,1,2-trichloroethane, and use of personal protective equipment (PPE) and controls relevant to this OES.
- Whether 350 operating days per site-year is an appropriate default for EPA to use for the number of operating days for a manufacturing facility and also comment on the other default values that EPA uses for operating days for the other OESs assessed (see Table 3-4).
- Information on worker schedules and exposures, including shift hours, working days per week, and working years, for any of the COUs and OESs assessed by EPA in this draft risk evaluation.
- Containers and method of transport for how 1,1,2-trichloroethane is distributed to COUs that were not reported by CDR reporters such as adhesives and sealants, as a laboratory chemical, and for cleaning and degreasing applications such as vapor degreasing and cold cleaning.
- Information on process descriptions for how 1,1,2-trichloroethane is used in adhesives and sealants (Use of Adhesives and Sealants OES), as a laboratory chemical (Commercial Use of a Laboratory Chemical OES), and in cleaning and degreasing applications such as vapor degreasing and cold cleaning (Use of Cleaning and Degreasing Solvents OES).
- Whether these are current uses of 1,1,2-trichloroethane for the OES of Use of Cleaning and Degreasing Solvents.
- Process description and worker activity information for remediation processes involving 1,1,2-trichloroethane, including information on whether the remediation OES is representative of the Disposal COU.
- Additional worker inhalation monitoring data for any of the COUs and OESs assessed by EPA in the draft risk evaluation, as well as specific information on respiratory protection usage (*e.g.,* what type of respirator and for what tasks, how respirators are selected and assigned, etc), including for the Manufacturing COU.
- Information that may be useful to EPA related to existing dermal protections include specifications from the manufacturers or suppliers that demonstrate an impervious barrier to

1,1,2-trichloroethane during expected durations of use and normal conditions of exposure within the workplace, accounting for potential chemical permeation, penetration, or breakthrough times.

- EPA provided additional discussion of the available information on dermal PPE usage and existing controls for the Manufacturing as a Byproduct OES in the risk determination (see Section 6.1.3). EPA welcomes additional information on how dermal protection is selected, applied, and utilized for this OES.
- Additional data on environmental releases for any of the COUs and OES assessed by EPA in the draft risk evaluation.
- As described in Section 4.3.2.1.3, EPA relied on conservative assumptions to estimate facility throughput that is utilized in the occupational exposure model for the OES of Repackaging for Laboratory Chemical Use. EPA seeks additional information to inform the use of these conservative assumptions or to further refine the assumptions utilized in this exposure model.
- EPA seeks comment on characterizing the representativeness of high-end exposure estimates for intermediate inhalation and dermal occupational exposures. Intermediate exposures are defined as 22 working days out of a 30-day total duration for all OESs in this assessment. For many OESs, EPA generally considers that consistent high-end exposure estimates are more likely to occur over shorter time periods (acute, intermediate), while central tendency exposure estimates are used for longer term exposures as it is unlikely that a worker would experience the high-end concentration repeatedly across days and years. EPA seeks comment on what and how specific information could be used to inform this assessment as it relates to intermediate duration exposures, such as information on worker schedules, statistical analysis methods, and/or modeling approaches.

1 INTRODUCTION

EPA evaluated 1,1,2-trichloroethane under the Toxic Substances Control Act (TSCA) section 6(b). 1,1,2-Trichloroethane is produced as a byproduct and is used as a solvent and as an intermediate in the production of other chemicals. Section 1.1 summarizes the scope of this draft 1,1,2-trichloroethane risk evaluation; Section 1.1 provides the conditions of use (COUs) under TSCA; and Section 1.3 includes an overview of the systematic review process.

Figure 1-1 provides an overview of the major inputs, phases, and outputs/components of a typical TSCA risk evaluation process—from chemical prioritization to scoping to releasing the final risk evaluation.

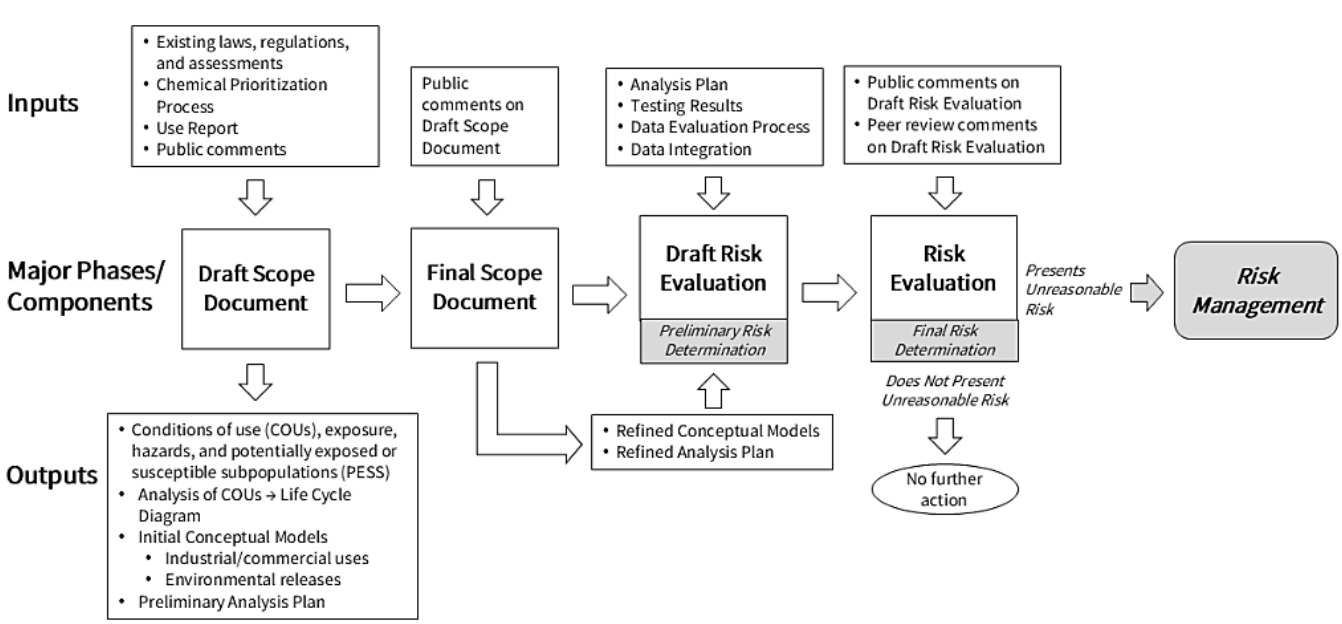


Figure 1-1. Overview of TSCA Existing Chemical Risk Evaluation Process

1.1 Scope of the Risk Evaluation

EPA evaluated risk to human and environmental populations for 1,1,2-trichloroethane. This draft risk evaluation comprises a package of technical support documents (TSDs) and supplemental files. A basic diagram showing the organization and relationship of these assessments is provided below in Figure 1-2 (see also Appendix C).

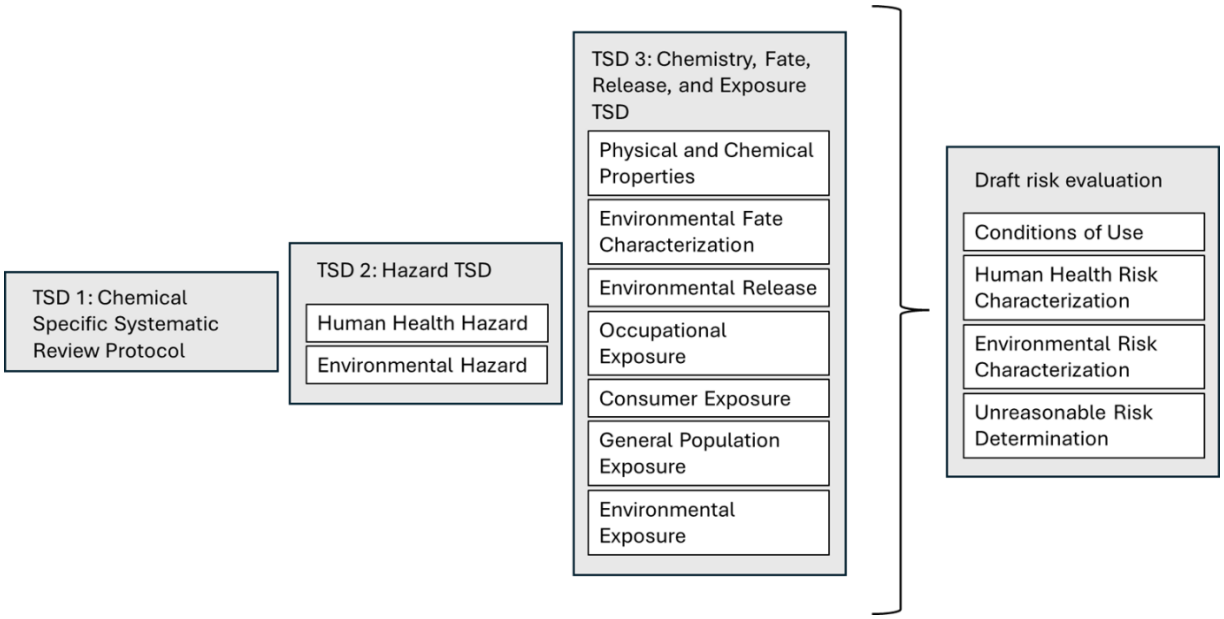


Figure 1-2. Draft Risk Evaluation Document Summary Map for 1,1,2-Trichloroethane

1.1.1 Life Cycle and Production Volume

The LCD shown in Figure 1-3 depicts the COUs that are within the scope of the risk evaluation during various life cycle stages, including manufacturing, processing, commercial use, distribution and disposal. The information in the LCD is grouped according to the Chemical Data Reporting (CDR) processing codes and use categories (including functional use codes for industrial uses and product categories for industrial and commercial users). The CDR Rule under TSCA requires U.S. manufacturers (including importers) to provide EPA with information on the chemicals they manufacture or import into the United States. EPA collects CDR data approximately every 4 years with the latest five collections occuring in 2006, 2012, 2016, 2020, and 2024.

The production volume reported in the *Final Scope of the Risk Evaluation for 1,1,2-Trichloroethane; CASRN 79-00-5* (also called the "final scope document") (U.S. EPA, 2020b) was between 100 million and 250 million pounds (lb), based on total production volume in 2015 from the 2016 CDR reporting period. The range increased in the 2020 CDR reporting period with a reported total production volume in 2019 between 100 million and 1 billion lb. The total production volume in 2023 was between 10 million and 50 million lb, which is provided as a range to protect confidential business information (CBI). For the 2016, 2020, and 2024 CDR cycles, data collected per chemical included the company name, volume of each chemical manufactured/imported, the number of workers at each site, and information on whether the chemical is used in the commercial, industrial, and/or consumer sector(s).

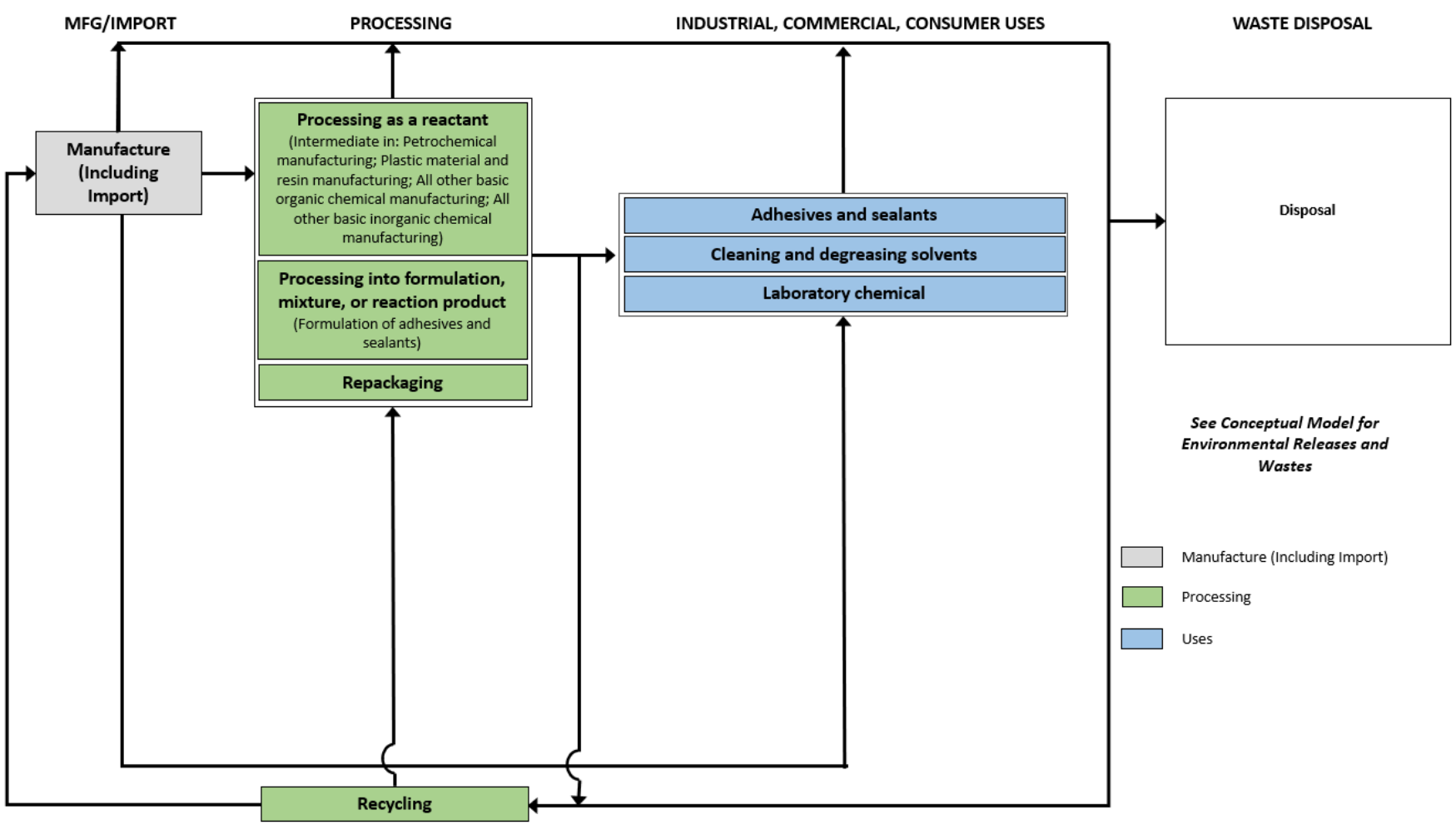


Figure 1-3. 1,1,2-Trichloroethane Life Cycle Diagram
See Table 1-1 for categories and subcategories of conditions of use.

1.2 Conditions of Use Included in the Risk Evaluation

The final scope document (U.S. EPA, 2020b) identified and described the life cycle stages, categories, and subcategories that comprise COUs that EPA planned to consider in the risk evaluation. The COUs included in this draft risk evaluation are reflected above in the LCD (Figure 1-3) and below in the conceptual models (Section 1.2.1). These COUs are evaluated for acute, intermediate, chronic, and lifetime exposures, as applicable, based on reasonably available exposure and hazard data as well as the relevant study populations for each. Table 1-1 presents all COUs for 1,1,2-trichloroethane, under TSCA.

A complete list of updates and explanations of the updates made to COUs for 1,1,2-trichloroethane from the final scope document to this draft risk evaluation is provided in Appendix E. Table 1-1 presents the revised COUs that were included and evaluated in this assessment. Appendix F contains a summary description of each COU for 1,1,2-trichloroethane.

Table 1-1. Conditions of Use in the Draft Risk Evaluation for 1,1,2-Trichloroethane

Conditions of Use[d]			Source(s)
Life Cycle Stage[a]	**Category[b]**	**Subcategory[c]**	
Manufacturing	Domestic manufacture	Domestic manufacture	2016, 2020, 2024 CDR data
	Import	Import	2016, 2020, 2024 CDR data
Processing	As a reactant	Intermediate in: Plastic manufacturing; Petrochemical manufacturing; All other chemical product manufacturing	2016, 2020, 2024 CDR data
	Repackaging	Repackaging	
	Recycling	Recycling	2016, 2020, 2024 CDR data
	Incorporation into a formulation, mixture, or reaction product	Formulation of adhesives and sealants	
Distribution in commerce	Distribution in commerce	Distribution in commerce	
Industrial use	Solvents	Solvents	2017 National Emissions Inventory data
Industrial and Commercial use	Adhesives and sealants	Adhesives and sealants	EPA-HQ-OPPT-2018-0427-0003; EPA-HQ-OPPT-2018-0421-0006; EPA-HQ-OPPT-2018-0421-0013
Commercial use	Other use	Laboratory chemical	2016, 2020, 2024 CDR data
Consumer use	Adhesives and sealants	Adhesives and sealants	EPA-HQ-OPPT-2018-0427-0003; EPA-HQ-OPPT-2018-0421-0013
Disposal	Disposal	Disposal	

[a] Life cycle stage use definitions (40 CFR 711.3):
- "Industrial Use" means use at a site at which 1 or more chemicals or mixtures are manufactured (including imported) or processed.
- "Commercial Use" means the use of a chemical or a mixture containing a chemical (including as part of an article) in a commercial enterprise providing saleable goods or services.
- "Consumer Use" means the use of a chemical or a mixture containing a chemical (including as part of an article, such as furniture or clothing) when sold to or made available to consumers for their use.
- Although EPA has identified both industrial and commercial uses here for purposes of distinguishing scenarios in this document, the Agency interprets the authority over "any manner or method of commercial use" under TSCA section 6(a)(5) to reach both.

[b] These categories of conditions of use (COUs) appear in the life cycle diagram (LCD) reflect Chemical Data Reporting (CDR) codes and broadly represent COUs of 1,1,2-trichloroethane in industrial, commercial, and/or consumer settings.

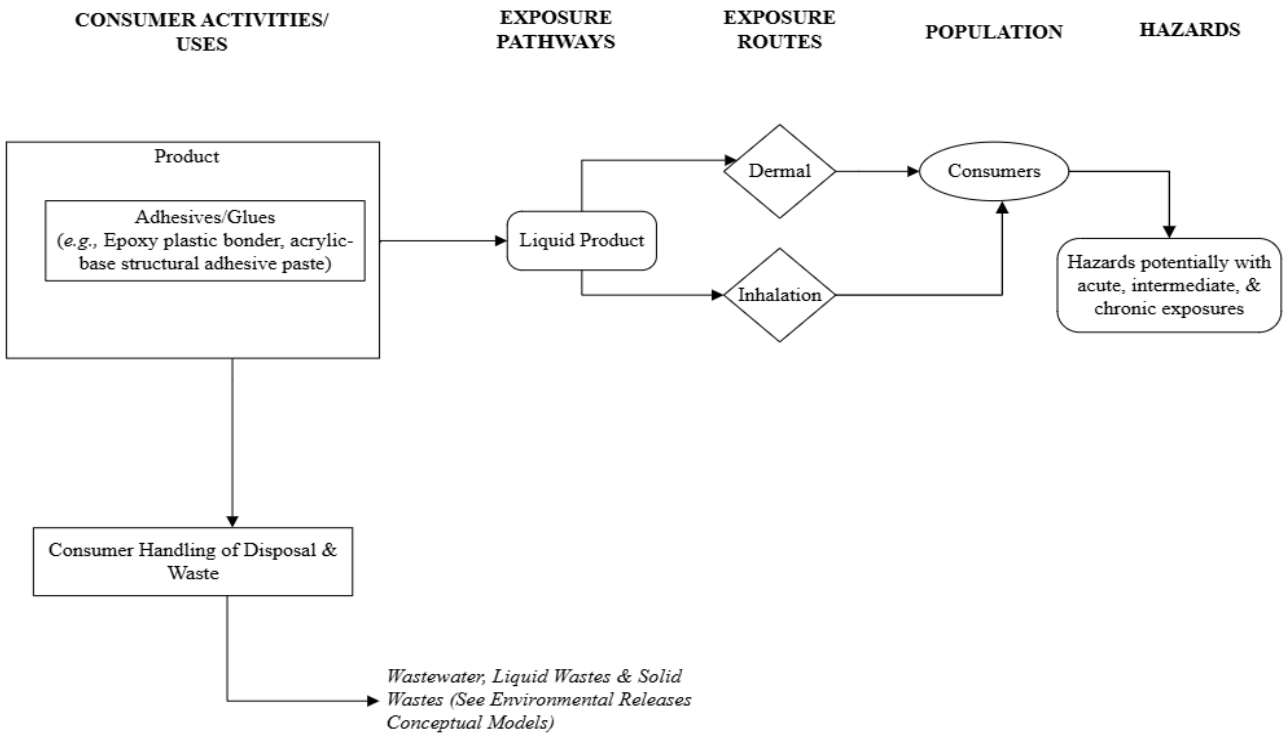
[c] These subcategories reflect more specific COUs of 1,1,2-trichloroethane.

[d] The total number of COUs (12) are determined by the categories/subcategories.

1.2.1 Conceptual Models

The conceptual models presented in this section show the exposure pathways, routes, and hazards to human and ecological populations from uses of 1,1,2-tricholoroethane. The conceptual model for consumer exposure to 1,1,2-trichloroethane (Figure 1-4) shows exposures are expected via the inhalation and dermal routes due to its use in adhesives/glues. EPA did not assess consumer exposure via the oral route quantitively because there are no reasonably expected uses of the products identified that would result in an oral exposure scenario. The Agency did not assess cancer risk to consumers based on the consumer use patterns of the product identified and the scientific evidence, which do not indicate a single, acute exposure would lead to cancer effects. Specifically, for cancer the consumer use pattern for the adhesive product identified has a 5-minute use window and 5 to 20 minutes of inhalation exposure when used to repair items. This use profile does not align with a daily, weekly, or monthly use pattern every year for a consumer's entire lifetime. Additionally, findings from the National Cancer Institute (NCI) mouse study (NCI, 1978) found it took 55 weeks at the low dose of 195 mg/kg-day for 5 days per week to develop the first observed tumors in the liver. A later study (Milman et al., 1988) showed it took 7 weeks of exposure at a dose of 70 mg/kg/day to develop precancerous lesions in the liver when also pre-treated with a potent tumor initiator. Since these continuous, longer term, high doses do not align with the consumer use profile for the product evaluated or the relative inhaled concentration from the consumer product, the Agency determined there are no single consumer exposure scenarios expected that could lead to cancer effects identified for 1,1,2-trichloroethane; therefore, EPA did not evaluate cancer risk to consumers in this assessment.

The conceptual model for environmental and general population exposure to 1,1,2-trichloroethane (Figure 1-5) shows exposures are expected via the surface water pathway (incidental dermal and incidental oral routes), drinking water pathway (dermal and oral routes), sediment pathway (dermal and oral routes), and ambient air pathway (inhalation route) due to industrial facility releases of 1,1,2-trichloroethane to the respective media. 1,1,2-Trichloroethane enters ambient surface water from industrial releases and municipal wastewater discharges (publicly owned treatment works, POTWs) into water bodies, which leads to human and aquatic organism exposures. As 1,1,2-trichloroethane partitions into sediment or pore water, aquatic organisms in sediment are exposed. 1,1,2-Trichloroethane enters ambient air as a result of fugitive and stack releases from industrial activities that lead to inhalation exposure of humans and terrestrial species. The conceptual model for occupational exposure to 1,1,2-trichloroethane (Figure 1-6) shows exposures are expected via the inhalation and dermal routes due to its use in manufacturing, processing, handling, storage, and disposal activities. Occupational exposures via inhalation are expected for both workers and ONUs, whereas dermal exposures are only expected for workers.



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759 **Figure 1-4. 1,1,2-Trichloroethane Conceptual Model for Consumer Activities and Uses: Potential**
760 **Exposures and Hazards**

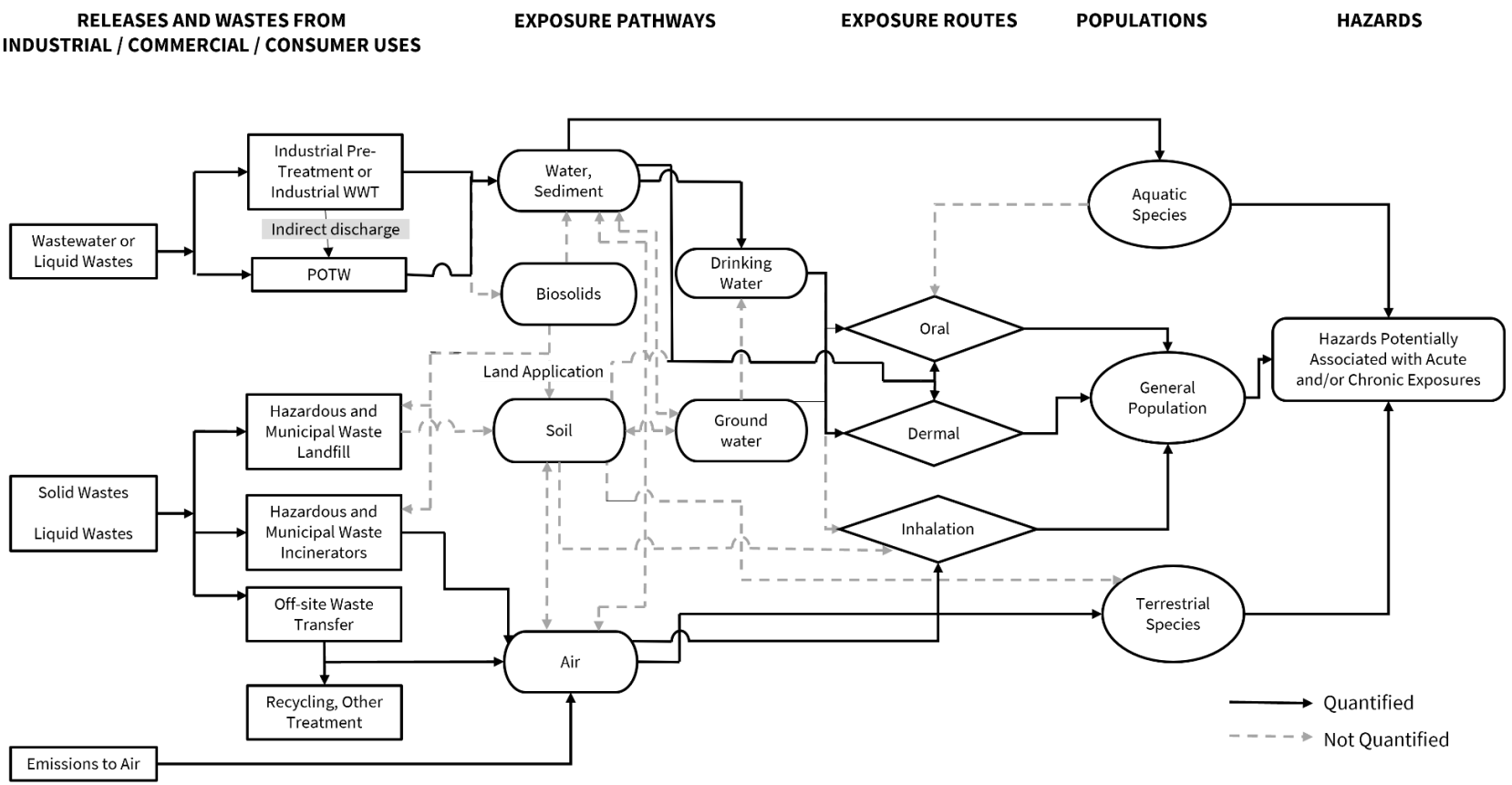

Figure 1-5. 1,1,2-Trichloroethane Environmental Exposure and General Population Model of Scenarios Assessed

The rationale for why exposure pathways and routes were not quantified is available in the *Draft Chemistry, Fate, Release, and Exposure Assessment for 1,1,2-Trichloroethane* (U.S. EPA, 2026g)

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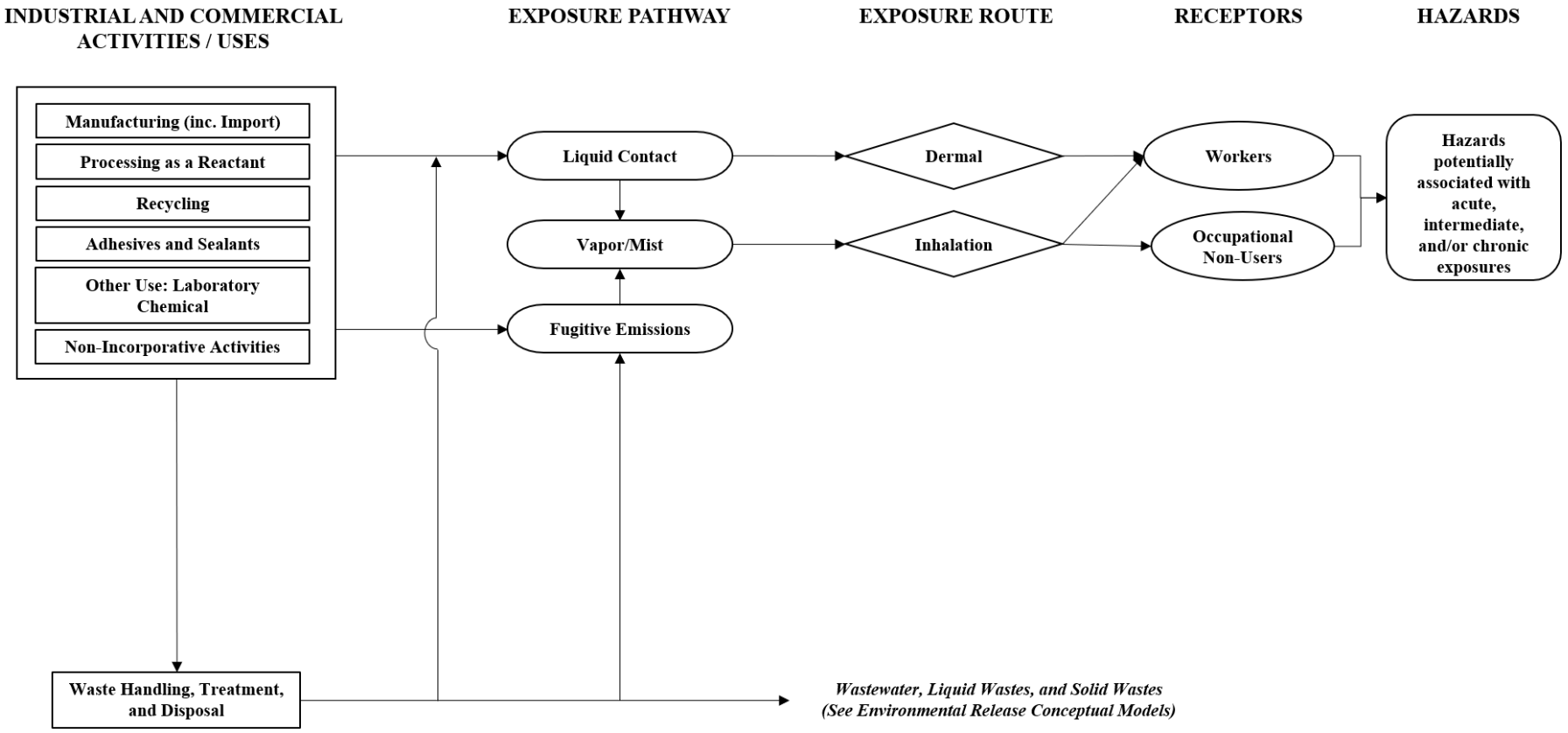

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770 **Figure 1-6. 1,1,2-Trichloroethane Occupational Exposure Conceptual Model for Industrial and Commercial Activities and Uses:**
771 **Worker and Occupational Non-User Exposure and Hazards**

1.2.2 Populations and Durations of Exposures Assessed

Based on the conceptual models presented in Section 1.2.1, EPA evaluated risk to environmental and human populations. Environmental risks were evaluated for acute (daily) and chronic (annual) exposure scenarios for aquatic and terrestrial species. Human health risks were evaluated for the following exposure scenarios, as applicable: acute (daily), intermediate (30-days), chronic (annual), and lifetime (30 and 40 years for occupational, 78 years for general population). Detailed descriptions of the durations of exposure and exposure scenarios evaluated are provided in the *Draft Chemistry, Fate, Release, and Exposure Assessment for 1,1,2-Trichloroethane* (U.S. EPA, 2026g).

1.2.2.1 Potentially Exposed or Susceptible Subpopulations and Sentinel Populations

TSCA section 6(b)(4)(A) requires that risk evaluations "determine whether a chemical substance presents an unreasonable risk of injury to health or the environment, without consideration of costs or other non-risk factors, including an unreasonable risk to a potentially exposed or susceptible subpopulation identified as relevant to the risk evaluation by the Administrator, under the conditions of use." TSCA section 3(12) states that "the term 'potentially exposed or susceptible subpopulation' (PESS) means a group of individuals within the general population identified by the Administrator who, due to either greater susceptibility or greater exposure, may be at greater risk than the general population of adverse health effects from exposure to a chemical substance or mixture, such as infants, children, pregnant women, workers, or the elderly."

This draft risk evaluation considers PESS throughout the human health risk assessment (Section 4), including throughout the exposure assessment, hazard identification, and dose-response analysis supporting this assessment. Evaluation of the qualitative and quantitative evidence for PESS begins as part of the systematic review process (Section 1.3). Any available relevant published studies and other data are identified from a broad literature search strategy across several databases and focused only on the chemical (including synonyms and trade names) with no additional search limits. This broad search process is described in the *Draft Systematic Review Protocol Supporting TSCA Risk Evaluations for Chemical Substances: A Generic TSCA Systematic Review Protocol with Chemical-specific Methodologies* (also referred to as "[2021] Draft Systematic Review Protocol"; see Section 1.3 (U.S. EPA, 2021). When adequate and complete, evidence related to PESS informs the derivation of exposure estimates and human health hazard endpoints/values that are protective of those PESS.

PESS factors can influence the selection of relevant exposure pathways, the sensitivity of derived hazard values, the identification of human subpopulations, and the discussion of uncertainties throughout the assessment. In this risk evaluation, EPA integrated and assessed available information in hazards and exposures for the COUs of 1,1,2-trichloroethane, including information relevant to specific risks of injury to PESS. In addition to workers, PESS identified as relevant include infants exposed to drinking water during formula bottle feeding, men and women of reproductive age, people with aldehyde dehydrogenase-2 polymorphisms, lifestyle factors such as smoking cigarettes or secondhand smoke, and communities near facilities that emit 1,1,2-trichloroethane.

1.3 Systematic Review

EPA applies systematic review principles in the development of risk evaluations. Section 26(h) of TSCA requires the Agency to use scientific information, technical procedures, measures, methods, protocols, methodologies, and models consistent with the best available science and to base decisions under section 6 on the weight of scientific evidence.

Within the TSCA risk evaluation context, the weight of the scientific evidence is defined as "a systematic review method, applied in a manner suited to the nature of the evidence or decision, that uses a pre-established protocol to comprehensively, objectively, transparently, and consistently identify and evaluate each stream of evidence, including strengths, limitations, and relevance of each study and to integrate evidence as necessary and appropriate based upon strengths, limitations, and relevance" (40 CFR 702.33).

To meet the TSCA section 26(h) science standard, EPA used the TSCA systematic review process described in the 2021 Draft Systematic Review Protocol (U.S. EPA, 2021) and *Draft Systematic Review Protocol for 1,1,2-Trichloroethane* (U.S. EPA, 2026aj) (also called the "1,1,2-Trichloroethane Systematic Review Protocol"). Systematic review supports the risk evaluation in that data searching, screening, evaluation, extraction, and evidence integration are used to develop the exposure and hazard assessment based on reasonably available information. EPA defines "reasonably available information" to mean information that the Agency possesses or can reasonably obtain and synthesize for use in risk evaluation, considering the deadlines for completing the evaluation (40 CFR 702.33).

The systematic review process steps are briefly described below in Figure 1-7. Additional details regarding these steps are available in the 2021 Draft Systematic Review Protocol (U.S. EPA, 2021) and 1,1,2-Trichloroethane Systematic Review Protocol (U.S. EPA, 2026aj). The latter is a chemical-specific systematic review protocol used to transparently document any updates or classifications made to the systematic review process used for considering information identified for 1,1,2-trichloroethane, as compared to the steps described and published in the Draft Systematic Review Protocol (U.S. EPA, 2026aj). For this draft risk evaluation, the literature search was conducted as described in Section 4 of the 2021 Draft Systematic Review Protocol (U.S. EPA, 2021), where the peer-reviewed and gray literature updated search followed the approach outlined in Sections 4.2 and 4.3 of the 2021 Draft Systematic Review Protocol, respectively (U.S. EPA, 2021).

An update to the peer-reviewed literature search to capture information published since the initial search in September 2019 was performed in April 2025 to identify any potential additional data sources available and relevant to environmental release and occupational exposure; general population, consumer, and environmental exposure; and environmental and human health hazard for 1,1,2-trichloroethane. EPA had sufficient information on physical and chemical properties as well as environmental fate and transport properties to support the *Draft Risk Evaluation for 1,1,2-Trichloroethane* (U.S. EPA, 2026ag) and did not proceed with an update to the peer-reviewed literature for these disciplines. Any new data identified from the updated search is described in the Draft Systematic Review Protocol (U.S. EPA, 2021) and integrated into the TSDs and this risk evaluation.

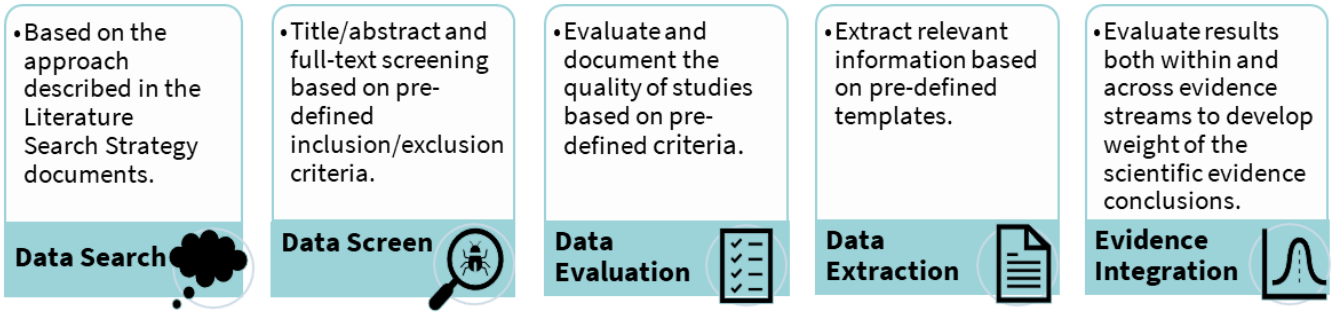

Figure 1-7. Diagram of the Systematic Review Process

EPA also identified key assessments conducted by other Agency programs and other U.S. and international organizations. Depending on the source, these assessments include information on hazards, exposures, and PESS. Some of the most pertinent assessments that were consulted for this draft 1,1,2-trichloroethane risk evaluation include the following:

- California Environmental Protection Agency, Office of Environmental Health Hazard Assessment (OEHHA) 2006 *Public Health Goals for Chemical in Drinking Water: 1,1,2-Trichloroethane* (OEHHA, 2006);
- U.S. Department of Human Health Services, Public Service, Agency for Toxic Substances and Disease Registry (ATSDR) 2021 *Toxicological Profile for 1,1,2-Trichloroethane* (ATSDR, 2021);
- U.S. EPA 2011 Provisional Peer Reviewed Toxicity Values (PPRTV) for 1,1,2-Trichloroethane (CASRN 79-00-5) (U.S. EPA, 2011b); and
- U.S. EPA 1987 Integrated Risk Information System (IRIS) for 1,1,2-Trichloroethane (U.S. EPA, 1987).

2 CHEMISTRY AND FATE AND TRANSPORT OF 1,1,2-TRICHLOROETHANE

Physical and chemical properties determine the behavior and characteristics of a chemical that inform its condition of use, environmental fate and transport, potential toxicity, exposure pathways, routes, and hazards. Environmental fate and transport include environmental partitioning, accumulation, degradation, and transformation processes. Environmental transport is the movement of the chemical within and between environmental media such as air, water, soil, and sediment. Thus, understanding the environmental fate of 1,1,2-trichloroethane informs the specific exposure pathways as well as the potential human and environmental exposed populations that EPA considered in this 1,1,2-trichloroethane draft risk evaluation.

Sections 2.1 and 2.2 summarize the physical and chemical properties and environmental fate and transport of 1,1,2-trichloroethane, respectively. For detailed information see the *Draft Chemistry, Fate, Release, and Exposure Assessment for 1,1,2-Trichloroethane* (U.S. EPA, 2026g).

2.1 Summary of Physical and Chemical Properties

1,1,2-Trichloroethane is a volatile organic compound (vapor pressure = 23 mmHg at 25 °C) and is a clear, colorless liquid at standard temperature and pressure. It has a water solubility of 4,580 mg/L at 25 °C, is readily soluble in organic solvents, and has Henry's Law constant of 8.24×10^{-4} atm·m^3/mol at 25 °C. EPA evaluated physical and chemical property data (U.S. EPA, 2026w) and information according to the process described in the *Draft Systematic Review Protocol for 1,1,2-Trichloroethane* (U.S. EPA, 2026aj). The Agency considered both measured and estimated physical and chemical property data/information as described in the *Draft Chemistry, Fate, Release, and Exposure Assessment for 1,1,2-Trichloroethane* TSD (U.S. EPA, 2026g). The selected values are summarized in Table 2-1. Information on the full extracted dataset is available in the *Draft Data Quality Evaluation and Data Extraction Information for Physical and Chemical Properties for 1,1,2-Trichloroethane* (U.S. EPA, 2026m).

Table 2-1. Select Physical and Chemical Properties of 1,1,2-Trichloroethane[a]

Property	Selected Value(s)	Reference(s)	Overall Data Quality Determination
Molecular formula	$C_2H_3Cl_3$	N/A	N/A
Molecular weight	133.41 g/mol	N/A	N/A
Physical form	Clear, colorless liquid at room temperature with a sweet, chloroform-like odor	Dreher et al. (2014); O'Neil (2013); NIOSH (2007)	High
Melting point	−36.5 °C	Rumble (2018a); OEHHA (2011)	High
Boiling point	114 °C	U.S. EPA (2019a); NIOSH (2007)	High
Density	1.4416 g/cm^3 at 20 °C	NCBI (2020a); NLM (2018); O'Neil (2013)	High
Vapor pressure	23 mmHg at 25 °C	U.S. EPA (2019a); NLM (2018); RIVM (2007)	High

Property	Selected Value(s)	Reference(s)	Overall Data Quality Determination
Vapor density	4.21 (relative to air = 1)	NCBI (2020a); NLM (2018)	High
Water solubility	4,580 mg/L at 25 °C	NLM (2018); Rumble (2018b)	High
Octanol:water partition coefficient (log K_{OW})	2.05 (unitless) at 25 °C	Elsevier (2019); OECD (2000); Mueller and Klein (1992)	High
Henry's Law constant	8.24×10^{-4} atm·m^3/mol at 25 °C	U.S. EPA (2019a); NLM (2018)	High
Viscosity	1.69 centipoise (cP) at 20 °C	NLM (2018)	High

[a] Additional information on value selection can be found in the *Draft Chemistry, Fate, Release, and Exposure Assessment for 1,1,2-Trichloroethane* (U.S. EPA, 2026g).

2.2 Summary of Environmental Fate and Transport

Fate parameters—including biotic and abiotic biodegradation rates, removal during wastewater treatment, volatilization from lakes and rivers, and organic carbon:water partition coefficient (log K_{OC})—are used in the current draft risk evaluation. In assessing the environmental fate and transport of 1,1,2-trichloroethane, EPA considered the full range of results from data that were rated high and medium quality. Information on the full extracted dataset is available in the *Draft Data Quality Evaluation and Data Extraction Information for Environmental Fate and Transport for 1,1,2-Trichloroethane* (U.S. EPA, 2026k) and the *Draft Systematic Review Protocol for 1,1,2-Trichloroethane* (U.S. EPA, 2026aj). Other fate estimates were based on modeling results from EPI Suite™ (U.S. EPA, 2012), a predictive tool for physical and chemical properties and environmental fate estimation.

EPA evaluated the reasonably available information to characterize the environmental fate and transport of 1,1,2-trichloroethane. The key points of the fate assessment for 1,1,2-trichloroethane are summarized below and listed in Table 2-2 (see also Figure 2-1). Given the consistent results from numerous high-quality studies, there is robust evidence that 1,1,2-trichloroethane

- will not undergo direct photolysis;
- will undergo indirect photolysis by reacting slowly with hydroxyl radicals in the atmosphere, with an estimated half-life of 55 days;
- will exist as a vapor in air and is not expected to partition to organic matter in the air;
- will hydrolyze very slowly in water at environmentally relevant pHs and temperatures;
- will be subject to low to moderate sorption to soil/sediments and therefore will undergo moderate to rapid migration to groundwater;
- will have low bioaccumulation potential in aquatic organisms;
- will be removed during wastewater treatment processes, mainly due to volatilization, with significant biodegradation occuring in some WWTPs;
- is not readily biodegradable in aerobic surface waters;
- will biodegrade slowly in anaerobic soils;
- can form as an environmental transformation product due to the biodegradation of 1,1,2,2-tetrachloroethane under anaerobic conditions;

- can biodegrade to form vinyl chloride, 1,2-dichloroethane, and ethene under anaerobic conditions;
- may volatilize from surface water and moist surface soil; and
- has the potential to undergo long-range transport in the air due to slow indirect photodegradation.

As a result of limited studies identified, there is moderate confidence that 1,1,2-trichloroethane

- will have low removal rates from conventional drinking water systems but can be removed by advanced treatment technologies (*e.g.,* packed tower aeration);
- can biodegrade in sediments under anaerobic conditions with a half-life on the order of months—especially when the microbial communities have been pre-exposed to 1,1,2-trichloroethane; and
- will have low bioaccumulation potential in terrestrial organisms.

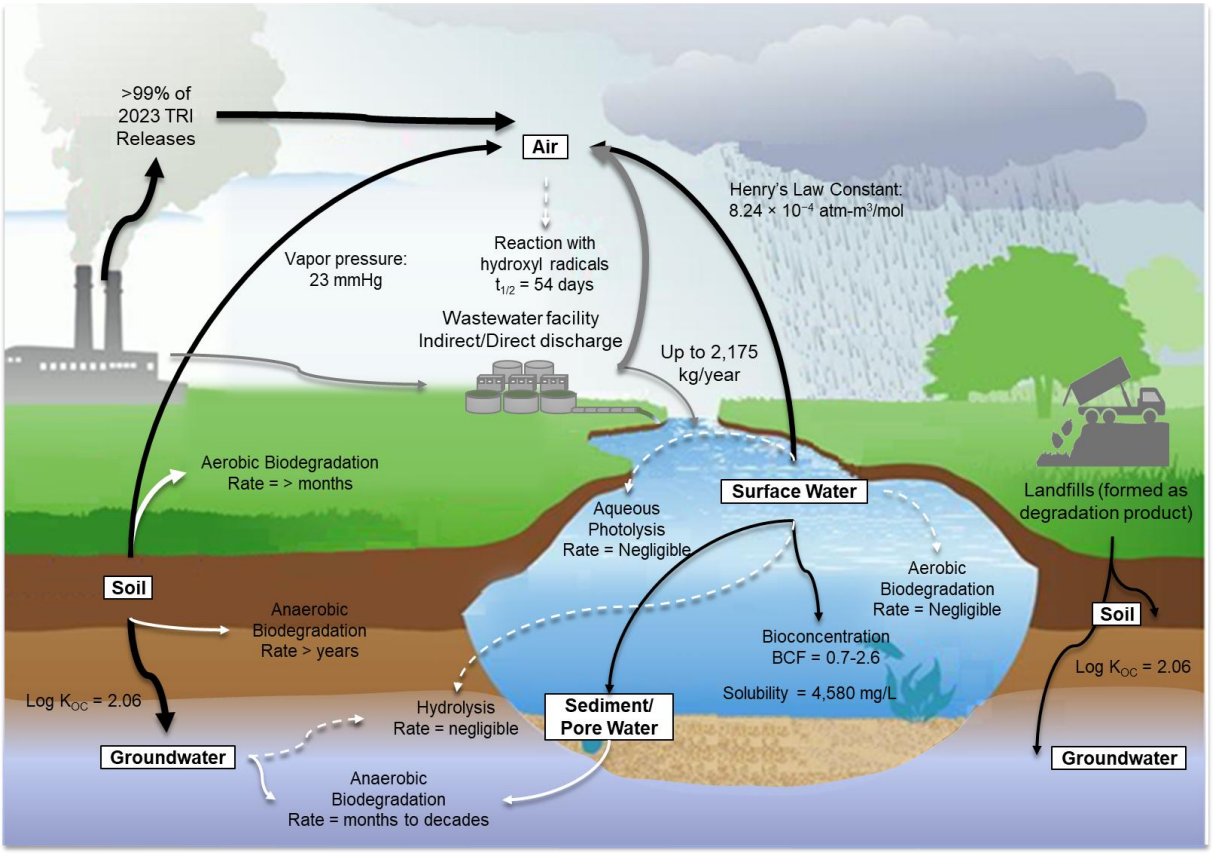

Figure 2-1. Transport, Partitioning, and Degradation of 1,1,2-Trichloroethane in the Environment

2.2.1 Weight of Scientific Evidence Conclusions for Fate and Transport

The partitioning analyses, which incorporate high-quality physical and chemical properties, provide robust evidence that air is likely to be the major medium of exposure for 1,1,2-trichloroethane. For the reporting years of 2019, 2020, 2021, and 2023, greater than 99% of reported Toxics Release Inventory (TRI) releases were to air. In this assessment, EPA considered the TRI reporting years of 2019 to 2023. The TRI reported releases show that, while small compared to air, there are releases to water and land. The partitioning analysis shows that when released to water and land, some 1,1,2-trichloroethane will stay in the media of release. Therefore, land and water pathways could be important depending on the specific release pattern (specific exposure scenarios assessed in the evaluation are discussed in Section 4.1.3).

When released to air, there is also strong evidence that 1,1,2-trichloroethane will exist as a vapor and will not partition to particulate matter. 1,1,2-Trichloroethane is expected to have a relatively long half-life in air (≈55 days). Modeling suggests that 1,1,2-trichloroethane can be subject to long-range transport given its atmospheric half-life (≈55 days). While EPA identified monitoring data showing 1,1,2-trichloroethane being consistently detected across the United States, monitoring locations are not necessarily spatially or temporally aligned with releases from COUs and therefore might not be representative of actual release scenarios. The Agency did not identify monitoring data demonstrating its long-range atmospheric transport of 1,1,2-trichloroethane.

In aquatic environments, 1,1,2-trichloroethane is expected to volatilize from surface waters. EPA did not identify any studies directly measuring volatilization rates and used EPI Suite™ (U.S. EPA, 2012) to estimate a rate for a model lake and stream. Therefore, there is uncertainty in the volatilization rate as it can vary based on the characteristics of the water body. EPA has strong evidence that 1,1,2-trichloroethane is not readily biodegradable in surface water and that hydrolysis is slow under environmentally relevant conditions. The Agency identified limited monitoring data with measurable concentrations in surface water but monitoring locations are not necessarily spatially or temporally aligned with releases from COUs and therefore might not be representative of actual release scenarios. The Agency also did not identify sediment monitoring data, but 1,1,2-trichloroethane could be present in sediment pore water given its relatively high solubility. EPA also identified one Organisation for Economic Co-operation and Development (OECD) guideline study with a measured bioconcentration factor (BCF) of 0.7 to 4.0 L/kg when exposed to concentrations of 0.03 and 0.3 mg/L at 25 °C for 6 weeks (OECD, 2000), meaning there is uncertainty in the actual value. Modeling using EPI Suite™ (U.S. EPA, 2012) estimated bioaccumulation factor (BAF) values of 4.91 to 6.59 L/kg. Overall, EPA has high confidence the BAF and BCF values will be low given a guideline OECD study and the modeled values.

In terrestrial environments, 1,1,2-trichloroethane can volatilize from surface soils; however, EPA did not identify any studies measuring volatilization rates from soil, so there is uncertainty in the exact rate, as it will depend on the specific soil characteristics and local conditions (*e.g.,* temperature). Soil and groundwater biodegradation studies reported a large range of half-lives. Despite this uncertainty, EPA expects biodegradation rates to be slow in both aerobic and anaerobic soils and groundwater (Table 2-2). EPA has strong evidence demonstrating that 1,1,2-trichloroethane will migrate to groundwater when released to land, given the amount of data measuring it in groundwater across the United States.

Table 2-2. Summary of Environmental Fate Information for 1,1,2-Trichloroethane[a]

Parameter	Value	Reference(s)	Overall Data Quality Determination
Direct photodegradation	Not expected to be susceptible because light absorption at wavelengths >290 nm was negligible	Rathbun (1998)	Medium
Indirect photodegradation	$t_{1/2}$ = 54.6 days (based on •OH rate constant of 1.96E−13 cm^3/mole-sec with [•OH] = 1.5E06 •OH/cm^3) [b]	U.S. EPA (2012)	High
Hydrolysis half-life	$t_{1/2}$ = 85 days at pH 9 and 25 °C	OECD (2000)	High
	$t_{1/2}$ = 37–25,400 years at pH 7 and 25 °C	Rathbun (1998)	Medium
	$t_{1/2}$ = 904 years at pH 7 and 10 °C		

Parameter	Value	Reference(s)	Overall Data Quality Determination
	$t_{1/2}$ = 3,020 years at pH 5.6 and 25 °C		
	$t_{1/2}$ = 21,300 years at pH 5.6 and 10 °C		
Aerobic biodegradation (aquatic)	5% over 28 days (OECD 301C)	OECD (2000)	High
Aerobic biodegradation (soil)	$t_{1/2}$ = 6 months–1 year	NCBI (2020b)	Medium
Anaerobic biodegradation (aquatic)	64% over 250 days	Hunkeler et al. (2002)	High
	100% over 8 days at 35 °C	Enzminger (1988)	Medium
Anaerobic biodegradation (sediment)	100% over 21 days	Chen et al. (1996)	High
	$t_{1/2}$ = 6 days, 26 days, 335 days, 16 years (in aquifer with 1, 0.1, 0.01, 0.001% organic carbon content)	NCBI (2020b)	Medium
Anaerobic biodegradation (soil)	$t_{1/2}$ = 722–1,444 days	NCBI (2020b)	Medium
Bioconcentration factor (BCF) (L/kg wet weight)	0.7–2.6 in carp (*Cyprinus carpio*) when exposed to 0.3 mg/L for 6 weeks at 25°C; 2.9–4.0 in carp (*Cyprinus carpio*) when exposed to 0.03 mg/L for 6 weeks at 25 °C	OECD (2000)	High
	Upper trophic level = 6.59 [b]; Middle trophic level = 5.31 [b]; Lower trophic level = 4.91 [b]	U.S. EPA (2012)	High
Bioaccumulation factor (BAF) (L/kg lipid weight, unless noted)	Upper trophic level = 6.59 [b]; Middle trophic level = 5.31 [b]; Lower trophic level = 4.91 [b]	U.S. EPA (2012)	High
Removal in wastewater treatment	70.8±7.1% (with pre-exposed acclimated biomass) in pilot-scale activated sludge system from Cincinnati, Ohio	Bhattacharya et al. (1996)	High
	>29%, >94%, 96% in U.S. POTWs	U.S. EPA (1982)	High
	27.43% [b]	U.S. EPA (2012)	High

NCBI = National Center for Biotechnology Information; OECD = Organisation for Economic Cooperation and Development; POTW = publicly owned treatment works
[a] Additional information on value selection can be found in the *Draft Chemistry, Fate, Release, and Exposure Assessment for 1,1,2-Trichloroethane* (U.S. EPA, 2026g)
[b] Information estimated using EPI Suite™ (U.S. EPA, 2012)

986

3 RELEASES AND CONCENTRATIONS OF 1,1,2-TRICHLOROETHANE IN THE ENVIRONMENT

EPA estimated environmental releases and environmental concentrations of 1,1,2-trichloroethane. Section 3.1 describes the approach and methodology for estimating releases and Section 3.2 presents estimates of environmental releases.

Lifecycle Summary for 1,1,2-Trichloroethane

CDR provides data from domestic manufacturers (including importers) of 1,1,2-trichloroethane. Based on reported CDR data, mapping of facility reported release data, data from the test order process, and other sources, EPA's current understanding is that manufacture as an unintended byproduct is the primary source of manufacturing. Chemical manufacturers will seek to reclaim value from byproduct streams, and process further as a reactant based on information from CDR. A discussion of this was included in the assessment of byproducts that EPA completed for the 1,2-dichloroethane risk evaluation (U.S. EPA, 2026a) and supports the use of byproduct streams as reactants in the manufacture of other chemicals. Also related to manufacture of 1,1,2-trichloroethane as an unintended byproduct, facility reported release data was mapped to pulp and paper production facilities. 1,1,2-Trichloroethane can be formed as a byproduct in pulp and paper production. There were no CDR reports from pulp and paper production, which suggests smaller quantities of release from these facilities (CDR reporting threshold is 25,000 lb and 100,000 lb for small manufacturers or small importers).

Information from non-CDR data sources, including facility reported data to Tocis Release Inventory (TRI), Discharge Monitoring Report (DMR) and National Emissions Inventory (NEI), and safety data sheet (SDS), and import landings data from Datamyne (Descartes Systems Group, 2018), indicated several downstream industrial and commercial COUs. This consisted of commercial use as a laboratory chemical, industrial and commercial use as an adhesive and sealant, and industrial use as a solvent for cleaning and degreasing. CDR reporting does not indicate these other downstream COUs, but this may be due to production and use below the CDR reporting threshold of 25,000 lb and 100,000 lb for small manufacturers or small importers. EPA has uncertainty whether there is a direct path from manufacturers of 1,1,2-trichloroethane as a byproduct chemical to these downstream COUs. EPA also has uncertainty as to whether smaller non-CDR reported quantities may be purchased by chemical distributors for these downstream COUs; therefore, the Agency assumed production quantities up to the CDR threshold were possible for these downstream COUs. EPA is interested in receiving any information that may inform potential uses not captured by CDR that are occuring in volumes under the reporting thresholds.

The import landings data from Datamyne, referenced above, provides evidence of imports of 1,1,2-trichloroethane by laboratory chemical distributors. 1,1,2-Trichloroethane is a solvent for the adhesive chemicals. Based on the evidence of the presence of 1,1,2-trichloroethane in adhesive and sealant products, a formulation step would be required, and EPA assessed this as an OES. There was a TRI report from one site (Freeport Olin in Brazoria County, Texas) that reported manufacturing as a byproduct along with processing as a reactant and processing as a formulation component. There is limited evidence on the solvent for cleaning and degreasing pertaining specifically to the OES of Open-Top Vapor Degreasing and Cold Cleaning, though the Agency is uncertain whether these are current uses. EPA seeks information on the prevalence and process details of these uses.

Although there are facility-reported release data for 1,1,2-trichloroethane from sites associated with disposal, including incinerators, landfills, and wastewater treatment facilities at industrial facilities and POTWs, EPA assessed these as individual OES under the overall COU of Disposal. The pathway of

1,1,2-trichloroethane to these disposal sites would be from sites that manufacture, process, and use 1,1,2-trichloroethane and the disposal of their wastes (Table 3-3).

3.1 Approach and Methodology

This section provides an overview of the approach and methodology for assessing releases to the environment from industrial, commercial, and consumer uses.

3.1.1 Manufacturing, Processing, Industrial, and Commercial Uses

This section describes the grouping of manufacturing, processing, industrial, and commercial COUs into OESs as well as the use of 1,1,2-trichloroethane within each OES. Specifically, Section 3.1.1.1 provides a crosswalk of COUs to OESs whereas Section 3.1.1.2 provides descriptions for the function of 1,1,2-trichloroethane within each OES.

3.1.1.1 Crosswalk of Conditions of Use to Occupational Exposure Scenarios

EPA categorized the COUs listed in Table 1-1 into OESs. Table 3-1 provides a crosswalk between the COUs and OESs. Note that the total number of COUs (12) are determined by the categories/ subcategories. Each OES is developed based on a set of occupational activities and conditions such that similar occupational exposures and environmental releases are expected from the use(s) covered under that OES. For each OES, EPA provided occupational exposure and environmental release results, which are expected to be representative of the entire population of workers and sites for the given OES in the United States. In some cases, the Agency defined only a single OES for multiple COUs, whereas in other cases EPA developed multiple OESs for a single COU. The Agency made this determination by considering variability in release and use conditions and whether the variability required discrete scenarios or could be captured as a distribution of exposures.

Table 3-1. Crosswalk of Conditions of Use to Assessed Occupational Exposure Scenarios

Conditions of Use			Occupational Exposure Scenarios (OESs) for Assessment
Life Cycle Stage [a]	**Category [b]**	**Subcategory [c]**	
Manufacturing	Domestic manufacture	Domestic manufacture	Manufacturing as a Byproduct at Chemical Manufacturing Facilities (OES #1)
			Manufacturing as a Byproduct in the Pulp and Paper Industry (OES #2)
	Import	Import	Repackaging for Laboratory Chemical Use (OES #3)
Processing	Processing as a reactant	Intermediate in: Plastic manufacturing	Processing as a Reactant (OES #4)
		Intermediate in: Petrochemical manufacturing	
		Intermediate in: All other chemical product manufacturing	
	Recycling	Recycling	
	Repackaging	Repackaging	Repackaging for Laboratory Chemical Use (OES #3)
	Incorporation into a formulation, mixture, or reaction product	Formulation of adhesives and sealants	Formulation of Adhesives and Sealants (OES #5)

Conditions of Use			Occupational Exposure Scenarios (OESs) for Assessment
Life Cycle Stage [a]	**Category [b]**	**Subcategory [c]**	
Distribution in commerce	Distribution in commerce	Distribution in commerce	Distribution in Commerce (OES #15) [d]
Industrial use	Adhesives and sealants	Adhesives and sealants	Use of Adhesives and Sealants (OES #6)
	Solvents (for cleaning and degreasing)	Solvents (for cleaning and degreasing)	Open-Top Vapor Degreasing (OES #7)
			Cold Cleaning (OES #8)
Commercial use	Adhesives and sealants	Adhesives and sealants	Use of Adhesives and Sealants (OES #6)
	Other use	Laboratory chemical	Use of Laboratory Chemicals (OES #9)
Consumer use	Adhesives and sealants	Adhesives and sealants	N/A [e]
Disposal	Disposal	Disposal	Disposal to Incineration (OES #10)
			Disposal to Landfill (OES #11)
			Disposal to POTW (OES #12)
			Disposal to Non-POTW WWT (OES #13)
			Remediation (OES #14)

POTW = publicly owned treatment works; WWT = wastewater treatment

[a] Life Cycle Stage Use Definitions (40 CFR 711.3)
– "Industrial Use" means use at a site at which 1 or more chemicals or mixtures are manufactured (including imported) or processed.
– "Commercial Use" means the use of a chemical or a mixture containing a chemical (including as part of an article) in a commercial enterprise providing saleable goods or services.
– "Consumer Use" means the use of a chemical or a mixture containing a chemical (including as part of an article, such as furniture or clothing) when sold to or made available to consumers for their use.
– Although EPA has identified both industrial and commercial uses here for purposes of distinguishing scenarios in this document, the Agency interprets the authority over "any manner or method of commercial use" under TSCA section 6(a)(5) to reach both.

[b] These categories of conditions of use (COUs) appear in the life cycle diagram (LCD), reflect Chemical Data Reporting (CDR) codes, and broadly represent COUs of 1,1,2-trichloroethane in industrial and/or commercial settings and for consumer uses.

[c] These subcategories reflect more specific COUs of 1,1,2-trichloroethane.

[d] Releases and exposures during distribution in commerce are not quantitatively assessed in this draft risk evaluation.

[e] Consumer uses are not assigned to OESs but are assessed in Sections 4.1.2 and 4.3.3 in this draft risk evaluation.

3.1.1.2 Description of Role/Function of 1,1,2-Trichloroethane for Each OES

An understanding of the role/function of 1,1,2-trichloroethane for each OES is important in mapping data to an OES and selecting appropriate modeling approaches to estimate releases and exposures. Brief summaries of the role/function of 1,1,2-trichloroethane for all OES are presented in Table 3-2.

1064 **Table 3-2. Description of the Function of 1,1,2-Trichloroethane for Each OES**

OES	Role/Function of 1,1,2-Trichloroethane
Manufacturing as a Byproduct at Chemical Manufacturing Facilities (OES #1)	This OES captures part of the Domestic manufacture condition of use (COU) category. 1,1,2-Trichloroethane is manufactured as a non-isolated byproduct during the intentional manufacturing of 1,2-dichloroethane and methyl chloroform.
Manufacturing as a Byproduct in the Pulp and Paper Industry (OES #2)	This OES captures part of the Domestic manufacture COU category. 1,1,2-Trichloroethane is not used as an input in the pulp and paper manufacturing process but may form as an unintentional byproduct during bleaching or incomplete combustion in the pulp and paper industry.
Repackaging for Laboratory Chemical Use (OES #3)	This OES captures the Repackaging and Import COU categories 1,1,2-Trichloroethane may be transported in liquid cargo barges, railcars, tank trucks, tank containers, intermediate bulk containers (IBCs)/totes, and drums. EPA expects that 1,1,2-trichloroethane will be repackaged from import containers into smaller product containers for laboratory use.
Processing as a Reactant (OES #4)	This OES captures Processing as a reactant and Recycling COU categories. 1,1,2-Trichloroethane is used as an intermediate in the production of various chemicals, including 1,1-dichloroethane, *cis*- and *trans*-dichloroethylene, vinylidene chloride, carbon tetrachloride, perchloroethylene, and hydrochloric acid.
Formulation of Adhesives and Sealants (OES #5)	This OES captures the Processing – Incorporated into formulation, mixture, or reaction product COU category. Incorporation into a formulation, mixture or reaction product refers to the process of mixing or blending of several raw materials to obtain a product or mixture. 1,1,2-Trichloroethane is expected to be mixed or blended into adhesives and sealants.
Use of Adhesives and Sealants (OES #6)	This OES captures the Industrial and Commercial use of adhesives and sealants COU category. 1,1,2-Trichloroethane is used as a component of acrylic and methacrylate adhesive formulations used by civil aviation and U.S. Department of Defense customers. In addition, 1,1,2-trichloroethane is a component of common off-the-shelf adhesives such as 2-part acrylic and epoxy adhesives.
Open-Top Vapor Degreasing (OES #7)	This OES captures part of the Solvents (for cleaning and degreasing) COU category. According to reported 2017 NEI data, 1,1,2-trichloroethane is used as a solvent in open-top vapor degreasing and cold cleaning. In open-top vapor degreasing, it functions as a volatilized cleaning solvent that condenses on parts to dissolve and remove greases.
Industrial Use in Cold Cleaning (OES #8)	This OES captures part of the Solvents (for cleaning and degreasing) COU category. According to reported 2017 NEI data, 1,1,2-trichloroethane is used as a solvent in open-top vapor degreasing and cold cleaning. In cold cleaning, it functions as a liquid cleaning solvent that removes oils and greases through spraying or immersion.
Commercial Use of Laboratory Chemicals (OES #9)	This OES captures the Commercial use of laboratory chemicals COU category.

OES	Role/Function of 1,1,2-Trichloroethane
	1,1,2-Trichloroethane is used in analytical standards, research, equipment calibration, and sample preparation applications, including as a reference sample for analysis of terrestrial and extraterrestrial material samples.
Disposal to Incineration (OES #10)	This OES captures part of the Disposal COU category. Each of the OESs may generate waste streams of 1,1,2-trichloroethane that are transferred to third-party sites for disposal or treatment, and these cases are assessed under these OESs. Waste containing 1,1,2-trichloroethane may be shipped in containers or piped directly to incineration sites. Incineration can result in releases of 1,1,2-trichloroethane to air or water through volatilization at loading and unloading points, incomplete combustion, or container cleaning
Disposal to Landfill (OES #11)	This OES captures part of the Disposal COU category. Each of the OES may generate waste streams of 1,1,2-trichloroethane that are collected and transported to third-party landfill sites for disposal and these cases are assessed under this OES. Waste containing 1,1,2-trichloroethane may be shipped in containers to landfill sites at various concentrations. 1,1,2-Trichloroethane is a U-listed hazardous waste under code U227 under RCRA; therefore, discarded, unused pure and commercial grades of 1,1,2-trichloroethane are regulated as a hazardous waste under RCRA (40 CFR 261.33(f)). Hazardous waste landfills are excavated or engineered sites specifically designed for the final disposal of non-liquid hazardous waste. Releases of 1,1,2-trichloroethane may occur through volatilization to air and leachate release to groundwater.
Disposal to POTW (OES #12)	This OES captures part of the Disposal COU category. Each of the OES may generate waste streams of 1,1,2-trichloroethane that are collected and transported to third-party POTW sites for disposal and these cases are assessed under this OES. Disposal to POTW refers to the collection and routing of 1,1,2-trichloroethane-containing wastes to third-party publicly owned treatment works which treat the wastes utilizing water treatment units. Releases of 1,1,2-trichloroethane to air or water might occur through volatilization during loading/unloading and wastewater treatment, fugitive leaks, or container cleaning.
Disposal to Non-POTW WWT (OES #13)	This OES captures part of the Disposal COU category. Each of the OES may generate waste streams of 1,1,2-trichloroethane that are collected and transported to third-party non-POTW WWT sites for disposal and these cases are assessed under this OES. Disposal to WWT refers to the collection and routing of 1,1,2-trichloroethane-containing wastes to third-party water treatment systems which treat the wastes utilizing water treatment units. Releases of 1,1,2-trichloroethane to air or water may occur through volatilization during loading/unloading and wastewater treatment, fugitive leaks, or container cleaning.
Remediation (OES #14)	This OES captures part of the Disposal COU category. Remediation refers to the removal of 1,1,2-trichloroethane from contaminated soil, water, or air. Thermal, biological, physical, and chemical treatment methods can be applied to contaminated media at the release site.
OES = occupational exposure scenario; NEI = National Emissions Inventory; POTW = publicly owned treatment works; RCRA = Resource Conservation and Recovery Act; WWT = wastewater treatment	

1065

3.1.1.3 Distribution in Commerce

EPA expects that 1,1,2-trichloroethane- and 1,1,2-trichloroethane-containing products are distributed throughout commerce from manufacturing sites to repackaging sites, processing as a reactant or formulation sites, and then to other downstream end use sites. Table 3-3 below provides EPA's understanding of how each OES receives 1,1,2-trichloroethane and how it distributes the chemical for further processing or use.

Table 3-3. Receipt and Distribution in Commerce of 1,1,2-Trichloroethane per OES

OES	How the OES Receives the Chemical	How the OES Distributes the Chemical
Manufacturing as a Byproduct at Chemical Manufacturing Facilities	Not applicable	Bulk transport from chemical manufacturing facilities via railcars, bulk marine vessels and barges to chemical manufacturing and processing facilities.
Manufacturing as a Byproduct in the Pulp and Paper Industry	Not applicable	EPA did not identify evidence of further distribution of 1,1,2-trichloroethane created from this source for further processing and uses.
Repackaging for Laboratory Chemical Use	Import in large containers for repackaging into small container sizes	Transport to commercial laboratory uses.
Processing as a Reactant	Bulk transport from chemical manufacturing facilities	Not applicable. 1,1,2-trichloroethane is reacted away.
Formulation of Adhesives and Sealants	EPA assumes transport from chemical manufacturing facilities or through chemical distributors	Transport to industrial/commercial users of adhesives and sealants.
Use of Adhesives and Sealants	Transport from processing-formulation facilities	Not applicable; no further distribution in commerce expected after use.
Open-Top Vapor Degreasing and Cold Cleaning	Uncertain. EPA has limited evidence for this use – assume chemical distributors	Not applicable; no further distribution in commerce expected after use.
Commercial Use of Laboratory Chemicals	Transport from importer-repackaging facilities	Not applicable; no further distribution in commerce expected after use.
Disposal (Incineration, Landfill, POTW, Non-POTW WWT, or Remediation)	Transport of waste from manufacturing, processing, or use facilities	Not applicable.
OES = occupational exposure scenario; POTW = publicly owned treatment works; WWT = wastewater treatment		

3.1.2 Estimating the Number of Release Days per Year for Facilities in Each OES

In this assessment, EPA utilized facility reported data on annual releases and estimated daily (kg/site-day) release rates for a facility based on the number of operating days. The annual release and average daily release of 1,1,2-trichloroethane are utilized in evaluating potential environmental concentrations, as discussed in Section 4.1.3 and Section 5.1. Data on the number of release days for a facility are not available from data sources such as Discharge Monitoring Reports (DMR), TRI, or Chemical Data Reporting (CDR). The National Emissions Inventory (NEI) includes a field for operating days per year (days/year). EPA uses facility-reported operating days from NEI whenever available and also utilizes data from test order summary reports such as submitted by the Vinyl Institute. According to the

information in the test order, representative facilities that manufacture 1,1,2-trichloroethane as a non-isolated byproduct operate on a continuous process on a 24 hours/day, 7 days/week schedule for 360 to 365 days per year (Stantec ChemRisk, 2024). EPA defaults to generic values only when this information is missing. For facilities that did not report to NEI or when operating days were not reported to NEI, the Agency uses generic estimates of the number of operating days (days/year) for facilities in each OES as presented in Table 3-4.

Table 3-4. Generic Estimates of Number of Operating Days per Year for Each OES for Facilities Not Reporting to NEI or When Operating Days Were Not Reported to NEI[a]

OES	Operating Days (days/year)	Basis
Manufacturing	350[b]	For the manufacture of the large-PV solvents, EPA assumes 350 days/year for release frequency. This assumes both the plant runs 7 days/week and 50 weeks/year (with 2 weeks down for turnaround) and that the plant is continually producing chemicals.
Repackaging for Laboratory Use	260	The Chemical Repackaging Generic Scenario (GS) estimates a default of 260 operating days/year (U.S. EPA, 2022).
Processing as a Reactant	350	EPA assumed the manufacture of commodity chemicals occurs 350 days per year such that the use of chemicals as a reactant to manufacture a commodity chemical would also occur 350 days per year.
Processing Through Formulation of Adhesives and Sealants	30–365	Facility operating days were calculated as a model output using the production rate and batch size, ranging from 30–365 days/year. Production rate and batch size were estimated using parameters provided by the Adhesive Formulation ESD (OECD, 2009).
Industrial and Commercial Use in Adhesives and Sealants	260	The April 2015 ESD on Use of Adhesives (OECD, 2015a) estimates a default of 260 operating days/year.
Industrial Use as Cleaning and Degreasing Solvent in Open-Top Vapor Degreasing	260	The ESD on the Use of Vapour Degreasers (OECD, 2021) estimates a default of 260 operating days/year.
Industrial Use as a Cleaning and Degreasing Solvent in Cold Cleaning	N/A	OES is being qualitatively assessed.
Commercial Use of Laboratory Chemicals	260	The Draft GS on Use of Laboratory Chemicals (U.S. EPA, 2023d) estimates a default of 260 operating days/year per the U.S. Bureau of Labor Statistics OES data.
Disposal to Incineration	250	Because it is unlikely that incineration facilities handle 1,1,2-trichloroethane every day; EPA assumes 250 days/year (5 days/week, 50 weeks/year).
Disposal to Landfill	250	Because it is unlikely that landfills handle 1,1,2-trichloroethane every day; EPA assumes 250 days/year (5 days/week, 50 weeks/year).
Disposal to POTW	365	POTWs are expected to operate continuously over 365 days/year; therefore, EPA assumes 365 days/year.

OES	Operating Days (days/year)	Basis
Disposal to Non-POTW WWT	250	It is unlikely that non-POTW disposal facilities handle 1,1,2-trichloroethane every day; therefore, EPA assumes 250 days/year (5 days/week, 50 weeks/year).
Disposal – Remediation	365	Remediation sites are expected to operate continuously over 365 days/year; therefore, 365 days/year is assumed.

ESD = emission scenario document; NEI = National Emissions Inventory; OES = occupational exposure scenario; POTW = publicly owned treatment works; PV = production volume; WWT = wastewater treatment
[a] See Section 4 of the *Draft Chemistry, Fate, Release, and Exposure Assessment for 1,1,2-Trichloroethane* (U.S. EPA, 2026g) for more information on the number of days. Default operating days shown in this table were only used for estimating exposures when release data (*e.g.,* from NEI or test orders) were not available.
[b] According to the information in the test order, representative facilities that manufacture 1,1,2-trichloroethane as a non-isolated byproduct operate on a continuous process on a 24 hours/day, 7 days/week schedule for 360 to 365 days per year (Stantec ChemRisk, 2024). As such, EPA did not use the generic value of 350 in the assessment.

3.1.3 Daily Release Estimation

3.1.3.1 Facility-Reported Release Data

EPA collected facility release data for 1,1,2-trichloroethane from the TRI (years 2019–2023), DMR (years 2019–2023), and National Emissions Inventory (NEI; years 2017 and 2020). TRI provides facility-specific data on releases to air, water, and land; DMR includes data on water releases; and NEI provides process-level data (*i.e.,* contains data on air emissions).

3.1.3.2 Mapping of Facility Release Data

EPA developed the OES to group processes or applications with similar sources of release that occur at industrial and commercial workplaces within the scope of the risk evaluation. Data is available in the TRI, DMR, and NEI that can be utilized to map the facility to an OES. The full details of the methodology for mapping facilities from EPA reporting programs is described in the *Draft Chemistry, Fate, Release, and Exposure Assessment for 1,1,2-Trichloroethane* (U.S. EPA, 2026ag). In brief, mapping consists of using facility-reported industry sectors (typically reported as either North American Industry Classification System [NAICS] or Standard Industrial Classification [SIC] codes), and chemical activity, processing, and use information to assign the most likely OES to each facility.

3.1.3.3 Modeling to Estimate Releases

When releases are expected for an OES, but TRI, DMR, and/or NEI data or release data from systematic review are not available, EPA used modeling to estimate releases. Modeling is also performed when there is limited facility release data available and the number of sites for the OES may be much higher than what is captured by the facility release data. Of the 15 OESs, facility release data were available for 10; however, for 3 of these, the data were limited and modeling was used to supplement release estimates. Two OESs had no facility release data available. EPA modeled releases for the following OESs: Import-Repackaging for Laboratory Chemical Use; Formulation of Adhesives and Sealants; Use of Adhesives and Sealants; Open-Top Vapor Degreasing; and Use of Laboratory Chemicals.

EPA identified model input parameters and equations from relevant literature sources, generic scenarios (GSs), or emission scenario documents (ESDs). For each modeled OES, a Monte Carlo simulation with 100,000 iterations was conducted to capture variability in input parameters and estimate total 1,1,2-trichloroethane releases by environmental media across all sources in each iteration. EPA selected the

50th and 95th percentile values to represent the central tendency and high-end releases, respectively.

The key modeling parameters used for each OES are presented in Table 3-5. For a full list of input parameters used in release modeling, refer to the *Draft Chemistry, Fate, Release, and Exposure Assessment for 1,1,2-Trichloroethane* (U.S. EPA, 2026w).

Table 3-5. Key Modeling Parameters Used to Model Environmental Releases

OES	Modeling Parameter	Variable Type	Value(s)	Source
All OESs Modeled for Releases	Production volume of 1,1,2-trichloroethane for this OES	Derived value	34,019.43 kg/year	2024 CDR (U.S. EPA, 2026b)
Repackaging	Facility annual product throughput	Discrete distribution	1–315,479 kg/site-year	2022 Chemical Repackaging Revised Draft Generic Scenario (U.S. EPA, 2022)
	1,1,2-Trichloroethane concentration	Discrete distribution	0.1–100% by weight	Product-specific parameter[a]
	Import container volume	Triangular distribution	100–1,000 gallons; mode of 550 gallons	ChemSTEER User Guide (U.S. EPA, 2015a)
	Laboratory chemical product container volume	Triangular distribution	1 mL to 1 L	Product-specific parameter[a]
Formulation of Adhesives and Sealants	Facility adhesive production rate	Uniform distribution	380,000–4,000,000 kg/site-year	2009 Emission Scenario Document on Adhesive Formulation (OECD, 2009)
	1,1,2-Trichloroethane concentration prior to formulation	Uniform distribution	1–30% by weight	2024 CDR (U.S. EPA, 2026b)
	Product concentration of 1,1,2-trichloroethane after formulation	Uniform distribution	1–5% by weight	Product-specific parameter[b]
Use of Adhesives and Sealants	Annual facility adhesive throughput	Default value	13,500 kg/site-year	2015 Emission Scenario Document on the Use of Adhesives (OECD, 2015a)
	Concentration of 1,1,2-trichloroethane in adhesive/sealant product	Uniform distribution	1–5% by weight	Product-specific parameter[b]
	Volume of adhesive/sealant product containers containing 1,1,2-trichloroethane	Discrete distribution	0.013 or 0.1 gallons	Product-specific parameter[b]

OES	Modeling Parameter	Variable Type	Value(s)	Source
Open-Top Vapor Degreasing	Vapor degreaser emissions (release point 2)	Discrete distribution	0.008–7,230 kg/site-year	2017 and 2020 NEI (U.S. EPA, 2020c)
	Concentration of 1,1,2-trichloroethane	Default value	100% by weight	2021 Emission Scenario Document on the Use of Vapour Degreasers (OECD, 2021)
	Frequency of solvent changeout	Default value	26 days/year	2021 Emission Scenario Document on the Use of Vapour Degreasers (OECD, 2021)
Use of Laboratory Chemicals	Facility laboratory chemical throughput	Discrete distribution	0.50–4,000 mL/site-day	2023 Use of Laboratory Chemicals Revised Draft Generic Scenario (U.S. EPA, 2023d)
	Product concentration	Discrete distribution	0.1–100% by weight	Product-specific parameter [a]
	Container volume	Triangular distribution	0.00026–0.66 gallons	Product-specific parameter [a]

CDR = Chemical Data Reporting
[a] Products used to derive the repackaging and laboratory chemical 1,1,2-trichloroethane concentration and container volume distributions include ThermoFisher Scientific (2018) Matheson Tri-Gas (2017), Phenova (2018) Santa Cruz Biotechnology (2019), Sigma-Aldrich Inc. (2020), and SPEX CertiPrep (2019).
[b] The product used for the adhesive product 1,1,2-trichloroethane concentration and container volume distributions was from Hunstman Advance Materials Americas LLC (2018).

3.1.3.4 Facility Release Controls

Reported facility release data from TRI, DMR, and NEI reflects the release amount after emission controls are applied at the facility.

For the modeled release estimates, release control efficiencies are applied to incineration and water release media. For the release estimates to incineration, a release control efficiency was applied based on the National Emission Standards for Hazardous Pollutants from Hazardous Waste Combustors (40 CFR part 63, subpart EEE) requirement that all hazardous waste combustors achieve a destruction removal efficiency of 99.99% for each principal organic hazardous constituent including 1,1,2-trichloroethane. For the release estimates to water, a removal efficiency of 73% was applied based on the average removal efficiency for POTWs, which closely aligns with the measured data of a pilot scale system (70.8 ± 7.1%). Due to a lack of data, EPA did not apply removal efficiencies for fugitive air emissions controls in the modeled release estimates.

3.1.3.5 Release Metrics

EPA compiled the environmental releases by air, water, and disposal media for each OES. For facility releases, the Agency summed annual releases that were reported directly by facilities and then averaged across the corresponding number of years of release. For example, for fugitive air releases, the Agency averaged the total yearly releases from 2019 through 2023 TRI and 2017 and 2020 NEI to develop an average annual release estimate. For modeled release estimates, EPA selected the central tendency (50th percentile) and high-end outputs (95th percentile) per release media. Annual and daily release estimates

are presented as 50th and 95th percentiles. Where available, EPA used NEI, GSs, or ESDs to estimate number of release days, which the Agency used to convert between annual release estimates and daily release estimates. EPA used CDR (2016, 2020, 2024), TRI (2019–2023), DMR (2019–2023), NEI (2017, 2020), and Monte Carlo modeling data to estimate the number of sites using 1,1,2-trichloroethane within an OES.

For each OES, EPA develops a conclusion on the weight of scientific evidence supporting the environmental release estimates based on the strengths, limitations, and uncertainties associated with the release estimates. The Agency considers factors that increase or decrease the strength of the evidence supporting the release estimate—including quality of the data/information, applicability of the release data to the COU (including considerations of temporal relevance, locational relevance), and the representativeness of the estimate across the whole industry.

The *Draft Chemistry, Fate, Release, and Exposure Assessment for 1,1,2-Trichloroethane* (U.S. EPA, 2026g) describes EPA's approach and methodology for estimating daily releases and provides detailed facility-level results for each OES.

3.2 Summary of Environmental Releases

3.2.1 Industrial and Commercial Releases

EPA combined its estimates for annual releases, release days, number of facilities, and hours of release per day to estimate a range of daily releases for each OES. Table 3-6 presents a summary of these ranges across facilities. See the *Draft Chemistry, Fate, Release, and Exposure Assessment for 1,1,2-Trichloroethane* (U.S. EPA, 2026g, 2025a) for additional detail. EPA was unable to estimate site-specific releases for the OES covering the final use of articles. As mentioned above, disposal sites handling post-consumer, end-use 1,1,2-trichloroethane were not quantifiable based on the data available.

Table 3-6. Summary of Environmental Releases by Occupational Exposure Scenario for 1,1,2-Trichloroethane

OES	Type of Discharge, [a] Air Emission, [b] or Transfer for Disposal [c]	Estimated Annual Release (kg/site-year) [d]		Estimated Daily Release (kg/site-day) [e]		Number of Data Points [f]	Number of Facilities [g]	Source(s)
		Central Tendency[g]	High-End	Central Tendency	High-End			
Manufacturing as a Byproduct at Chemical Manufacturing Facilities	Surface water	1.8	29	5.2E−03	8.4E−02	17	5	2019–2023 TRI
	Surface water	2.8	1,339	8.0E−03	3.8	10	3	2019–2023 DMR
	Fugitive air	97	4,166	0.28	12	61	13	2019–2023 TRI
	Fugitive air	109	2,323	0.26	5.5	23	12	2017 and 2020 NEI
	Stack air	11	717	3.2E−02	2.0	49	10	2019–2023 TRI
	Stack air	13	588	3.5E−02	1.6	20	11	2017 and 2020 NEI
	Land	1.4	9,208	3.9E−03	26	17	6	2019–2023 TRI
Manufacturing as a Byproduct in the Pulp and Paper Industry	Fugitive air	46	1,102	0.13	3.0	79	45	2017 and 2020 NEI
	Stack air	11	241	3.4E−02	0.69	106	66	2017 and 2020 NEI
Repackaging for Laboratory Chemical Use	Surface water	0.65	236	2.6E−03	0.95	10	5	2019–2023 DMR
	Fugitive air	0.60	5.0	2.4E−03	1.3E−02	6	4	2017 and 2020 NEI
	Stack air	0.20	0.85	5.5E−04	3.3E−03	7	4	2017 and 2020 NEI
	Fugitive air	287	778	1.4	3.5	–	–	Environmental release modeling
	Uncertain media (total):	24	631	0.11	3.0			
	If Incineration	2.4E−03	6.3E−02	1.1E−05	3.0E−04			
	If Landfill	24	631	0.11	3.0			
Processing as a Reactant	Surface water	0.33	10	9.5E−04	2.9E−02	192	57	2019–2023 DMR
	Fugitive air	173	274	0.49	0.78	17	4	2019–2023 TRI
	Fugitive air	1.2	116	3.2E−03	0.32	16	11	2017 and 2020 NEI
	Stack air	5.9	52	1.7E−02	0.15	13	4	2019–2023 TRI
	Stack air	1.9E−02	42	5.2E−05	0.12	8	4	2017 and 2020 NEI
	Land	5.4	11	1.6E−02	3.1E−02	4	2	2019–2023 TRI
Formulation of Adhesives and Sealants	Fugitive air	2.5	3.9	6.3E−02	0.14	–	–	Environmental release modeling
	Stack air	8.2	39	6.5E−02	0.16			
	Uncertain media (total):	668	829	4.7	19			
	If Water	180	224	1.3	5			
	If Incineration	6.7E−02	8.3E−02	4.7E−04	1.9E−03			
	If Landfill	668	829	4.7	19			

OES	Type of Discharge, [a] Air Emission, [b] or Transfer for Disposal [c]	Estimated Annual Release (kg/site-year) [d]		Estimated Daily Release (kg/site-day) [e]		Number of Data Points [f]	Number of Facilities [g]	Source(s)
		Central Tendency[g]	High-End	Central Tendency	High-End			
Use of Adhesives and Sealants	Fugitive air	2.5	39	7.2E−03	0.16	5	4	2017 and 2020 NEI
	Stack air	0.46	3.1	1.8E−03	1.2E−02	8	6	2017 and 2020 NEI
	Fugitive air	402	643	1.5	2.5	–	–	Environmental Release modeling
	Uncertain media (total):	2.7	5.9	1.0E−02	2.3E−02			
	If Water	0.73	1.6	2.7E−03	6.2E−03			
	If Incineration	2.7E−04	5.9E−04	1.0E−06	2.3E−06			
	If Landfill	2.7	5.9	1.0E−02	2.3E−02			
Use of Cleaning and Degreasing Solvents (Open-Top Vapor Degreasing and Cold Cleaning)	Fugitive air	304		1.2		1	1	2019–2023 TRI
	Fugitive air	0.45	654	4.4E−02	2.2	7	5	2017 and 2020 NEI
	Stack air	3,638		14		1	1	2019–2023 TRI
	Stack air	3,615	6,869	14	26	4	2	2017 and 2020 NEI
	Fugitive air or Stack air	0.46	4,069	1.8E−03	12	–	–	Environmental Release modeling
	Water	17	32	0.19	0.33			
	Incineration	1.0E−03	3.9E−02	3.9E−05	1.5E−03			
	Uncertain media (total):	1.9	188	5.7E−03	0.55			
	If Incineration	1.9E−04	1.9E−02	5.7E−07	5.5E−05			
	If Landfill	0.46	4,069	5.7E−03	0.55			
Use of Laboratory Chemicals	Surface water	0.15	1.9	5.9E−04	7.2E−03	10	2	2019–2023 DMR
	Fugitive air	2.5E−05		7.2E−08		2	1	2017 and 2020 NEI
	Fugitive air or Stack air	4.8	13	2.1E−02	5.3E−02	–	–	Environmental Release modeling
	Uncertain media (total):	317	1,040	1.4	4.5			
	If Incineration	3.2E−02	0.10	1.2E−04	4.0E−04			
	If Landfill	317	1,040	1.4	4.5			
Disposal to Incineration	Surface water	2.1E−02	2.2E−02	8.2E−05	9.0E−05	2	1	2019–2023 DMR
	Fugitive air	0.50	45	2.0E−03	0.18	21	5	2019–2023 TRI
	Fugitive air	3.2E−03	8.7	1.3E−05	3.3E−02	15	9	2017 and 2020 NEI
	Stack air	0.13	2.8	5.3E−04	1.1E−02	16	5	2019–2023 TRI
	Stack air	0.27	143	1.1E−03	0.53	25	14	2017 and 2020 NEI
	Landfill	1.8E−02	4.7	7.3E−05	1.9E−02	5	3	2019–2023 TRI

OES	Type of Discharge, [a] Air Emission, [b] or Transfer for Disposal [c]	Estimated Annual Release (kg/site-year) [d]		Estimated Daily Release (kg/site-day) [e]		Number of Data Points [f]	Number of Facilities [g]	Source(s)
		Central Tendency[g]	High-End	Central Tendency	High-End			
Disposal to Landfill	Surface water	3.6E−02	0.97	1.4E−04	3.9E−03	15	6	2019–2023 DMR
	Fugitive air	9.1E−02	117	3.6E−04	0.47	17	5	2019–2023 TRI
	Fugitive air	0.74	24	2.5E−03	9.4E−02	105	64	2017 and 2020 NEI
	Stack air	0.23	3.0	9.3E−04	1.2E−02	12	4	2019–2023 TRI
	Stack air	0.60	61	2.5E−03	0.25	54	34	2017 and 2020 NEI
	Landfill	2.3	4.3	9.1E−03	1.7E−02	3	3	2019–2023 TRI
Disposal to POTW	Surface water	1.9	28	5.2E−03	7.6E−02	253	108	2019–2023 DMR
	Fugitive air	3.1E−02	18	8.8E−05	7.1E−02	7	5	2017 and 2020 NEI
	Stack air	8.1E−06		2.3E−08		2	1	2017 and 2020 NEI
Disposal to Non-POTW WWT	Surface water	0.32	7.8	1.3E−03	3.1E−02	22	54	2019–2023 DMR
	Fugitive air	1.8	13	7.3E−03	3.5E−02	19	28	2017 and 2020 NEI
	Stack air	5.5E−05	8.3E−04	2.2E−07	3.3E−06	224	431	2017 and 2020 NEI
Remediation	Surface water	1.5E−02	0.24	6.1E−05	9.7E−04	44	130	2019–2023 DMR
	Fugitive air	4.5	186	8.8E−05	7.1E−02	4	6	2017 and 2020 NEI
	Stack air	39	73	0.15	0.29	2	4	2017 and 2020 NEI
Facilities Not Mapped to an OES	Surface water	6.3E−02	0.49	2.5E−04	2.0E−03	36	13 [h]	2019–2023 DMR
Non-OES (Miscellaneous)	Fugitive air	2.3E−02	1.5	1.0E−04	4.6E−03	797	510	2017 and 2020 NEI
	Stack air	0.18	14	8.0E−04	5.7E−02	1,923	1,198	2017 and 2020 NEI
Non-OES (Combustion)	Fugitive air	2.2E−03	89	8.7E−06	0.35	6	5	2017 and 2020 NEI
	Stack air	0.28	14	1.1E−03	4.3E−02	495	287	2017 and 2020 NEI

OES	Type of Discharge, [a] Air Emission, [b] or Transfer for Disposal [c]	Estimated Annual Release (kg/site-year) [d]		Estimated Daily Release (kg/site-day) [e]		Number of Data Points [f]	Number of Facilities [g]	Source(s)
		Central Tendency[g]	High-End	Central Tendency	High-End			

[a] Direct discharge to surface water; indirect discharge to non-POTW WWT; indirect discharge to POTW
[b] Emissions via fugitive air, stack air, or treatment via incineration
[c] Transfer to surface impoundment, land application, or landfills
[d] For modeled results, the presented central tendency and high-end are the 50th and 95th percentile values of the modeled distribution. For programmatic data (*e.g.,* NEI, TRI, and DMR), the presented central tendency is calculated from the median reported release amounts and high-end from the reported maximum release amounts. The specific central tendency and high-end values presented depends on the number of sites with programmatic data. For databases with 6 or more reporting facilities, EPA estimated central tendency and high-end releases using the 50th and 95th percentile values, respectively. For 3–5 facilities, EPA estimated the central tendency and high-end releases using the 50th percentile and maximum values, respectively. For 2 sites, EPA presented the midpoint and the maximum value. Finally, EPA presented sites with only 1 data point as-is from the programmatic database.
[e] Where available, EPA used peer reviewed literature (*e.g.,* GSs or ESDs) to provide a basis to estimate the number of release days of 1,1,2-trichloroethane within a COU.
[f] Data points represent the total number of reports submitted during the years included in the assessment.
[g] Where available, EPA used the 2020 CDR (U.S. EPA, 2020a), NEI (U.S. EPA, 2023a), DMR (U.S. EPA, 2023c), and TRI databases (U.S. EPA, 2023e), 2020 U.S. County Business Practices (U.S. Census Bureau, 2022), and Monte Carlo models to estimate the number of sites that use 1,1,2-trichloroethane for each COU. Some modeled OES calculated the number of facilities/sites, presented as 50th and 95th percentiles. Other modeled OESs set the number of facilities deterministically, presented as 1 value.
[h] The central tendency values for NEI air were calculated using the median of the reported releases at each site.
[i] There were 13 facilities not mapped to an OES with 1,1,2-trichloroethane releases that EPA was unable to map due to the lack of information regarding the activity of 1,1,2-trichloroethane at the site. These sites do not fit in any of the 1,1,2-trichloroethane OESs because they are mainly hotels, businesses, and various chemical facilities where 1,1,2-trichloroethane use is unknown.

1176

Table 3-7 to Table 3-9 provide data for release trends over the reporting years included in this risk evaluation.

Table 3-7. 1,1,2-Trichloroethane TRI Release Trends for Reporting Years 2019–2023

Reporting Year	Air (kg/year)			Water (kg/year)			Land (kg/year)
	Fugitive	Stack	Fugitive and Stack	On-Site Discharge	Transfer to POTW	Transfer to WWT (Non-POTW)	
2023	5,591	4,182	9,772	8.9	0	12	2.5E04
2022	5,819	4,299	1.0E04	38	0	16	5,304
2021	7,314	2,904	1.0E04	44	0	22	11
2020	6,642	2,605	9,247	3.8	0	22	22
2019	6,586	6,579	1.3E04	3.3	0	22	6.0
POTW = publicly owned treatment works; TRI = Toxics Release Inventory; WWT = wastewater treatment							

Table 3-8. 1,1,2-Trichloroethane NEI Release Trends for Reporting Years 2017 and 2020

Reporting Year	Stack Air (kg/year)	Fugitive Air (kg/year)	Fugitive and Stack Air (kg/year)
2020	1.3E04	2.2E04	3.5E04
2017	2.3E04	2.3E04	4.7E04
NEI = National Emissions Inventory			

Table 3-9. 1,1,2-Trichloroethane DMR Release Trends for Reporting Years 2019–2023

Reporting Year	Annual Releases to Surface Water (kg/year)
2023	312
2022	1,178
2021	3,322
2020	601
2019	713
DMR = Discharge Monitoring Report	

3.2.2 Weight of Scientific Evidence Conclusions for Environmental Releases from Industrial and Commercial Sources

For each OES, EPA considered the assessment approach, the quality of the data and models, and the uncertainties in the assessment results to determine a level of confidence for the environmental release estimates. Table 3-10 provides EPA's weight of scientific evidence rating for each OES.

1194 **Table 3-10. Summary of Overall Confidence in Environmental Release Estimates by OES**

OES	Weight of Scientific Evidence Conclusion in Release Estimate	Confidence Rating
Manufacturing as a Byproduct at Chemical Manufacturing Facilities	***Evidence Found:*** For this OES, EPA had release information for water, land, and air from the Toxics Release Inventory (TRI), water from the Discharge Monitoring Report (DMR), and air from National Emissions Inventory (NEI) programs. ***Strengths:*** Water releases are assessed using reported releases from 2019-2023 for both DMR and TRI. These databases received a medium to high data quality rating in systematic review. The primary strength of TRI data is that TRI compiles the best readily available release data for all reporting facilities. Based on reporting thresholds, TRI captures the highest throughput sites. Since releases are related to throughput, this increases confidence that the highest emitters are captured in this assessment. Air releases are assessed using reported releases from 2019–2023 TRI, and 2017 and 2020 NEI. A strength of NEI data is that NEI captures additional sources that are not included in TRI due to reporting thresholds. ***Limitations/Assumptions/Uncertainties:*** Factors that decrease the overall confidence for the water estimates include the uncertainty in the accuracy of reported releases, and uncertainty in mapping sites in DMR to the Manufacturing OES. Most facilities only report NAICS codes; therefore, it is uncertain whether the site performs manufacturing or another chemical process, such as processing as a reactant. Additionally, there are nine byproduct manufacturing sites that report releases to other media in other reporting databases (TRI and NEI), but do not report releases to water in TRI. It is unclear whether these sites do not release to water or if the site does not meet reporting thresholds for TRI. Factors that decrease the overall confidence for the air estimates include the uncertainty in the accuracy of reported releases, and the limitations in representativeness to all sites because TRI and NEI may not capture all relevant sites. In some cases, operating days were reported by facilities in NEI. Otherwise, EPA made assumptions on the number of operating days to estimate daily releases. Factors that decrease the overall confidence for the land release estimates include the uncertainty in the accuracy of reported releases, and the limitations in representativeness to all sites because TRI may not capture all relevant sites. Based on other reporting databases (DMR and NEI), there are nine additional byproduct manufacturing sites that report releases to other media but do not report releases to land. ***Weight of Scientific Evidence Conclusion:*** Although there is uncertainty of whether the databases capture all sites releasing to each medium, the release data are rated medium to high in systematic review and provide releases directly from a wide number of manufacturing facilities. Based on this information, EPA has concluded that the weight of scientific evidence for this assessment provides moderate-to-robust confidence in the estimate of releases in consideration of the strengths and limitations of reasonably available data.	Moderate-to-Robust

OES	Weight of Scientific Evidence Conclusion in Release Estimate	Confidence Rating
Manufacturing as a Byproduct in the Pulp and Paper Industry	***Evidence Found:*** For this OES, EPA had air release data from NEI. EPA did not identify air, water, or land release data from TRI or DMR. ***Strengths:*** Air releases are assessed using reported releases from 2017 and 2020 NEI. A strength of NEI data is that NEI captures additional sources that are not included in TRI due to reporting thresholds, and the release data are rated high in systematic review. ***Limitations/Assumptions/Uncertainties:*** Factors that decrease the overall confidence for the estimates include the uncertainty in the accuracy of reported releases, and the limitations in representativeness to all sites because NEI may not capture all relevant sites. In some cases, operating days were reported by facilities in NEI. Otherwise, EPA made assumptions on the number of operating days to estimate daily releases. ***Weight of Scientific Evidence Conclusion:*** Although there is uncertainty of whether the databases capture all sites releasing to each medium, the release data are rated high in systematic review and provide releases directly from a wide number of manufacturing facilities (71 sites). Based on this information, EPA has concluded that the weight of scientific evidence for this assessment provides moderate confidence in the estimate of releases in consideration of the strengths and limitations of reasonably available data.	Moderate
Repackaging for Laboratory Use	***Evidence Found:*** For this OES, EPA did not identify any release information from programmatic data. Therefore, releases to the environment are assessed using the GS on Chemical Repackaging, which has a high data quality rating from the systematic review process (U.S. EPA, 2022). EPA used EPA/OPPT models combined with Monte Carlo modeling to estimate releases to the environment, with media of release assessed using assumptions from the GS and EPA/OPPT models. ***Strengths:*** A strength of the Monte Carlo modeling approach is that variation in model input values and a range of potential releases values is more likely than a discrete value to capture actual releases at sites. ***Limitations/Assumptions/Uncertainties:*** The Agency believes the primary limitation to be the uncertainty in the representativeness of values toward the true distribution of potential releases. In addition, EPA lacks 1,1,2-trichloroethane repackaging throughput data; therefore, throughput estimates are based on the Chemical Repackaging GS and CDR reporting thresholds. EPA assumed that the media of release for repackaging waste is to hazardous waste landfill or incineration, per the GS. ***Weight of Scientific Evidence Conclusion:*** Based on this information, EPA has concluded that the weight of scientific evidence for this assessment provides slight-to-moderate confidence in the estimate of releases in consideration of the strengths and limitations of reasonably available data.	Slight-to-Moderate

OES	Weight of Scientific Evidence Conclusion in Release Estimate	Confidence Rating
Processing as a Reactant	***Evidence Found:*** For this OES, EPA had release information for water, air, and land from TRI, water from DMR, and air from NEI. ***Strengths:*** Water releases are assessed using reported releases from 2019–2023 DMR, which has a medium overall data quality determination from the systematic review process. The primary strength of TRI data is that TRI compiles the best readily available release data for all reporting facilities. Based on reporting thresholds, TRI captures the highest throughput sites. Because releases are related to throughput, this increases confidence that the highest emitters are captured in this assessment. The water release assessment is based on 57 reporting sites. Air releases are assessed using reported releases from 2019–2023 TRI as well as 2017 and 2020 NEI. A strength of NEI data is that NEI captures additional sources that are not included in TRI due to reporting thresholds. ***Limitations/Assumptions/Uncertainties:*** There is uncertainty in mapping sites to TRI and DMR as most facilities only report NAICS code; therefore, it is uncertain what type of chemical process the site performs (manufacturing, processing as a reactant, etc.). Based on other reporting databases (NEI and TRI), there are 16 additional sites that report releases to other media but do not report releases to water. Factors that decrease the overall confidence for this OES include the uncertainty in the accuracy of reported releases and the limitations in representativeness to all sites because TRI and NEI may not capture all relevant sites. Based on other reporting databases (DMR), there are 56 additional sites that report releases to other media but do not report releases to air. The primary limitation of the land release estimates is that the assessment is based on three reporting sites and EPA did not have additional sources to estimate land releases from this OES. Based on other reporting databases (DMR, NEI, TRI), there are 70 additional sites that report releases to other media but do not report releases to land. ***Weight of Scientific Evidence Conclusion:*** Although there is uncertainty of whether the databases capture all sites releasing to each medium, the release data are rated medium to high in systematic review and provide releases directly from a wide number of facilities (73 sites) that process 1,1,2-trichloroethane as a reactant. Based on this information, EPA has concluded that the weight of scientific evidence for this assessment provides moderate-to-robust confidence in the estimate of releases in consideration of the strengths and limitations of reasonably available data.	Moderate-to-Robust
Formulation of Adhesives and Sealants	***Evidence Found:*** For this OES, EPA did not identify any release information from programmatic data. Therefore, releases to the environment are assessed using the April 2009 Emission Scenario Document on Adhesive Formulation, which has a high data quality rating from the systematic review process (OECD,	Slight-to-Moderate

OES	Weight of Scientific Evidence Conclusion in Release Estimate	Confidence Rating
	2009). EPA used EPA/OPPT models combined with Monte Carlo modeling to estimate releases to the environment. ***Strengths:*** A strength of the Monte Carlo modeling approach is that variation in model input values and a range of potential releases values is more likely than a discrete value to capture actual releases at sites. ***Limitations/Assumptions/Uncertainties:*** The Agency believes the primary limitation to be the uncertainty in the representativeness of values toward the true distribution of potential releases. In addition, EPA lacks 1,1,2-trichloroethane formulation throughput data; therefore, throughput estimates are based on the ESD and CDR reporting thresholds. Media of release were assessed using assumptions from the GS and EPA/OPPT models. ***Weight of Scientific Evidence Conclusion:*** Based on this information, EPA has concluded that the weight of scientific evidence for this assessment provides slight-to-moderate confidence in the estimate of releases in consideration of the strengths and limitations of reasonably available data.	
Use of Adhesives and Sealants	***Evidence Found:*** For this OES, EPA had release information only for air from NEI. EPA identified 9 facilities reporting air releases of 1,1,2-trichloroethane that were potentially relevant to the use of adhesives and sealants. EPA determined these data are not sufficient to confidently capture the entirety of environmental releases for this scenario due to the fact they were from the NEI database and only reported on releases to air. Therefore, releases to the environment were also assessed using the ESD on Use of Adhesives (OECD, 2015a). ***Strengths:*** The ESD has a high data quality rating from the systematic review process. EPA used this ESD combined with Monte Carlo modeling to estimate releases to the environment, with media of release assessed using assumptions from the ESD Model. More information about the details and assumptions of the model can be found in the *Draft Chemistry, Fate, Release, and Exposure Assessment for 1,1,2-Trichloroethane* (U.S. EPA, 2026g, 2025a). A strength of the Monte Carlo modeling approach is that variation in model input values and a range of potential releases values is more likely than a discrete value to capture actual releases at sites. ***Limitations/Assumptions/Uncertainties:*** The Agency further believes the primary limitation to be the uncertainty in the representativeness of values toward the true distribution of potential releases. In addition, EPA lacks 1,1,2-trichloroethane chemical throughput data (*i.e.,* kg of chemical used per site per year); therefore, EPA used default values suggested in the Use of Adhesives Emission Scenario Document to model releases for this scenario. The facility annual adhesive use rate is 13,500 kg/site-year (OECD, 2015a). Comparison of modeled values with the NEI data is difficult due to uncertainty on the throughput (kg/site-year) of 1,1,2-trichloroethane at the NEI sites in comparison to the throughput value used in the modeling.	Slight-to-Moderate

OES	Weight of Scientific Evidence Conclusion in Release Estimate	Confidence Rating
	Weight of Scientific Evidence Conclusion: Overall, EPA concludes the weight of scientific evidence for this assessment is slight-to-moderate.	
Use as a Solvent for Cleaning and Degreasing	***Evidence Found:*** For this OES, EPA had release information for air from TRI and NEI. EPA identified seven facilities reporting air releases of 1,1,2-trichloroethane. Due to the difficulty of determining the exact activities that occur at each site and the method of use (aerosol vs non-aerosol), EPA assumed that the 7 sites may potentially use non-aerosol cleaning/degreasing based on the industry and source classification codes for each source. Because so few sites reported to the databases and data points from NEI report only air releases, EPA also chose to model releases for cleaning and degreasing to obtain estimates for releases to other media. ***Strengths:*** To bolster the limited release data for this OES, EPA modeled this OES under the assumption that vapor degreasing is the method used for cleaning and degreasing using products containing 1,1,2-trichloroethane. Releases to the environment are assessed using assumptions and methods from the ESD on the Use of Vapour Degreasers, which has a high data quality rating from the systematic review process (OECD, 2021). A strength of the Monte Carlo modeling approach is that variation in model input values and a range of potential release values is more likely than a discrete value to capture actual releases at sites. ***Limitations/Assumptions/Uncertainties:*** EPA believes the primary limitation to be the uncertainty in the actual method when 1,1,2-trichloroethane is used in cleaning and degreasing (vapor degreasing chosen based on reported NEI data), and uncertainty about the representativeness of values toward the true distribution of potential releases. In addition, EPA lacks 1,1,2-trichloroethane throughput data and number of facilities; therefore, the number of facilities and throughput estimates are based on throughputs provided by the ESD (see *Draft Chemistry, Fate, Release, and Exposure Assessment for 1,1,2-Trichloroethane* (U.S. EPA, 2026g, 2025a)) ***Weight of Scientific Evidence Conclusion:*** Based on this information, EPA has concluded that the weight of scientific evidence for this assessment provides slight-to-moderate confidence in the estimate of releases in consideration of the strengths and limitations of reasonably available data.	Slight-to-Moderate
Use as a Laboratory Chemical	***Evidence Found:*** For this OES, EPA had release information for water from DMR and for air from NEI. EPA identified 3 facilities reporting water and air releases of 1,1,2-trichloroethane. However, EPA determined that these data are not sufficient to capture the entirety of environmental releases for this scenario. Therefore, releases to the environment are assessed using the Draft GS on the Use of Laboratory Chemicals, which has a high data quality rating from the systematic review process (U.S. EPA, 2023d). EPA used EPA/OPPT models combined with Monte Carlo modeling to estimate releases to the environment. ***Strengths:*** EPA believes a strength of the Monte Carlo modeling approach is that variation in model input values and a range of potential releases values is more likely than a discrete value to capture actual releases at sites.	Moderate

OES	Weight of Scientific Evidence Conclusion in Release Estimate	Confidence Rating
	Limitations/Assumptions/Uncertainties: The Agency believes the primary limitation to be the uncertainty in the representativeness of values toward the true distribution of potential releases. In addition, EPA lacks 1,1,2-trichloroethane laboratory chemical throughput data; therefore, throughput estimates are based on stock solution throughputs from the Draft GS on the Use of Laboratory Chemicals and on CDR reporting thresholds. The Agency also has an estimate for the number of laboratories only through the three facilities reporting to DMR and NEI, which may not capture all sites if some laboratories do not report to the programmatic databases. EPA assumed that the media of release for disposal of laboratory waste is to hazardous waste landfill or incineration, per the GS. EPA has more certainty regarding the use of 1,1,2-trichloroethane for this OES from SDSs and combines that with the facility release data available and supporting evidence from the model. ***Weight of Scientific Evidence Conclusion:*** Based on this information, EPA has concluded that the weight of scientific evidence for this assessment provides moderate confidence in the estimate of releases in consideration of the strengths and limitations of reasonably available data.	
Disposal to Incineration	***Evidence Found:*** For this OES, EPA had release information for air and land from TRI, for water from DMR, and for air from TRI and NEI. ***Strengths:*** Water releases for incineration sites are assessed using reported releases from 2019–2023 DMR. A strength of using DMR data and the Pollutant Loading Tool is that the tool calculates an annual pollutant load by integrating monitoring period release reports provided to the EPA and extrapolating over the course of the year. Air releases for incineration sites are assessed using reported releases from 2019–2023 TRI as well as the 2017 and 2020 NEI. A strength of NEI data is that NEI captures additional sources that are not included in TRI due to reporting thresholds. Based on reporting thresholds, TRI captures the highest throughput sites. Since releases are related to throughput, this increases confidence that the highest emitters are captured in this assessment. ***Limitations/Assumptions/Uncertainties:*** The DMR approach assumes average quantities, concentrations, and hydrologic flows for a given period are representative of other times of the year. In some cases, operating days were reported by facilities in NEI. Otherwise, EPA made assumptions on the number of operating days to estimate daily releases. Factors that decrease the confidence for this OES include the uncertainty in the accuracy of reported releases, and the limitations in representativeness to all sites because TRI and NEI may not capture all relevant sites. ***Weight of Scientific Evidence Conclusion:*** Based on this information, EPA has concluded that the weight of scientific evidence for this assessment provides moderate-to-robust confidence in the estimate of releases in consideration of the strengths and limitations of reasonably available data.	Moderate-to-Robust

OES	Weight of Scientific Evidence Conclusion in Release Estimate	Confidence Rating
Disposal to Landfill	***Evidence Found:*** For this OES, EPA had release information for air and land from TRI, for water from DMR, and for air from TRI and NEI. ***Strengths:*** Water releases for landfill sites are assessed using reported releases from 2019–2023 DMR. A strength of using DMR data and the Pollutant Loading Tool is that the tool calculates an annual pollutant load by integrating monitoring period release reports provided to the EPA and extrapolating over the course of the year. Air releases for landfill sites are assessed using reported releases from 2019–2023 TRI as well as the 2017 and 2020 NEI. A strength of NEI data is that NEI captures additional sources that are not included in TRI due to reporting thresholds. Based on reporting thresholds, TRI captures the highest throughput sites. Since releases are related to throughput, this increases confidence that the highest emitters are captured in this assessment. ***Limitations/Assumptions/Uncertainties:*** The DMR approach assumes average quantities, concentrations, and hydrologic flows for a given period are representative of other times of the year. In some cases, operating days were reported by facilities in NEI. Otherwise, EPA made assumptions on the number of operating days to estimate daily releases. Factors that decrease the confidence for this OES include the uncertainty in the accuracy of reported releases, and the limitations in representativeness to all sites because TRI and NEI may not capture all relevant sites. ***Weight of Scientific Evidence Conclusion:*** In conclusion, although there is uncertainty of whether the databases capture all sites releasing to each medium, the release data are rated medium to high in systematic review and provide releases directly from a wide number of landfill facilities (89 sites). Based on this information, EPA has concluded that the weight of scientific evidence for this assessment provides moderate-to-robust confidence in the estimate of releases in consideration of the strengths and limitations of reasonably available data.	Moderate-to-Robust
Disposal to POTW	***Evidence Found:*** For this OES, EPA had release information for air from 2017 and 2020 NEI and for water from 2019–2023 DMR. ***Strengths:*** A strength of using DMR data and the Pollutant Loading Tool is that the tool calculates an annual pollutant load by integrating monitoring period release reports provided to the EPA and extrapolating over the course of the year. A strength of NEI data is that NEI captures additional sources that are not included in TRI due to reporting thresholds. ***Limitations/Assumptions/Uncertainties:*** The DMR approach assumes average quantities, concentrations, and hydrologic flows for a given period are representative of other times of the year. In some cases, operating days were reported by facilities in NEI. Otherwise, EPA made assumptions on the number of operating days to estimate daily releases. Factors that decrease the confidence for this OES include the uncertainty in the	Moderate-to-Robust

OES	Weight of Scientific Evidence Conclusion in Release Estimate	Confidence Rating
	accuracy of reported releases, and the limitations in representativeness to all sites because NEI may not capture all relevant sites. ***Weight of Scientific Evidence Conclusion:*** In conclusion, although there is uncertainty of whether the databases capture all sites releasing to each medium, the release data are rated medium to high in systematic review and provide releases directly from a wide number of POTW facilities (114 sites). Based on this information, for POTW releases, EPA has concluded that the weight of scientific evidence for this assessment provides moderate-to-robust confidence in the estimate of releases in consideration of the strengths and limitations of reasonably available data.	
Disposal to Non-POTW WWT	***Evidence Found:*** For this OES, EPA had release information for air from 2017 and 2020 NEI and for water from 2019–2023 DMR. ***Strengths:*** A strength of using DMR data and the Pollutant Loading Tool is that the tool calculates an annual pollutant load by integrating monitoring period release reports provided to the EPA and extrapolating over the course of the year. A strength of NEI data is that NEI captures additional sources that are not included in TRI due to reporting thresholds. ***Limitations/Assumptions/Uncertainties:*** The DMR approach assumes average quantities, concentrations, and hydrologic flows for a given period are representative of other times of the year. In some cases, operating days were reported by facilities in NEI. Otherwise, EPA made assumptions on the number of operating days to estimate daily releases. Factors that decrease the confidence for this OES include the uncertainty in the accuracy of reported releases, and the limitations in representativeness to all sites because NEI may not capture all relevant sites. ***Weight of Scientific Evidence Conclusion:*** In conclusion, although there is uncertainty of whether the databases capture all sites releasing to each medium, the release data are rated medium to high in systematic review and provide releases directly from a wide number of non-POTW WWT facilities (260 sites). Based on this information, for non-POTW WWT releases, EPA has concluded that the weight of scientific evidence for this assessment provides moderate-to-robust confidence in the estimate of releases in consideration of the strengths and limitations of reasonably available data.	Moderate-to-Robust
Remediation	***Evidence Found:*** For this OES, EPA had release information for air from 2017 and 2020 NEI and for water from 2019–2023 DMR. ***Strengths:*** A strength of using DMR data and the Pollutant Loading Tool is that the tool calculates an annual pollutant load by integrating monitoring period release reports provided to the EPA and extrapolating over the course of the year. A strength of NEI data is that NEI captures additional sources that are not included in TRI due to reporting thresholds. Factors that decrease the confidence for this OES include the uncertainty in	Moderate

OES	Weight of Scientific Evidence Conclusion in Release Estimate	Confidence Rating
	the accuracy of reported releases, and the limitations in representativeness to all sites because NEI may not capture all relevant sites. ***Limitations/Assumptions/Uncertainties:*** The DMR approach assumes average quantities, concentrations, and hydrologic flows for a given period are representative of other times of the year. In some cases, operating days were reported by facilities in NEI. Otherwise, EPA made assumptions on the number of operating days to estimate daily releases. ***Weight of Scientific Evidence Conclusion:*** Based on this information, EPA has concluded that the weight of scientific evidence for this assessment provides moderate confidence in the estimate of releases in consideration of the strengths and limitations of reasonably available data.	
Distribution in Commerce	***Evidence Found:*** For this OES, EPA had release information for water from DMR and for air from NEI. EPA identified 13 temporary storage and warehousing sites in programmatic data. ***Strengths:*** A strength of using DMR data and the Pollutant Loading Tool is that the tool calculates an annual pollutant load by integrating monitoring period release reports provided to the EPA and extrapolating over the course of the year. A strength of NEI data is that NEI captures additional sources that are not included in TRI due to reporting thresholds. Factors that decrease the confidence for this OES include the uncertainty in the accuracy of reported releases, and the limitations in representativeness to all sites because NEI may not capture all relevant sites. ***Limitations/Assumptions/Uncertainties:*** The DMR approach assumes average quantities, concentrations, and hydrologic flows for a given period are representative of other times of the year. In some cases, operating days were reported by facilities in NEI. Otherwise, EPA made assumptions on the number of operating days to estimate daily releases. ***Weight of Scientific Evidence Conclusion:*** Based on this information, for distribution in commerce releases, EPA has concluded that the weight of scientific evidence for this assessment provides moderate confidence in the estimate of releases in consideration of the strengths and limitations of reasonably available data.	Moderate

1195

4 HUMAN HEALTH RISK ASSESSMENT

1,1,2-Trichloroethane – Human Health Risk Assessment: Key Points

EPA evaluated all reasonably available information to support human health risk characterization of 1,1,2-trichloroethane for workers, ONUs, and consumers, as well as the general population exposed to 1,1,2-trichloroethane released to the environment.

Human Exposure

- EPA assessed exposure to workers through inhalation and dermal exposure.
- EPA assessed exposure to ONUs through inhalation exposure.
- EPA assessed exposure to consumers through dermal and inhalation exposure.
- EPA assessed exposure to the general population through inhalation of ambient air, dermal and oral exposure to surface water through swimming and drinking water.

Human Hazard

- EPA concluded that the weight of scientific evidence supports dose-response analysis on the following non-cancer hazard outcomes: (1) Acute, intermediate, chronic inhalation: olfactory effects (necrosis and lesions); (2) acute oral (acute neurotoxicity); and (3) intermediate, chronic oral (immunological toxicity).
- No identified dermal studies were appropriate for dose response analyses but a high-quality guideline dermal study requested through EPA's test order authority was used for oral to dermal extrapolation.
- Acute non-cancer inhalation POD is 316 mg/m^3 (LOAEC 58 ppm), based on a guideline study and olfactory necrosis with an uncertainty factor of 100.
- Intermediate and chronic non-cancer inhalation $BMCL_{10}$ human equivalent concentration (HEC) is 0.62 mg/m^3 (0.11 ppm), based on a guideline study and olfactory lesions with an uncertainty factor of 30 (intermediate) and 300 (chronic).
- Acute non-cancer oral human equivalent dose (HED) is 12.6 mg/kg, based on a guideline study and neurotoxicity effects with an uncertainty factor of 30.
- Intermediate and chronic non-cancer oral NOAEL HED is 0.52 mg/kg/day, based on high-quality literature study and immunotoxicity with an uncertainty factor of 30 (intermediate) and 300 (chronic).
- EPA concluded that the weight of scientific evidence supports dose-response analysis for the chronic cancer hazard outcome based on hepatocellular carcinoma.
- Chronic cancer oral and dermal slope factor is 0.0348 per mg/kg/day, based on a National Cancer Institute (gavage) study and liver tumors. The dermal slope factor is extrapolated from the oral data.
- Chronic cancer inhalation unit risk (IUR) is 2.98×10^{-6} per µg/m^3, extrapolated from the National Cancer study (gavage) oral data and utilizing the PBPK model for refinement.

Human Risk Characterization

- Risk estimates below the relative non-cancer benchmarks and above the cancer benchmark range were identified for workers and occupational non-users via inhalation and dermal exposures.
- When considering tiering, all risk estimates for the general population and consumer were above the relative non-cancer benchmarks and below the cancer benchmark range.

EPA assessed human health risks of 1,1,2-trichloroethane exposure. Section 4.1 provides a summary of human exposures; Section 4.2 summarizes human health hazard; and Section 4.3 summarizes risk characterization for human health risk.

4.1 Summary of Human Exposures

EPA evaluated all reasonably available information for occupational, consumer, and general population human exposures, including consideration of increased exposure across PESS considerations.

4.1.1 Occupational Exposures

The following sections briefly describe EPA's approach to assessing occupational exposures and estimating inhalation and dermal exposure for each COU assessed. For additional details on development of approaches and results refer to the *Draft Chemistry, Fate, Release, and Exposure Assessment for 1,1,2-Trichloroethane* (U.S. EPA, 2026g). 1,1,2-Trichloroethane has a vapor pressure of approximately 23 mmHg at 25 °C. Based on this volatility, EPA anticipates that workers and ONUs will be exposed primarily to vapor via the inhalation route. EPA expects worker exposure to liquids via the dermal route but does not expect dermal exposure for ONUs because they do not directly handle 1,1,2-trichloroethane.

Where there was sufficient detail in the monitoring data, EPA assessed exposure to Similar Exposure Groups (SEGs). For example, EPA received inhalation monitoring data for 1,1,2-trichloroethane manufacturing as a byproduct where specific worker SEGs were identified and monitored. Where information on specific SEGs were not available from the monitoring data or were not able to be assessed from the modeling approach used, EPA assessed exposure to generic exposure groups of (1) "workers" (*i.e.,* workers who work in close proximity to 1,1,2-trichloroethane, and may handle and have direct contact with 1,1,2-trichloroethane); and (2) ONUs who do not directly handle 1,1,2-trichloroethane but may be indirectly exposed to it as part of their employment. EPA identified tasks performed by the workers for each OES.

The Occupational Safety and Health Administration (OSHA; accessed March 5, 2026) set a permissible exposure limit (PEL) of 10 ppm as an 8-hour time-weighted average (TWA) for 1,1,2-trichloroethane, with a skin notation indicating potential for dermal absorption. Other governmental agencies and independent groups have also set recommended exposure limits established for 1,1,2-trichloroethane. The NIOSH Recommended Exposure Limit (REL) is 10 ppm as a TWA for up to a 10-hour workday, with a skin notation indicating potential for dermal absorption (https://www.cdc.gov/niosh/npg/; accessed March 5, 2026). The American Conference of Governmental Industrial Hygienists (ACGIH) sets the Threshold Limit Value (TLV) at 10 ppm TWA (https://www.acgih.org/112-trichloroethane/; accessed March 5, 2026). There are no short-term or ceiling limits for 1,1,2-trichloroethane provided by OSHA, NIOSH, or ACGIH.

4.1.1.1 Approach and Methodology

The steps that EPA followed in assessing occupational exposure to 1,1,2-trichloroethane are illustrated in Figure 4-1.

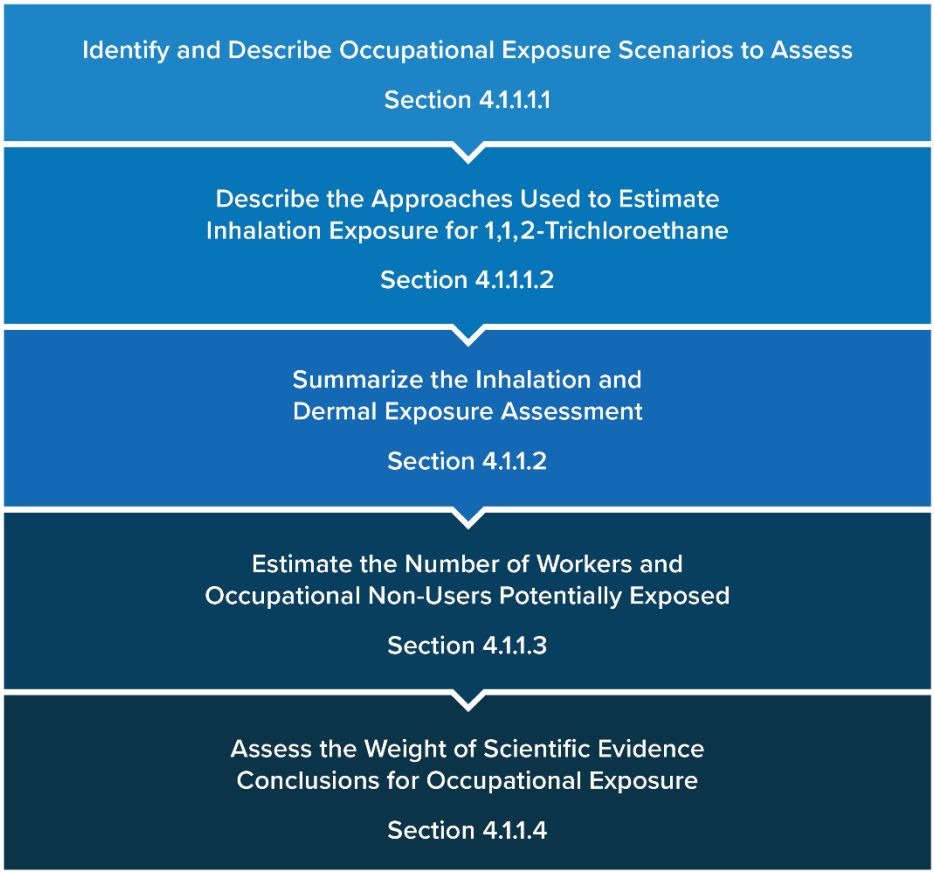

Figure 4-1. Overview of EPA's Approach to Estimate Occupational Exposure for 1,1,2-Trichloroethane

EPA followed the hierarchy established in Table 4-1 in selecting data and approaches for assessing occupational exposures to 1,1,2-trichloroethane (CEB, 1991).

Table 4-1. Hierarchy of Data and Approaches for Assessing Occupational Exposures to 1,1,2-Trichloroethane

Type of Approach	Description
1. Monitoring data	a) Personal and directly applicable
	b) Area and directly applicable
	c) Personal and potentially applicable or similar (analogous data)
	d) Area and potentially applicable or similar (analogous data)
2. Modeling approaches	a) Surrogate monitoring data
	b) Fundamental modeling approaches

4.1.1.1.1 Identify and Describe Occupational Exposure Scenarios

As discussed in Section 3.1.1, EPA has identified OESs from the COUs to group scenarios with similar sources of exposure at industrial and commercial workplaces within the scope of the risk evaluation. The Agency identified exposure groups for each OES as presented below in Table 4-2. Additional details on worker activities performed by the exposure groups for each OES can be found in the *Draft Chemistry, Fate, Release, and Exposure Assessment for 1,1,2-Trichloroethane* (U.S. EPA, 2026g).

Table 4-2. Similar Exposure Groups (SEGs) Assessed for 1,1,2-Trichloroethane

OES	SEGs Assessed by OES
Manufacturing as a Byproduct at Chemical Manufacturing Facilities	The final study report published by the Vinyl Institute Consortium (Stantec ChemRisk, 2024) detailed worker activities per SEG that occurred at 1,1,2-trichloroethane manufacturing (as a byproduct) sites. The SEGs of operators/process technicians, laboratory technicians, logistics/distribution technicians, maintenance technicians, and ONUs were identified and monitored for inhalation exposure
Manufacturing as a Byproduct in the Pulp and Paper industry	EPA did not quantify exposures for this OES, as EPA could not identify reasonably available data or modeling approach to assess inhalation exposures for this OES. EPA did assess exposure from byproducts formed unintentionally in the OES of Manufacturing as a byproduct from chemical manufacturing, and EPA considers that this data may be comparable for this OES.
Repackaging for Laboratory Chemical Use	EPA assessed the general SEG categories of workers and ONUs. Workers are potentially exposed to 1,1,2-trichloroethane when transferring 1,1,2-trichloroethane from bulk containers into smaller containers. Workers may also be exposed via inhalation of vapor or dermal contact with liquids when cleaning transport containers following emptying. ONUs include supervisors, managers, and other employees that work at sites that process 1,1,2-trichloroethane into formulations, mixtures, or reaction products but do not directly handle 1,1,2-trichloroethane, who are expected to have lower inhalation exposures and no dermal exposure.
Processing as a Reactant	The final study report published by the Vinyl Institute Consortium (Stantec ChemRisk, 2024) detailed worker activities per SEG that occurred at 1,1,2-trichloroethane manufacturing sites. The SEGs of operators/process technicians, laboratory technicians, logistics/distribution technicians, maintenance technicians, and ONUs were identified and monitored for inhalation exposure. EPA assumed that these SEGs could be similar to those at processing as a reactant sites.
Formulation of Adhesives and Sealants	EPA assessed the general SEG categories of workers and ONUs. Workers are potentially exposed to 1,1,2-trichloroethane in processing of 1,1,2-trichloroethane into formulations, mixtures, or reaction products during container unloading, container cleaning, equipment cleaning, and packaging of formulation into containers. They may also be exposed to vapors due to volatilization during the mixing process itself, during product sample collection and analysis, and process maintenance. ONUs are expected to have lower inhalation exposures and no dermal exposure.
Use of Adhesives and Sealants	EPA assessed the general SEG categories of workers and ONUs. Worker exposures to 1,1,2-trichloroethane may occur from use of adhesives and sealants during container cleaning and unloading, equipment cleaning, spraying or roll coating, and curing or drying activities. ONUs are potentially exposed via inhalation while present in the application area; however, EPA expects ONUs to have lower inhalation exposures than workers who handle or apply the products, and no expected dermal exposures. ONUs are expected to have lower inhalation exposures and no dermal exposure.
Open-Top Vapor Degreasing	EPA assessed the general SEG categories of workers and ONUs. Workers are potentially exposed to 1,1,2-trichloroethane during industrial and commercial non-aerosol cleaning and degreasing while unloading the chemical from transport containers, during degreaser operation, and during cleaning and maintenance activities. ONUs are expected to have lower inhalation exposures and no dermal exposure.
Cold Cleaning	EPA assessed the general SEG categories of workers and ONUs. Workers are potentially exposed to 1,1,2-trichloroethane during industrial and commercial non-aerosol cleaning and degreasing while unloading the chemical from transport containers, during degreaser operation, and during cleaning and maintenance activities. ONUs are expected to have lower inhalation exposures and no dermal exposure.

OES	SEGs Assessed by OES
Use of Laboratory Chemicals	EPA assessed the general SEG categories of workers and ONUs. Workers are potentially exposed to the chemical during the following activities: transferring 1,1,2-trichloroethane from transport containers to labware, sampling/analyses, and container/equipment cleaning. ONUs are expected to have lower inhalation exposures and no dermal exposure.
Disposal to Incineration	EPA assessed the general SEG categories of workers and ONUs. Workers are potentially exposed to 1,1,2-trichloroethane via inhalation of vapors or dermal contact with liquids during the unloading and cleaning of transport containers. ONUs are expected to have lower inhalation exposures and no dermal exposure.
Disposal to Landfill	EPA assessed the general SEG categories of workers and ONUs. Workers are potentially exposed to 1,1,2-trichloroethane via inhalation of vapors or dermal contact with liquids during the unloading and cleaning of transport containers. ONUs are expected to have lower inhalation exposures and no dermal exposure.
Disposal to POTW	EPA assessed the general SEG categories of workers and ONUs. Workers are potentially exposed to 1,1,2-trichloroethane via inhalation of vapors or dermal contact with liquids during the unloading and cleaning of transport containers. ONUs are expected to have lower inhalation exposures and no dermal exposure.
Disposal to Non-POTW WWT	Due to limited inhalation monitoring data, EPA combined the POTW and non-POTW WWT scenarios for the occupational exposure assessment because worker activities and sources of exposure are expected to be similar. EPA assessed the general SEG categories of workers and ONUs. Workers are potentially exposed to 1,1,2-trichloroethane via inhalation of vapors or dermal contact with liquids during the unloading and cleaning of transport containers. ONUs are expected to have lower inhalation exposures and no dermal exposure.
Remediation	EPA did not quantitatively assess exposures from this OES, as EPA could not identify reasonably available data or modeling approach to assess inhalation exposures for this OES. However, remediation activities are considered comparable to other disposal OESs, depending on the type of remediation being performed. For example, removal of 1,1,2-trichloroethane from contaminated water that involves utilizing wastewater treatment units is comparable to the Disposal to POTW or Disposal to Non-POTW WWT. However, there will likely be differences in the amounts handled and the concentration of the chemical, dependent on the type of remediation being performed.

1255

4.1.1.1.2 Approaches Used to Estimate Inhalation Exposure for 1,1,2-Trichloroethane

EPA followed the exposure assessment hierarchy depicted in Table 4-1 and used the highest rated approach available for each OES. A summary of the approaches used to estimate inhalation exposure for each OES for 1,1,2-trichloroethane is presented below in Table 4-3. Additional details on worker activities performed by the exposure groups for each OES can be found in the *Draft Chemistry, Fate, Release, and Exposure Assessment for 1,1,2-Trichloroethane* (U.S. EPA, 2026g).

Table 4-3. Approaches Used to Estimate Inhalation Exposure for Each OES for 1,1,2-Trichloroethane

OES	Approach Used to Estimate Inhalation Exposure [a]
Manufacturing as a Byproduct at Chemical Manufacturing Facilities	***1,1,2-Trichloroethane Personal Breathing Zone (PBZ) Monitoring Data from Test Order:*** Inhalation exposures were assessed based on inhalation monitoring data provided to EPA via a test order submission from the Vinyl Institute, which includes manufacturers of 1,1,2-trichloroethane (Stantec ChemRisk, 2024). The monitoring was conducted according to an EPA-approved study plan and exposures were monitored for 4 worker SEGs (as well as ONUs, described below). The test order monitoring study includes 116 full-shift PBZ worker samples across 4 manufacturing facilities where 1,1,2-trichloroethane was produced as an unwanted, non-isolated byproduct (the consortium did not identify any companies that manufactured 1,1,2-trichloroethane intentionally). There were 21 full-shift worker samples that were below the limit of detection (LOD) (range of LOD <6E−05 to <7E−05 ppm). Values below the limit of detection were replaced with LOD ÷ 2. The number of full-shift samples (and number of non-detects) for each SEG was as follows: 49 operator (0 non-detects), 29 laboratory technician (10 non-detects [NDs]), 15 logistics technician (4 non-detects), and 23 maintenance technician (7 non-detects). [a] For each SEG, EPA estimated the 50th and 95th percentile values to represent the central tendency and high-end exposures. ***ONUs:*** The 1,1,2-trichloroethane data set included 29 ONU full-shift PBZ samples from the same study described above; 11 samples were non-detect (LOD <6E−05 ppm) [a]. Values below the LOD were replaced with LOD ÷ 2. EPA estimated the 50th and 95th percentile values to represent the central tendency and high-end exposures.
Repackaging for Laboratory Chemical Use	***Exposure Modeling:*** For repackaging into smaller containers for laboratory use, EPA modeled exposure based on exposure estimation approaches for worker activities using the July 2022 Chemical Repackaging GS (U.S. EPA, 2022). EPA used vapor generation rate and exposure duration parameters from the 1991 Chemical Engineering Branch (CEB) Manual (CEB, 1991) and the EPA Mass Balance Inhalation Model to model the exposure and the modeling included Monte Carlo simulation to generate estimates at various percentiles including the 50th percentile for central tendency and 95th percentile for high-end. While the test order inhalation monitoring study captured bulk repackaging tasks, it did not include information on small container repackaging and therefore was not utilized to assess this OES. Bulk repackaging tasks such as connecting/disconnecting hoses that occur during chemical manufacturing or processing are assessed under those respective OES (*e.g.,* manufacturing as byproduct, processing as a reactant), as EPA does not have evidence supporting separate bulk repackaging OES. ***ONUs:*** EPA used the central tendency from modeled workers inhalation exposures to represent ONU inhalation exposures.
Processing as a Reactant	***1,1,2-Trichloroethane PBZ Monitoring Data from Test Order (Manufacturing as a Byproduct) Used as an Analogous Scenario:*** EPA did not identify inhalation exposure monitoring data related to 1,1,2-trichloroethane processing as a reactant. EPA used worker exposure data at 1,1,2-trichloroethane manufacturing (unwanted, non-isolated byproduct) facilities as an analogous scenario for use of 1,1,2-trichloroethane as a reactant. This information is described in the "Manufacturing as a Byproduct at Chemical Manufacturing Facilities" OES above. As described above in the "Manufacturing as a Byproduct at Chemical Manufacturing Facilities" OES, the test order provided 116 full-shift samples for workers; 21 worker samples were below the limit of detection (range of LOD <6E−05 to <7E−05 ppm) (Stantec ChemRisk, 2024). Values below the limit of detection were replaced with LOD ÷ 2. This data was chosen as an analogous scenario due to similarities in expected tasks performed during chemical manufacturing and processing, which is further discussed in Section 4.1.1.4 (Weight of Scientific Evidence Conclusions for Occupational Exposure). EPA estimated the 50th and 95th percentile values to represent the central tendency and high-end exposures.

OES	Approach Used to Estimate Inhalation Exposure [a]
	ONUs: The 1,1,2-trichloroethane data set included 29 ONU full-shift PBZ samples from the same study described above; 11 samples were non-detect LOD <6E−05 ppm). Values below the LOD were replaced with LOD ÷ 2. EPA estimated the 50th and 95th percentile values to represent the central tendency and high-end exposures.
Formulation of Adhesives and Sealants	***PBZ Monitoring Data from Test Order (Manufacturing as a Byproduct) Used as an Analogous Scenario:*** EPA did not identify inhalation exposure monitoring data related to formulation of 1,1,2-trichloroethane into adhesives and sealants. In the absence of any 1,1,2-trichloroethane monitoring data and in accordance with the data assessment hierarchy in Table 4-1, EPA identified and used worker exposure data at 1,1,2-trichloroethane manufacturing (unwanted, non-isolated byproduct) facilities as an analogous scenario. EPA expects the worker activities and sources of exposure between the two scenarios to be similar, as process descriptions are similar between the two manufacturing scenarios (this is further discussed in Section 4.1.1.4 (Weight of Scientific Evidence Conclusions for Occupational Exposure)). However, the use of this data is likely to overestimate exposures for this OES. From this data, EPA estimated the 50th and 95th percentile values to represent the central tendency and high-end exposures. ***ONUs:*** The 1,1,2-trichloroethane data set included 29 ONU full-shift PBZ samples from the same study described above; 11 samples were non-detect (LOD <6E−05 ppm). Values below the LOD were replaced with LOD ÷ 2. EPA estimated the 50th and 95th percentile values to represent the central tendency and high-end exposures.
Use of Adhesives and Sealants	***PBZ Monitoring Data for Trichloroethylene (TCE) from Published Risk Evaluation Used as a Surrogate to Estimate Exposure to 1,1,2-Trichloroethane:*** EPA used surrogate data from the trichloroethylene (TCE) risk evaluation during use of paints, coatings, adhesives, and sealants (U.S. EPA, 2020e; OSHA, 2017; NIOSH, 1981). The data includes 22 samples for workers; all samples were above the limit of detection. EPA selected this data based on the exposure assessment hierarchy, as this was the best surrogate dataset identified, and use of surrogate data is preferred over the use of modeling approaches. Use of surrogate data involves correcting for differences in both vapor pressure and mole fraction between the surrogate data chemical and the chemical being assessed. TCE has a vapor pressure of 69 mmHg, in comparison to a vapor pressure of 23 mmHg for 1,1,2-trichloroethane. The weight fraction of TCE present in the adhesives utilized during the inhalation sampling is unknown. However, a review of available products indicates that TCE concentrations in adhesive products in the inhalation monitoring study may fall within the ranges of 5-15%, 40-60%, and >90%. For adhesive and sealant products containing 1,1,2-trichloroethane, concentrations may range from 1-10% (Huntsman Advanced Materials Americas LLC, 2018) (EPA-HQ-OPPT-2018-0421-0003). Therefore, EPA assessed three different possibilities of differences in weight fraction in adhesives between TCE and 1,1,2-trichloroethane: (1) 90% TCE and 10% 1,1,2-trichloroethane (9:1), (2) 50% TCE and 10% 1,1,2-trichloroethane (5:1), and (3) 10% TCE and 10% 1,1,2-trichloroethane (1:1). For each of these scenarios, EPA estimated the 50th and 95th percentile values to represent the central tendency and high-end exposures. ***ONUs:*** The dataset described above included 2 samples for ONUs. EPA used the average of the two values for the central tendency and the high value for the high-end exposure estimate. Both samples were above the LOD. EPA applied the same vapor pressure and mole fraction conversions as described above for workers.
Open-Top Vapor Degreasing (OTVD)	***PBZ Monitoring Data for Trichloroethylene (TCE), Perchloroethylene (PCE), and 1-Bromopropane (1-BP) from Published Risk Evaluations Used as a Surrogate to Estimate Exposure to 1,1,2-Trichloroethane:*** EPA used surrogate data from the TCE, PCE, and 1-BP risk evaluations during open-top vapor degreasing (Miller, 2019; OSHA, 2019, 2013; U.S. EPA, 2006; NIOSH, 2002a, b, d; Reh and Nemhauser, 2001; Barsan, 1991; Seitz and Driscoll, 1989; Daniels et al., 1988; NIOSH, 1984, 1982; Ruhe et al., 1981; Lewis, 1980; Gilles et al., 1977; Rosensteel and Lucas, 1975; NIOSH, 1973). The data includes 331 samples for workers; all samples were above the limit of detection for each study. TCE has a vapor pressure of 69 mmHg, PCE has a vapor pressure of 18.5 mmHg,

OES	Approach Used to Estimate Inhalation Exposure[a]
	and 1-BP has a vapor pressure of 110.89 mmHg, vs. 23 mmHg for 1,1,2-trichloroethane. EPA assumed solvents would be used in neat form so corrected for vapor pressure differences only for surrogate chemicals vs. 1,1,2-trichloroethane. Surrogate data corrections were made for all data points and then EPA estimated the 50th and 95th percentile values to represent the central tendency and high-end exposures. ***ONUs:*** The data includes 97 samples for ONUs; all samples were above the LOD. Surrogate data corrections and statistics calculated using the same methods described for the worker exposure data.
Cold Cleaning	***PBZ Monitoring Data for Perchloroethylene (PCE), from Published Risk Evaluation Used as a Surrogate to Estimate Exposure to 1,1,2-Trichloroethane:*** EPA used surrogate data from the perchloroethylene (PCE) risk evaluation during cold cleaning (U.S. EPA, 2020d). PCE has a vapor pressure of 18.5 vs. 23 mmHg for 1,1,2-trichloroethane. EPA selected this data based on the exposure assessment hierarchy, as this was the best surrogate dataset identified, and use of surrogate data is preferred over the use of modeling approaches. The data includes 29 samples for workers. EPA assumed solvents for this OES would be used in neat form and did not perform any mole fraction corrections. EPA corrected for the vapor pressure difference between these two chemicals. Surrogate data corrections were made for all data points and then EPA estimated the 50th and 95th percentile values to represent the central tendency and high-end exposures. ***ONUs:*** Absent data on ONU exposures, the central tendency from worker concentrations was used to represent ONU exposures.
Use of Laboratory Chemicals	***1,1,2-Trichloroethane PBZ Monitoring Data from Test Order (Laboratory Technicians) Used as an Analogous Scenario:*** To assess inhalation exposure, EPA used worker exposure data for 1,1,2-trichloroethane at on-site QA/QC laboratories from the test order at sites that manufacture 1,1,2-trichloroethane. Data was available for the SEG of laboratory technicians, as an analogous scenario for use of 1,1,2-trichloroethane as a laboratory chemical. The Agency assumes the tasks described for laboratory technicians in a manufacturing setting would be similar to tasks performed by laboratory technicians in a commercial laboratory setting. The test order inhalation monitoring study provided 29 full-shift personal breathing zone samples for laboratory technician workers; 10 samples were below the limit of detection (<0.06 ppb) (Stantec ChemRisk, 2024). Values below the limit of detection were replaced with LOD ÷ 2. EPA applied a mole fraction adjustment of the data to account for potential differences in concentrations experienced by workers in manufacturing facilities (exposed to up to 45% 1,1,2-trichloroethane by weight) and commercial laboratories (exposed to up to 100% 1,1,2-trichloroethane by weight) (Stantec ChemRisk, 2024; Sigma-Aldrich Inc., 2020; Matheson Tri-Gas, 2017). EPA estimated the 50th and 95th percentile values to represent the central tendency and high-end exposures. ***ONUs:*** There was no ONU data specific to laboratory settings, and therefore, the central tendency from worker concentrations was used to represent ONU exposures.
Disposal to Incineration	***1,1,2-Trichloroethane PBZ Monitoring Data from Test Order (Logistics Technicians; Maintenance Technicians) Used as an Analogous Scenario:*** EPA used worker exposure data to 1,1,2-trichloroethane during manufacturing as a byproduct for logistics technicians and maintenance technicians, as an analogous scenario for handling 1,1,2-trichloroethane during disposal to incineration. The test order provided 15 full-shift samples for logistics technicians (4 below the limit of detection) and 23 full-shift samples for maintenance technician samples (7 below the limit of detection) (Stantec ChemRisk, 2024). The LOD ranged from 6.0E−05 to 7.0E−05 ppm. EPA selected these worker SEGs as their job activities are expected to be similar to tasks performed at incineration facilities, such as loading/unloading tasks performed by logistics technicians. Additionally, maintenance technicians reportedly

OES	Approach Used to Estimate Inhalation Exposure[a]
	performed work with and around incinerators. EPA estimated the 50th and 95th percentile values to represent the central tendency and high-end exposures. ***ONUs:*** There was no ONU data specific to laboratory settings, and therefore, the central tendency from worker concentrations was used to represent ONU exposures.
Disposal to Landfill	***Area Monitoring Data for 1,1,2-Trichloroethane:*** EPA did not identify any PBZ monitoring data specific to this OES but did identify area data from a landfill study at hazardous and sanitary landfill in New Jersey, which included 115 samples (Harkov et al., 1985). There was no information about the limit of detection or if any samples were below the limit of detection. ***ONUs:*** EPA did not identify data applicable to estimation of ONU exposure at landfills, and therefore the central tendency from the area monitoring data was utilized to assess ONU exposures.
Disposal to POTW/Non-POTW WWT	***1,1,2-Trichloroethane PBZ Monitoring Data from Test Order (Wastewater Treatment):*** EPA identified two full-shift inhalation worker monitoring samples that indicate work in wastewater process areas. Both samples were above the limit of detection. EPA used the average of the two values for the central tendency and the high value for the high-end exposure estimate. ***Surrogate 1,2-Dichloroethane PBZ Monitoring Data Obtained from Test Order and Public Comment:*** Due to the limited number of samples specific to 1,1,2-trichloroethane, EPA also considered surrogate monitoring data from wastewater treatment that was specific to 1,2-dichloroethane. This information was received via a test order submission and public comment from the Vinyl Institute (VI, 2026; Stantec ChemRisk, 2024). From these two sources, EPA identified 71 operator samples; 35 of which were below the limit of detection (range: 0.024–0.28 ppm). Values below the LOD were replaced with LOD ÷ 2. This data was chosen due to the similarity in chemicals (both being volatile solvents), and high quality of the test order submission data (recent data with high number of samples). Vapor pressure adjustment was performed to account for the differences in vapor pressure between the two chemicals (1,1,2-trichloroethane vapor pressure: 23 mmHg; 1,2-dichloroethane vapor pressure: 78.9 mmHg). ***ONUs:*** Specific to 1,1,2-trichloroethane, EPA identified one ONU sample that described work relevant to the wastewater process area. EPA utilized this value for the central tendency and high-end exposure estimates. Specific to the 1,2-dichloroethane surrogate monitoring data, EPA identified 3 full-shift, personal breathing samples for ONUs; 2 samples were below the limit of detection (0.024 and 0.21 ppm). Values below the LOD were replaced with LOD ÷ 2.
[a] The Vinyl Institute Final Study Report compared four methods for handling data below the LOD (including use of LOD ÷ 2) and noted that there were "[n]o substantial differences" in estimated statistics computed by the four different methods (Stantec ChemRisk, 2024). The study authors utilized Kaplan Meier (KM) methods for handling data below the limit of detection. EPA utilized LOD ÷ 2 to replace values below the LOD.	

1264

4.1.1.1.3 Approaches Used to Estimate Dermal Exposure for 1,1,2-Trichloroethane

EPA did not identify any dermal exposure monitoring data for any OES through systematic review or through other reasonably available sources (*e.g.,* public comments). Therefore, to assess dermal exposure, the Agency used the EPA Dermal Exposure to Volatile Liquids Model (DEVL) to calculate the acute absorbed dose rate (AADR) for each OES. Additional information on the DEVL Model and all parameters utilized is provided below, and in the *Draft Chemistry, Fate, Release and Exposure Assessment for 1,1,2-Trichloroethane* (U.S. EPA, 2026g). EPA utilized information on fraction absorption data that was developed from a TSCA section 4 test order (Labcorp Early Development, 2023), and is further described in the *Draft Human Health and Environmental Hazard Assessment for 1,1,2-Trichloroethane* TSD (U.S. EPA, 2026w).

EPA did not assess dermal exposures to ONUs because EPA does not expect ONUs to directly handle 1,1,2-trichloroethane as part of their duties. Therefore, ONUs are not expected to have dermal exposures during the course of their work.

Dermal Exposure to Volatile Liquids (DEVL) Model

The DEVL (see Equation 4-1) modifies the EPA/OPPT Dermal Exposure to Liquids Model (peer-reviewed) by incorporating a "fraction absorbed (f_{abs})" parameter to account for the evaporation of volatile chemicals to estimate the acute absorbed dose rate (AADR):

Equation 4-1.

$$AADR = S \times Q_u \times f_{abs} \times Y_{derm} \times FT / BW$$

Where:

- S = Surface area of skin in contact with the chemical formulation (cm^2)
- Q_u = Dermal load (*i.e.,* the quantity of the chemical formulation on the skin after the dermal contact event, mg/cm^2-event)
- f_{abs} = Fractional absorption, (*i.e.,* the portion of chemical formulation absorbed systemically, accounting for evaporation of the chemical from the dermal load, Q_u (unitless, $0 \leq f_{abs} \leq 1$)
- Y_{derm} = Weight fraction of the chemical of interest in the liquid (unitless, $0 \leq Y_{derm} \leq 1$)
- FT = Frequency of events (integer number/day)
- BW = Body weight (kg)

Parameter Values

A summary of the dermal model input parameters utilized in this risk evaluation is provided in Table 4-4.

Table 4-4. Summary of Dermal Model Input Parameter Values

Input Parameter	Symbol	Value(s)	Unit	Reference
Dermal load	Q_u	0.7 (lower bound) 1.4 (mid-range) 2.1 (upper bound)	mg/cm^2-event	(U.S. EPA, 1992)
Surface area	S	0 (lower bound) 1,070 (upper bound)	cm^2	(U.S. EPA, 2011a)
Weight fraction of chemical	Y_{derm}	OES-dependent (see Table 4-5)	Unitless	–

Input Parameter	Symbol	Value(s)	Unit	Reference
Frequency of events	FT	1	dermal exposure events/workday	–
Fractional absorption[a]	$f_{abs, a}$	0.96% (neat 1,1,2-trichloroethane sample) [b]	Unitless	(Labcorp Early Development, 2024)
	$f_{abs, b}$	0.84% (50% 1,1,2-trichloroethane in 1,2-dichloroethane sample)	Unitless	
	$f_{abs, c}$	0.47% (10% 1,1,2-trichloroethane in 1,2-dichloroethane sample)	Unitless	
	$f_{abs, d}$	0.63% (1% 1,1,2-trichloroethane in 1,2-dichloroethane sample)	Unitless	
Body weight	BW	80	kg	(U.S. EPA, 2011a)

[a] Represents a mass balance corrected mean fractional absorption value. Mass balance corrections were performed to account for mass balance <95%, absorption <5%, and the coefficient of variation (*e.g.,* high % coefficient of variation >25%), in accordance with 2022 OECD GD156 and 2017 EFSA dermal guidance (OECD, 2022). These calculations and adjustments are further described in Section 2.2.1 and Table 2-1 of the *Draft Human Health and Environmental Hazard Assessment for 1,1,2-Trichloroethane* (U.S. EPA, 2026w).
[b] As described in the *Draft Human Health and Environmental Hazard Assessment for 1,1,2-Trichloroethane* (U.S. EPA, 2026w), the neat 1,1,2-trichloroethane OECD 428 dermal absorption testing had six testing replicates. The replicate with 9.72% absorption could be excluded from the final mean and SD calculations since that skin sample failed the skin QC step (trans epidermal water loss or TEWL). However, the dermal absorption replicate with 1.02% absorption was included in the analysis for a total of 5 replicates.

Probabilistic Modeling with Monte Carlo

The weight fraction is determined based on EPA's review of currently available products and formulations containing 1,1,2-trichloroethane. The weight fraction and fraction absorbed used for each OES are summarized in Table 4-5.

Table 4-5. Summary of OES Weight Fraction and Fraction Absorbed Values in the Probabilistic Monte Carlo Modeling

OES	Approach Used to Estimate Dermal Exposure
Manufacturing as a Byproduct at Chemical Manufacturing Facilities	EPA assessed dermal exposures for this OES using a weight fraction uniform distribution from 4.5E−02 to 45% based on information provided in the Vinyl Institute Final Study Report (Stantec ChemRisk, 2024). The purification process for the intended product at the sites where the unintended 1,1,2-trichloroethane byproduct is produced can result in multiple process streams containing the byproduct chemicals, which can create a wide range in concentrations. Based on the expected weight fractions, EPA applied fraction absorbed values of 0.63, 0.47, and 0.84%.
Repackaging for Laboratory Chemical Use	EPA applied a discrete distribution for the weight fraction ranging from 0.1–100% based on product safety data sheets identified for laboratory chemicals containing 1,1,2-trichloroethane (Sigma-Aldrich Inc., 2020; Santa Cruz Biotechnology, 2019; SPEX CertiPrep LLC, 2019; Phenova, 2018; ThermoFisher Scientific, 2018; Matheson Tri-Gas, 2017). EPA applied fraction absorbed values of 0.63, 0.47, 0.84, and 0.96%. The wide range in 1,1,2-

OES	Approach Used to Estimate Dermal Exposure
	trichloroethane weight fractions is due to its presence as an impurity in some SDSs for some products and as a main component for SDSs for other products.
Processing as a Reactant	EPA applied a uniform distribution for the weight fraction ranging from 4.5E−02 to 100% based on product safety data sheets (Spectrum Chemical Manufacturing Corp, 2019; Westlake Vinyls Company LP, 2015). EPA applied fraction absorbed values of 0.63, 0.47, 0.84, and 0.96%. The weight fraction from manufacturing ranged from 4.5E−02% to 45%. The byproduct streams would need to be concentrated further to get to weight fractions up to 100% to be used in processing as a reactant.
Formulation of Adhesives and Sealants	EPA applied a uniform distribution from 1–45% based on the product safety data sheet for adhesive containing 1,1,2-trichloroethane (1%) and the manufacturing distribution (upper bound of 45%). The chemical arrives at formulation sites in manufactured form, and workers may come into contact with these higher concentrations when handling raw 1,1,2-trichloroethane. EPA applied fraction absorbed values of 0.63, 0.47, 0.84, and 0.96%.
Use of Adhesives and Sealants	The concentration range evaluated for this OES is a uniform distribution from 1 to 10% based on a product safety data sheet for an adhesive containing 1,1,2-trichloroethane and a comment from the American Coatings Association (Huntsman Advanced Materials Americas LLC, 2018) (EPA-HQ-OPPT-2018-0421-0003). Based on the expected concentration, EPA applied a fraction absorbed value of 0.63%.
Open-Top Vapor Degreasing/Cold Cleaning	The concentration evaluated for this OES is a static 100% based on the typical halogenated solvent concentration provided by the ESD on the Use of Vapour Degreasers (OECD, 2021). EPA applied a fraction absorbed value of 0.96%.
Use of Laboratory Chemicals	EPA applied a discrete distribution for the weight fraction ranging from 0.1 to 100% based on product safety data sheets identified for laboratory chemicals containing 1,1,2-trichloroethane (Sigma-Aldrich Inc., 2020; Santa Cruz Biotechnology, 2019; SPEX CertiPrep LLC, 2019; Phenova, 2018; ThermoFisher Scientific, 2018; Matheson Tri-Gas, 2017). EPA applied fraction absorbed values of 0.63, 0.47, 0.84, and 0.96%. The wide range in 1,1,2-trichloroethane weight fractions is due to its presence as an impurity in some SDS for some products and as a main component for SDS for other products.
Disposal to Incineration, Disposal to Landfills, and Disposal to POTW/WWT	The concentration range evaluated for these OES is a uniform distribution from 4.5E−02 to 100% based on the range of expected upstream concentrations. EPA assumed that the weight fraction of 1,1,2-trichloroethane in waste streams sent for disposal would correspond to the range of weight fractions in the chemical's lifecycle. EPA applied fraction absorbed values of 0.63, 0.47, 0.84, and 0.96%.

EPA used a Monte Carlo simulation with 100,000 iterations and the Latin Hypercube sampling method using the DEVL Model. Specific details of the dermal exposure assessment for each OES can be found in the *Draft Chemistry, Fate, Release and Exposure Assessment for 1,1,2-Trichloroethane Technical Support Document* (U.S. EPA, 2026g). Table 4-6 contains a list of specific parameters and distributions utilized in the Monte Carlo Monitoring.

Table 4-6. Parameters Utilized in the Probabilistic Monte Carlo Monitoring

Input Parameter	Symbol	Uncertainty Analysis Distribution Parameters			Unit	Reference
		Lower Bound	Upper Bound	Distribution Type		
Dermal load	Q_u	0.7	2.1	Uniform	mg/cm^2-event	(U.S. EPA, 1992)
Surface area	S	0	1,070	Uniform	cm^2	(U.S. EPA, 2011a)
Frequency of events	FT	–	–	–	Events/day	–
Body weight	BW	–	–	–	kg	(U.S. EPA, 2011a)

4.1.1.1.4 Exposure Frequency and Working Years

Exposure Frequency

EPA estimated worker exposure frequency as the number of days per year that workers are potentially exposed to 1,1,2-trichloroethane. In some cases, it may be reasonable to assume a worker is exposed to the chemical on each working day. In other cases, it may be more appropriate to estimate a workers' exposure to the chemical occurs during a subset of the worker's annual working days. In general, the exposure frequency is the same as the number of operating days per year for a given OES. However, if the number of operating days exceeded 250 days per year, EPA assumed that a single worker would not work more than 250 days per year such that the maximum exposure days per year was still 250. EPA assumed up to 250 days/year of exposure for each SEG based on assumptions that each SEG could have tasks that needed to be performed on a daily basis as well as 50 weeks per year and 5 days per week.

The Vinyl Institute Test order submission provided daily and weekly task frequency information for sites that manufacture 1,1,2-trichloroethane as a byproduct (Stantec ChemRisk, 2024). Tasks across SEGs occurred daily or on an "as needed", two to four times/week, or three to four times/month basis, with each SEG having at least one daily task. Additional details on task frequencies and durations by SEG are provided in the *Draft Chemistry, Fate, Release and Exposure Assessment for 1,1,2-Trichloroethane* (U.S. EPA, 2026g).

Working Years

For the Manufacturing of 1,1,2-Trichloroethane as a Non-Isolated Byproduct OES, EPA used industry data from the Vinyl Institute on worker length of service at facilities where inhalation monitoring was conducted (The Vinyl Institute, 2026). These facilities manufacture 1,2-dichloroethane and also generate 1,1,2-trichloroethane as a byproduct. Based on this data, EPA selected 8.9 years as the central tendency estimate and 33 years as the high-end estimate for working years.

For all remaining OES, EPA used worker tenure data from the Bureau of Labor Statistics (BLS) and the U.S. Census Bureau. Based on these sources, EPA selected 31 years as the central tendency estimate and 40 years as the high-end estimate for working years. The Bureau of Labor Statistics (U.S. BLS, 2014) provides information on employee tenure with current employer obtained from the Current Population Survey (CPS), which is a monthly sample survey of about 60,000 households that provides information on the labor force status of the civilian non-institutional population aged 16 and over. The U.S. Census's (U.S. Census Bureau, 2019) Survey of Income and Program Participation (SIPP) provides information on lifetime tenure with all employers. SIPP is a household survey that collects data on income, labor

force participation, social program participation and eligibility, and general demographic characteristics through a continuous series of national panel surveys of between 14,000 and 52,000 households.

Exposure frequency and working years are parameters used to estimate chronic exposure and risks, which are presented in Section 4.3.2. While working years is a parameter in calculating chronic, non-cancer exposures (*e.g.,* average daily concentration [ADC] and chronic absorbed dose [CAD]), the exposure dose over the working years is averaged over the working years. The working years are included in both the numerator and denominator in the calculations, and they cancel out. For cancer effects, the exposure dose over the working years is averaged over the lifetime years, which includes the years with no exposure. EPA uses a default of 78 years for the lifetime years. For additional details on the parameters and equations used to calculate acute, intermediate, and chronic exposures, refer to the *Draft Chemistry, Fate, Release and Exposure Assessment for 1,1,2-Trichloroethane* (U.S. EPA, 2026g).

4.1.1.2 Summary of the Inhalation and Dermal Exposure Assessment

Table 4-7 presents a summary of full-shift inhalation exposure results based on reasonably available monitoring data and exposure modeling for each OES. This table provides a summary of the 8-hour TWA inhalation exposure estimates for workers and ONUs. Table 4-7 also presents a summary of dermal exposure results. The *Draft Chemistry, Fate, Release, and Exposure Assessment for 1,1,2-Trichloroethane* (U.S. EPA, 2026g) provides additional details regarding EPA's approach and methodology for estimating inhalation and dermal exposures.

Using the 8-hour TWA exposure concentrations in Table 4-7, EPA the calculated acute, intermediate, and chronic (non-cancer and cancer) exposures. Table 4-7, Table 4-8, and Table 4-9 provide summaries for these inhalation and dermal metrics. The *Draft Chemistry, Fate, Release, and Exposure Assessment for 1,1,2-Trichloroethane* (U.S. EPA, 2026g) provides more detail on the estimation of the inhalation and dermal exposure metrics.

Table 4-7. Summary of Occupational Inhalation and Dermal Exposure Results by Occupational Exposure Scenarios

OES	SEG Description	Exposure Days (day/year)	Number of Samples	Number of Non-Detects [a]	LOD (ppm)	Inhalation Estimates (ppm)		Worker Dermal Exposure Estimates (mg/day)		Sources for Inhalation Data [b]
						Central Tendency	High-End	Central Tendency	High-End	
Manufacturing as a Byproduct at Chemical Manufacturing Facilities	Operator/Process Technicians	250	49	0	6.0E−05 to 7.0E−05	4.6E−03	9.1E−02	0.74	4.2	1,1,2-trichloroethane test order data (Stantec ChemRisk, 2024)
	Laboratory technicians	250	29	10		1.7E−04	3.2E−02			
	Logistics/Distribution Technicians	250	15	4		5.1E−04	3.8E−02			
	Maintenance technicians	250	23	7		1.5E−04	0.27			
	ONUs	250	29	11		1.2E−04	3.8E−03	N/A	N/A	
Repackaging for Laboratory Chemical Use (modeled)	Worker	250	–	–	N/A	4.0E−02	0.25	1.6	15	Repackaging model (U.S. EPA, 2022)
	ONU	250	–	–		4.0E−02		NA	NA	
Processing as a Reactant	Operator/Process Technicians	250	49	0	6.0E−05 to 7.0E−05	4.6E−03	9.1E−02	2.2	9.8	Analogous data from 1,1,2-trichloroethane test order data (manufacturing as a byproduct) (Stantec ChemRisk, 2024)
	Laboratory technicians	250	29	10		1.7E−04	3.2E−02			
	Logistics/Distribution Technicians	250	15	4		5.1E−04	3.8E−02			
	Maintenance technicians	250	23	7		1.5E−04	0.27			
	ONU	250	29	11		1.2E−04	3.8E−03	N/A	N/A	
Formulation of Adhesives and Sealants	Operator/Process Technician	250	49	0	6.0E−05 to 7.0E−05	4.6E−03	9.1E−02	0.77	4.3	Analogous data from 1,1,2-trichloroethane test order data (manufacturing as a byproduct) (Stantec ChemRisk, 2024)
	Laboratory Technician	250	29	10		1.7E−04	3.2E−02			
	Logistics/Distribution Technician	250	15	4		5.1E−04	3.8E−02			
	Maintenance technician	250	23	7		1.5E−04	0.27			

OES	SEG Description	Exposure Days (day/year)	Number of Samples	Number of Non-Detects [a]	LOD (ppm)	Inhalation Estimates (ppm)		Worker Dermal Exposure Estimates (mg/day)		Sources for Inhalation Data [b]
						Central Tendency	High-End	Central Tendency	High-End	
Formulation of Adhesives and Sealants	ONU	250	29	11	6.0E−05 to 7.0E−05	1.2E−04	3.8E−03	N/A	N/A	Analogous data from 1,1,2-trichloroethane test order data (manufacturing as a byproduct) (Stantec ChemRisk, 2024)
Use of Adhesives and Sealants (1:1 concentration adjustment)	Worker	250	22	0	N/A	1.5	13	0.19	0.73	Surrogate data – TCE (OSHA, 2017; NIOSH, 1981)
	ONU	250	2	0		0.30	0.33	N/A	N/A	
Use of Adhesives and Sealants (9:1 concentration adjustment)	Worker	250	22	0	N/A	0.17	1.5	0.19	0.73	Surrogate data – TCE (OSHA, 2017; NIOSH, 1981)
	ONU	250	2	0		3.3E−02	3.7E−02	N/A	N/A	
Use of Adhesives and Sealants (5:1 concentration adjustment)	Worker	250	22	0	N/A	0.31	2.6	0.19	0.73	Surrogate data – TCE (OSHA, 2017; NIOSH, 1981)
	ONU	250	2	0		6.0E−02	6.7E−02	N/A	N/A	
Open-Top Vapor Degreasing	Worker	250	331	0	N/A	2.1	28	6.6	16	Surrogate data – TCE, PCE, and 1-BP [d]
	ONU	250	97	0		2.1E−02	1.8	N/A	N/A	
Cold Cleaning	Worker	250	29	0	N/A	3.0	5.1	6.6	16	Surrogate data – PCE (NIOSH, 2002c; Vulcan Chemicals, 1994)
	ONU [c]	250	–	–		3.0		N/A	N/A	
Use of Laboratory Chemicals	Laboratory technician	250	29	10	6.0E−05	3.9E−04	7.6E−02	1.6	15	Analogous data from 1,1,2-trichloroethane test order data (manufacturing as a byproduct, laboratory technicians) (Stantec ChemRisk, 2024)
	ONU [c]	250	–	–		3.9E−04		N/A	N/A	

OES	SEG Description	Exposure Days (day/year)	Number of Samples	Number of Non-Detects [a]	LOD (ppm)	Inhalation Estimates (ppm)		Worker Dermal Exposure Estimates (mg/day)		Sources for Inhalation Data [b]
						Central Tendency	High-End	Central Tendency	High-End	
Disposal to Incineration	Logistics technician	250	15	4	6.0E−05	5.1E−04	3.8E−02	2.2	9.8	Analogous data from 1,1,2-trichloroethane test order data (manufacturing as a byproduct, logistics technicians) (Stantec ChemRisk, 2024)
	ONU [c]	250	–	–		5.1E−04		N/A	N/A	
	Maintenance technician	250	23	7	7.0E−05	1.5E−04	0.27	2.2	9.8	Analogous data from 1,1,2-trichloroethane test order data (manufacturing as a byproduct, maintenance technicians) (Stantec ChemRisk, 2024)
	ONU [c]	250	–	–		1.5E−04		N/A	N/A	
Disposal to Landfill	Area landfill	250	115	Not reported	Not reported	1.4E−06	5.2E−06	2.2	9.8	1,1,2-trichloroethane area landfill data (Harkov et al., 1985)
	ONU [c]	250	–	–	–	1.4E−06		NA	NA	
Disposal to POTW/Disposal to Non-POTW WWT	Worker (chemical-specific)	250	2	0	N/A	2.1E−02	4.3E−02	2.2	9.8	Analogous data from 1,1,2-trichloroethane test order data (Stantec ChemRisk, 2024)
	ONU (chemical-specific)	250	1	0		8.0E−05		N/A	N/A	
	Worker (surrogate)	250	70	35	0.024–0.28 [e]	4.1E−02	0.21	2.2	9.8	(EPA-HQ-OPPT-2018-0427-0169; (Stantec ChemRisk, 2024))
	ONU (surrogate)	250	3	2	0.024–0.21 [e]	1.3E−02	3.8E−02	N/A	N/A	

[a] Values below the limit of detection were replaced with LOD ÷ 2, unless otherwise noted.
[b] Additional information on the sources for the inhalation data can be found in Table 4-3.
[c] Where EPA was not able to estimate ONU inhalation exposure from monitoring data or models, this was assumed equivalent to the central tendency experienced by workers for the corresponding OES; dermal exposure for ONUs was not evaluated because they are not expected to be in direct contact with 1,1,2-trichloroethane.
[d] (Miller, 2019; OSHA, 2019, 2013; U.S. EPA, 2006; NIOSH, 2002a, b, d; Reh and Nemhauser, 2001; Barsan, 1991; Seitz and Driscoll, 1989; Daniels et al., 1988; NIOSH, 1984, 1982; Ruhe et al., 1981; Lewis, 1980; Gilles et al., 1977; Rosensteel and Lucas, 1975; NIOSH, 1973)
[e] LOD noted is specific to 1,2-dichloroethane and does not represent the vapor pressure corrected values. In calculating the central tendency and high-end values, EPA utilized the vapor pressure corrected LOD ÷ 2 to assess non-detects.

1382

Table 4-8. Summary of Occupational Inhalation Exposure Metrics

OES	Category	8-Hour TWA Exposures		Acute, Non-Cancer Exposures		Intermediate, Non-Cancer Exposures		Chronic, Non-Cancer Exposures		Chronic, Cancer Exposures [a]	
		8-Hour TWA (ppm)		$AC_{8\text{-hour TWA}}$ (ppm)		$ADC_{8\text{-hour TWA}}$ (ppm)		$ADC_{8\text{-hour TWA}}$ (ppm)		$LADC_{8\text{-hour TWA}}$ (ppm)	
		CT	HE	CT	HE	CT	HE	CT	HE	CT	HE
Manufacturing as a Byproduct at Chemical Manufacturing Facilities	Operator / process technicians	4.6E−03	9.1E−02	3.1E−03	6.2E−02	2.3E−03	4.5E−02	2.1E−03	4.2E−02	2.4E−04	1.8E−02
	Laboratory technicians	1.7E−04	3.2E−02	1.1E−04	2.2E−02	8.3E−05	1.6E−02	7.7E−05	1.5E−02	8.8E−06	6.4E−03
	Logistics / distribution technicians	5.1E−04	3.8E−02	3.5E−04	2.6E−02	2.6E−04	1.9E−02	2.4E−04	1.8E−02	2.7E−05	7.4E−03
	Maintenance technicians	1.5E−04	0.27	1.0E−04	0.18	7.4E−05	0.13	6.9E−05	0.12	7.9E−06	5.2E−02
	ONU	1.2E−04	3.8E−03	8.1E−05	2.6E−03	5.9E−05	1.9E−03	5.5E−05	1.8E−03	6.3E−06	7.6E−04
Repackaging for Laboratory Chemical Use (modeled)	Worker	4.0E−02	0.25	3.4E−02	0.21	2.0E−02	0.12	1.9E−02	0.12	6.6E−03	4.5E−02
	ONU	4.0E−02		3.4E−02	3.4E−02	2.0E−02	2.0E−02	1.9E−02	1.9E−02	6.6E−03	9.6E−03
Processing as a Reactant	Operator / process technicians	4.6E−03	9.1E−02	3.1E−03	6.2E−02	2.3E−03	4.5E−02	2.1E−03	4.2E−02	8.5E−04	2.2E−02
	Laboratory technicians	1.7E−04	3.2E−02	1.1E−04	2.2E−02	8.3E−05	1.6E−02	7.7E−05	1.5E−02	3.1E−05	7.7E−03
	Logistics / distribution technicians	5.1E−04	3.8E−02	3.5E−04	2.6E−02	2.6E−04	1.9E−02	2.4E−04	1.8E−02	9.5E−05	9.0E−03
	Maintenance technicians	1.5E−04	0.27	1.0E−04	0.18	7.4E−05	0.13	6.9E−05	0.12	2.8E−05	6.3E−02
	ONU	1.2E−04	3.8E−03	8.1E−05	2.6E−03	5.9E−05	1.9E−03	5.5E−05	1.8E−03	2.2E−05	9.2E−04
Formulation of Adhesives and Sealants	Operator / process technicians	4.6E−03	9.1E−02	3.1E−03	6.2E−02	2.3E−03	4.5E−02	2.1E−03	4.2E−02	2.4E−04	1.8E−02
	Laboratory technicians	1.7E−04	3.2E−02	1.1E−04	2.2E−02	8.3E−05	1.6E−02	7.7E−05	1.5E−02	8.8E−06	6.4E−03
	Logistics / distribution technicians	5.1E−04	3.8E−02	3.5E−04	2.6E−02	2.6E−04	1.9E−02	2.4E−04	1.8E−02	2.7E−05	7.4E−03

OES	Category	8-Hour TWA Exposures		Acute, Non-Cancer Exposures		Intermediate, Non-Cancer Exposures		Chronic, Non-Cancer Exposures		Chronic, Cancer Exposures [a]	
		8-Hour TWA (ppm)		$AC_{8\text{-hour TWA}}$ (ppm)		$ADC_{8\text{-hour TWA}}$ (ppm)		$ADC_{8\text{-hour TWA}}$ (ppm)		$LADC_{8\text{-hour TWA}}$ (ppm)	
		CT	HE	CT	HE	CT	HE	CT	HE	CT	HE
Formulation of Adhesives and Sealants	Maintenance technicians	1.5E−04	0.27	1.0E−04	0.18	7.4E−05	0.13	6.9E−05	0.12	7.9E−06	5.2E−02
	ONU	1.2E−04	3.8E−03	8.1E−05	2.6E−03	5.9E−05	1.9E−03	5.5E−05	1.8E−03	6.3E−06	7.6E−04
Use of Adhesives and Sealants (1:1 concentration adjustment)	Worker	1.5	13	1.0	8.8	0.75	6.5	0.70	6.1	0.28	3.1
	ONU	0.30	0.33	0.20	0.22	0.15	0.16	0.14	0.15	5.6E−02	7.9E−02
Use of Adhesives and Sealants (9:1 concentration adjustment)	Worker	0.17	1.5	0.12	1.0	8.5E−02	0.73	7.9E−02	0.68	3.2E−02	0.35
	ONU	3.3E−02	3.7E−02	2.3E−02	2.5E−02	1.7E−02	1.8E−02	1.6E−02	1.7E−02	6.2E−03	8.8E−03
Use of Adhesives and Sealants (5:1 concentration adjustment))	Worker	0.31	2.6	0.21	1.8	0.15	1.3	0.14	1.2	5.7E−02	0.63
	ONU	6.0E−02	6.7E−02	4.1E−02	4.5E−02	3.0E−02	3.3E−02	2.8E−02	3.1E−02	1.1E−02	1.6E−02
Commercial Use of Adhesives and Sealants	Worker	1.5	13	1.0	8.8	0.75	6.5	0.70	6.1	0.28	3.1
	ONU	0.30	0.33	0.20	0.22	0.15	0.16	0.14	0.15	5.6E−02	7.9E−02
Open-Top Vapor Degreasing	Worker	2.1	28	1.4	19	1.0	14	0.98	13	0.39	6.7
	ONU	2.1E−02	1.8	1.4E−02	1.2	1.0E−02	0.90	9.8E−03	0.84	3.9E−03	0.43
Cold Cleaning	Worker	3.0	5.1	2.1	3.5	1.5	2.5	1.4	2.4	0.56	1.2
	ONU	3.0		2.1	2.1	1.5	1.5	1.4	1.4	0.56	0.72
Use of Laboratory Chemicals	Worker	3.9E−04	7.6E−02	2.7E−04	5.2E−02	1.9E−04	3.8E−02	1.8E−04	3.5E−02	7.2E−05	1.8E−02
	ONU	3.9E−04		2.1	2.1	1.5	1.5	1.4	1.4	0.56	0.72
Disposal to Incineration – Logistics technician	Worker	5.1E−04	3.8E−02	3.5E−04	2.6E−02	2.6E−04	1.9E−02	2.4E−04	1.8E−02	9.5E−05	9.0E−03
	ONU	5.1E−04		3.5E−04	3.5E−04	2.6E−04	2.6E−04	2.4E−04	2.4E−04	9.5E−05	1.2E−04

OES	Category	8-Hour TWA Exposures		Acute, Non-Cancer Exposures		Intermediate, Non-Cancer Exposures		Chronic, Non-Cancer Exposures		Chronic, Cancer Exposures [a]	
		8-Hour TWA (ppm)		$AC_{8\text{-hour TWA}}$ (ppm)		$ADC_{8\text{-hour TWA}}$ (ppm)		$ADC_{8\text{-hour TWA}}$ (ppm)		$LADC_{8\text{-hour TWA}}$ (ppm)	
		CT	HE	CT	HE	CT	HE	CT	HE	CT	HE
Disposal to Incineration – Maintenance technician	Worker	1.5E−04	0.27	1.0E−04	0.18	7.4E−05.	0.13	6.9E−05	0.12	2.8E−05	6.3E−02
	ONU	1.5E−04		1.0E−04	1.0E−04	7.4E−04	7.4E−04	6.9E−05	6.9E−05	2.8E−05	3.6E−05
Disposal to Landfill	Worker	1.4E−06	5.2E−06	9.7E−07	3.5E−06	7.1E−07	2.6E−06	6.6E−07	2.4E−06	2.6E−07	1.2E−06
	ONU	1.4E−06		9.7E−07	9.7E−07	7.1E−07	7.1E−07	6.6E−07	6.6E−07	2.6E−07	3.4E−07
Disposal to POTW and Non-POTW, WWT	Worker	2.1E−02	4.3E−02	1.5E−02	2.9E−02	1.1E−02	2.1E−02	1.0E−02	2.0E−02	4.0E−03	1E−02
	ONU	8.0E−05		5.5E−05	5.5E−05	4.0E−05	4.0E−05	3.7E−05	3.7E−05	1.5E−05	1.9E−05
	Worker (surrogate)	4.1E−02	0.21	2.8E−02	0.14	2.0E−02	0.10	1.9E−02	9.8E−02	7.6E−03	5.0E−02
	ONU (surrogate)	1.3E−02	3.8E−02	9.1E−03	2.6E−02	6.7E−03	1.9E−02	6.2E−03	1.8E−02	2.5E−04	9.1E−03

CT = central tendency; HE = high-end; TWA = time-weighted average

[a] For the Manufacturing as a Byproduct OES, EPA calculated the LADC using Vinyl Institute provided data on years of service for workers at manufacturing facilities (8.9 years central tendency; 33 years high-end) (EPA-HQ-OPPT-2018-0427-0181). For all other OES, EPA calculated the LADC using working years from the Bureau of Labor Statistics (BLS) data (31 years central tendency; 40 years high-end) (U.S. Census Bureau, 2019; U.S. BLS, 2014).

1384

Table 4-9. Summary of Occupational Dermal Exposure Metrics

OES	Category	Acute Absorbed Dose Rate		Acute Absorbed Dose		Intermediate Absorbed Dose, Non-Cancer		Chronic Absorbed Dose, Non-Cancer		Lifetime Chronic Absorbed Dose, Cancer [a]	
		AADR (mg/day)		AAD (mg/kg-day)		IAD (mg/kg-day)		CAD (mg/kg-day)		LCAD (mg/kg-day)	
		CT	HE	CT	HE	CT	HE	CT	HE	CT	HE
Manufacturing as a Byproduct at Chemical Manufacturing Facilities	Operator / Process technicians	0.74	4.2	9.3E−03	5.3E−02	6.8E−03	3.9E−02	6.4E−03	3.6E−02	2.7E−03	1.5E−02
	Laboratory technicians										
	Logistics / Distribution technicians										
	Maintenance technicians										
Repackaging for Laboratory Chemical Use	Worker	1.6	15	2.0E−02	0.18	1.2E−02	0.11	1.1E−02	0.10	4.0E−03	4.2E−02
Processing as a Reactant	Operator / Process technicians	2.2	9.8	2.7E−02	0.12	2.0E−02	9.0E−02	1.9E−02	8.4E−02	6.8E−03	3.4E−02
	Laboratory technicians										
	Logistics / Distribution technicians										
	Maintenance technicians										
Formulation of Adhesives and Sealants	Worker	0.77	4.3	9.7E−03	5.3E−02	7.1E−03	3.9E−02	6.6E−03	3.6E−02	2.5E−03	1.5E−02
Industrial Use of Adhesives and Sealants	Worker	0.19	0.73	2.4E−03	9.1E−03	1.8E−03	6.7E−03	1.7E−03	6.2E−03	6.2E−04	2.5E−03
Commercial Use of Adhesives and Sealants	Worker	0.19	0.73	2.4E−03	9.1E−03	1.8E−03	6.7E−03	1.7E−03	6.2E−03	6.2E−04	2.5E−03
Open-Top Vapor Degreasing	Worker	6.6	16	8.2E−02	0.20	6.0E−02	0.15	5.6E−02	0.14	2.1E−02	5.8E−02
Cold Cleaning	Worker										
Use of Laboratory Chemicals	Worker	1.6	15	2.0E−02	0.18	1.2E−02	0.11	1.1E−02	0.10	4.0E−03	4.2E−02
Disposal to Incineration	Worker	2.2	9.8	2.7E−02	0.12	2.0E−02	9.0E−02	1.9E−02	8.4E−02	6.8E−03	3.4E−02
Disposal to Landfill	Worker										
Disposal to POTW/Non-POTW WWT	Worker										

OES	Category	Acute Absorbed Dose Rate		Acute Absorbed Dose		Intermediate Absorbed Dose, Non-Cancer		Chronic Absorbed Dose, Non-Cancer		Lifetime Chronic Absorbed Dose, Cancer [a]	
		AADR (mg/day)		AAD (mg/kg-day)		IAD (mg/kg-day)		CAD (mg/kg-day)		LCAD (mg/kg-day)	
		CT	HE	CT	HE	CT	HE	CT	HE	CT	HE

[a] For the manufacturing as a byproduct OES, EPA calculated the LCRD using Vinyl Institute provided data on years of service for workers at manufacturing facilities (8.9 years central tendency; 33 years high-end) (EPA-HQ-OPPT-2018-0427-0181). For all other OESs, EPA calculated the LCRD using working years from the Bureau of Labor Statistics (BLS) data (31 years central tendency; 40 years high-end) (U.S. Census Bureau, 2019; U.S. BLS, 2014).

1386

4.1.1.3 Estimate the Number of Workers and Occupational Non-Users Potentially Exposed

Where available, EPA used CDR data to provide a basis to estimate the number of workers and ONUs. EPA supplemented the available CDR data using available market data; NAICS and Standard Industrial Classification (SIC) code data from TRI, DMR, and NEI sites identified for each COU; U.S. Bureau of Labor Statistics (BLS) and U.S. Census data; and GSs and ESDs.

Methodology

Data were available from the 2016, 2020, and 2024 CDR for manufacturing sites; however, the Agency determined this was not sufficient to determine the total number of workers for that OES. EPA supplemented the available CDR data using the methodology described in the *Draft Chemistry, Fate, Release, and Exposure Assessment for 1,1,2-Trichloroethane* (U.S. EPA, 2026g). Where market penetration data and site-specific NAICS/SIC codes from TRI/DMR/NEI were not available, EPA estimated the number of workers using data from GSs and ESDs. For additional details on development of estimates of number of workers refer to the *Draft Chemistry, Fate, Release, and Exposure Assessment for 1,1,2-Trichloroethane* (U.S. EPA, 2026g). EPA also determined the number of days per year that workers are potentially exposed to 1,1,2-trichloroethane. In general, the exposure frequency is the same as the number of operating days per year for a given OES. However, if the number of operating days exceeded 250 days per year, EPA assumed that a single worker would not work more than 250 days per year such that the maximum exposure days per year was still 250.

Results

Table 4-10 provides a summary for the number of workers and ONUs potentially exposed to 1,1,2-trichloroethane per facility. The estimates are provided for a facility within each OES.

Table 4-10. Total Number of Workers and ONUs Potentially Exposed to 1,1,2-Trichloroethane for Each OES

OES	Potential Number of Sites (Facility Data)	Potential Number of Sites (Modeled Data)	Potential Number of Workers per Site[a]	Potential Number of ONUs per Site[a]
Manufacturing as a Byproduct at Chemical Manufacturing Facilities	17	–	33	16
Manufacturing as a Byproduct in the Pulp and Paper Industry	Not assessed			
Repackaging for Laboratory Chemical Use	9	54[b]	1	1
Processing as a Reactant	73	–	27	15
Formulation of Adhesives and Sealants	–	1[b]	4	9
Use of Adhesives and Sealants (Commercial)	9	84[b]	3	1
Use of Adhesives and Sealants (Industrial)	9	84[b]	43	19
Open-Top Vapor Degreasing	7	436 [b]	76	22
Cold Cleaning	7	–	76	22

OES	Potential Number of Sites (Facility Data)	Potential Number of Sites (Modeled Data)	Potential Number of Workers per Site[a]	Potential Number of ONUs per Site[a]
Use of Laboratory Chemicals	3	105[b]	6	10
Disposal to Incineration	20	–	10	11
Disposal to Landfill	89	–	1	5
Disposal to POTW	114	–	1	1
Disposal to Non-POTW WWT	261	–	1	1
Remediation	Not assessed			

[a] Number of workers and ONUs estimates based on U.S. Census Bureau Data, U.S. BLS data, CDR, DMR, TRI, and NEI (U.S. BLS, 2023; U.S. Census Bureau, 2017)
[b] In cases where the number of sites was modeled via Monte Carlo Analysis, the 50th percentile number of sites is presented.

4.1.1.4 Weight of Scientific Evidence Conclusions for Occupational Exposure

EPA considered the assessment approach, the quality of the data, and uncertainties in assessment results to determine a weight of scientific evidence conclusion for the occupational exposure estimates. In Table 4-11, EPA summarizes the weight of scientific evidence ratings for the occupational inhalation exposures for each OES. Additionally, Table 4-11 summarizes the weight of scientific evidence rating for the dermal assessment approach, which was utilized across all OES. For more detail on the weight of scientific evidence determinations, see the *Draft Chemistry, Fate, Release, and Exposure Assessment for 1,1,2-Trichloroethane* (U.S. EPA, 2026g).

1424 **Table 4-11. Summary of Assumptions, Uncertainty, and Overall Confidence in Occupational Inhalation Exposure Estimates by OES**

OES	Confidence Rating	Weight of Scientific Evidence Conclusion in Occupational Exposure Estimates
Manufacturing as a Byproduct at Chemical Manufacturing Facilities	Robust (worker and ONU)	***Evidence Found:*** For this OES, EPA used inhalation monitoring data from facilities that manufacture 1,1,2-trichloroethane as a byproduct provided via a test order submission from the Vinyl Institute (Stantec ChemRisk, 2024). ***Strengths:*** The primary strengths of the inhalation occupational exposure estimates for this OES include the use of personal breathing zone samples directly applicable to this OES. The monitoring data were collected in accordance with a sampling plan that was reviewed and approved by EPA as part of the test order process, and the final study was performed in accordance with this plan. All of the agreed upon metadata was included in the final study report. The inhalation monitoring data collected included a sufficient number of samples for multiple worker SEGs and ONUs (15 to 49 samples per SEG). EPA used full-shift PBZ air concentration data to assess inhalation exposures, with the data source having a high data quality rating from the systematic review process. Another strength is that the data used from Vinyl Institute were 1,1,2-trichloroethane specific from multiple facilities that manufacture the chemical as a byproduct; the data included 116 worker and 29 ONU full-shift (8–12 hour) PBZ samples across 4 byproduct manufacturing facilities. Out of the 145 total samples, 32 were below the method detection limit. It should be noted that the limit of detection (<6E−05 ppm to <7E−05 ppm) was low in comparison to relevant benchmarks, including the occupational exposure value (OEV) provided in Appendix G (0.001 ppm). Additionally, EPA had industry and site-specific information on working years that were utilized in the cancer exposure estimates. ***Limitations/Assumptions/Uncertainties:*** There is uncertainty as to if the inhalation data accurately represents the entire manufacturing industry, as the inhalation exposure data was specific to sites where 1,1,2-trichloroethane was manufactured as an unwanted, non-isolated byproduct. Additionally, there were data in the test order summary report that indicated that certain tasks are done on a daily basis, while others are done less frequently. EPA assumed 250 exposure days/year for 8-hour TWAs based on 1,1,2-trichloroethane exposure each working day for a typical worker schedule. EPA acknowledges that certain tasks are not performed on a daily basis and has considered this in the risk characterization. ***Weight of Scientific Evidence Conclusion:*** Based on these strengths and limitations, EPA has concluded that the weight of scientific evidence for this assessment is robust for both workers and ONUs.
Repackaging for Laboratory Chemical Use	Slight-to-moderate (worker); slight (ONU)	***Evidence Found:*** EPA did not identify monitoring data for this OES; therefore, the Agency modeled inhalation exposures using EPA/Office of Pollution Prevention and Toxics (OPPT) models combined with Monte Carlo modeling. ***Strengths:*** A strength of the Monte Carlo modeling approach is that setting the range of model input values and conducting probabilistic modeling provides a full distribution of potential exposure values which are more likely than a discrete value to capture actual exposure at sites ***Limitations/Assumptions/Uncertainties:*** EPA used assumptions and values from the July 2022 Chemical Repackaging GS (U.S. EPA, 2022). The primary limitation is the uncertainty in the representativeness of values

OES	Confidence Rating	Weight of Scientific Evidence Conclusion in Occupational Exposure Estimates
		toward the true distribution of potential inhalation exposures. For example, EPA assumed that one import container is unloaded/day for repackaging, so the number of containers unloaded/year is equal to the number of exposure days/year (250). For ONUs, the Agency did not identify data or modeling approaches applicable to estimation of ONU exposure for repackaging and assumed that the central tendency from workers inhalation exposures was representative of ONU inhalation exposures. ***Weight of Scientific Evidence Conclusion:*** Based on these strengths and limitations, EPA concluded that the weight of scientific evidence for the repackaging assessment is slight-to-moderate for the small container scenario for workers. EPA has slight confidence in the ONU estimates due to the use of the central tendency modeled exposure.
Processing as a Reactant	Moderate (worker and ONU)	***Evidence Found:*** EPA did not identify monitoring data for the processing of 1,1,2-trichloroethane as a reactant. For this OES, EPA used inhalation monitoring data from facilities that manufacture 1,1,2-trichloroethane as a byproduct provided via a test order submission from the Vinyl Institute as analogous data for processing as a reactant (Stantec ChemRisk, 2024). ***Strengths:*** The primary strengths of this evaluation is that it utilized chemical-specific data that was collected as part of a test order process, as described above in the "Manufacturing as a Byproduct" OES weight of scientific evidence description. This dataset included personal breathing zone samples collected over a full-shift duration, and a sufficient number of samples for multiple worker SEGs and ONUs. Samples were collected across four facilities. While these samples are specific to manufacturing of 1,1,2-trichloroethane, EPA expects that similar tasks and processes would be used during processing operations. ***Limitations/Assumptions/Uncertainties:*** A limitation is that it is specific to one industry (manufacturing as a byproduct), and it is uncertain as to if the measured concentrations and exposure frequencies accurately represent processing across all facilities and processes within this OES. EPA also assumed 250 exposure days per year for 8-hours a day, and it is uncertain if this captures actual worker schedules and exposures. ***Weight of Scientific Evidence Conclusion:*** Based on these strengths and limitations, EPA has concluded that the weight of scientific evidence for this assessment is moderate estimate for both workers and ONUs.
Formulation of Adhesives and Sealants	Moderate (worker and ONU)	***Evidence Found:*** EPA did not identify any inhalation monitoring data during the formulation of 1,1,2-trichloroethane into adhesives and sealants; therefore, EPA used analogous monitoring data from Manufacturing as a byproduct provided via a test order submission from the Vinyl Institute (Stantec ChemRisk, 2024). ***Strengths:*** The primary strengths of this evaluation is that it utilized chemical-specific data that was collected as part of a test order process, as described above in the "Manufacturing as a Byproduct" OES weight of scientific evidence description. This dataset included personal breathing zone samples collected over a full-shift duration, and a sufficient number of samples for multiple worker SEGs and ONUs. Samples were collected across four facilities. While these samples are specific to manufacturing of 1,1,2-trichloroethane, EPA expects that similar tasks and processes would be used during formulation of adhesives.

OES	Confidence Rating	Weight of Scientific Evidence Conclusion in Occupational Exposure Estimates
		Limitations/Assumptions/Uncertainties: A limitation is that it is specific to one industry (manufacturing as a byproduct), and it is uncertain as to if the measured concentrations and exposure frequencies accurately represent processing across all industries. It is likely that the use of this data overestimated exposures for this OES. EPA assumed 250 exposure days/year based on 1,1,2-trichloroethane exposure each working day for a typical worker schedule. Additionally, it is uncertain if all SEGs represented in the test order are also represented at formulation sites. ***Weight of Scientific Evidence Conclusion:*** Based on these strengths and limitations, EPA has concluded that the weight of scientific evidence for this assessment is moderate for both workers and ONUs.
Use of Adhesives and Sealants	Moderate (worker and ONU)	***Evidence Found:*** EPA did not identify inhalation exposure monitoring data related to the use of 1,1,2-trichloroethane in the use of adhesives and sealants. Based on available data, EPA used surrogate data from trichloroethylene during use of paints, coatings, adhesives, and sealants. ***Strengths:*** The primary strength of these data is the use of personal breathing zone data, and they are expected to be applicable to 1,1,2-trichloroethane activities. The dataset, obtained from NIOSH HHEs as well as 3 OSHA facility inspections, contained 22 samples for workers and 2 samples for ONUs, and encompassed facilities using trichloroethylene in adhesive and coating applications. The studies had a medium to high data quality rating from the systematic review process. Use of surrogate data to estimate inhalation exposures involves correcting for both differences in the weight fraction and vapor pressure between the surrogate chemical that was monitored and the chemical being assessed. There was uncertainty in the weight fraction of TCE in the monitored data, so EPA considered 3 separate scenarios of differences in weight fraction between TCE adhesives and 1,1,2-trichloroethane adhesives. ***Limitations/Assumptions/Uncertainties:*** The primary limitation of this assessment is that it is based on data from a different chemical, which will cause inherent uncertainties due to differences in the chemical properties and possibly handling. For example, trichloroethylene and 1,1,2-trichloroethane have substantial differences in vapor pressure (69 mmHg for trichloroethylene vs. 23 mmHg for 1,1,2-trichloroethane). EPA assumed 250 exposure days/year based on exposure each working day for a typical worker schedule. It is uncertain whether this captures actual worker schedules and exposures. Additionally, the dataset contains inhalation monitoring collected at facilities that were inspected due to potential OSHA violations, which adds additional uncertainty as these data may not represent all facility conditions. ***Weight of Scientific Evidence Conclusion:*** Based on these strengths and limitations, EPA has concluded that the weight of scientific evidence for this assessment provides moderate for both workers and ONUs.
Use of Cleaning and Degreasing Solvents (Open-Top Vapor Degreasing and Cold Cleaning)	Moderate (worker and ONU)	***Evidence Found:*** EPA did not identify inhalation exposure monitoring data related to the use of 1,1,2-trichloroethane in the use of cleaning and degreasing solvents. Based on available data, EPA used surrogate data from trichloroethylene, perchloroethylene, and 1-bromopropane during open-top vapor degreasing and cold cleaning. ***Strengths:*** The primary strength of these data is the use of personal breathing zone data, and they are expected to be applicable to 1,1,2-trichloroethane activities. The open-top vapor degreasing datasets contained 331 samples for

OES	Confidence Rating	Weight of Scientific Evidence Conclusion in Occupational Exposure Estimates
		workers and 29 samples for ONUs and had medium to high data quality ratings from the systematic review process. The cold cleaning dataset contained 29 samples for workers and had a high data quality rating from the systematic review process. The ESD for Vapor Degreasing indicates that halogenated solvents are commonly used as neat substances for cold cleaning and vapor degreasing, which supports the use of trichloroethylene, perchloroethylene, and 1-bromopropane as appropriate surrogate chemicals (OECD, 2021). ***Limitations/Assumptions/Uncertainties:*** The primary limitation of this assessment is that it is based on data from different chemicals, which will cause inherent uncertainties due to differences in the chemical properties and possibly handling, and EPA assumed 250 exposure days/year based on exposure each working day for a typical worker schedule. It is uncertain whether this captures actual worker schedules and exposures. ***Weight of Scientific Evidence Conclusion:*** Based on these strengths and limitations, EPA has concluded that the weight of scientific evidence for this assessment is moderate for both workers and ONUs.
Use of Laboratory Chemicals	Moderate (worker); slight-to-moderate (ONU)	***Evidence Found:*** For this OES, EPA used analogous inhalation data from the Manufacturing as a Byproduct OES, which was provided by a test order submission from the Vinyl Institute. Inhalation data from the Exposure Group "laboratory technicians" were used in this assessment. ***Strengths:*** The primary strength of this data is that it is chemical-specific data that was collected as part of a test order process, as described above in the "Manufacturing as a Byproduct" OES weight of scientific evidence description. Specific to this OES, EPA utilized 29 full-shift personal breathing zone samples collected on laboratory technicians. Ten of the samples were below the limit of detection, which was sufficiently low in comparison to relative benchmarks (<0.06 ppb). ***Limitations/Assumptions/Uncertainties:*** The primary limitations include: (1) the data are for laboratory technicians in a manufacturing setting, rather than a commercial setting, and so the dataset may contain exposure from activities or environments that would not occur in a commercial setting; and (2) the lack of data for ONUs. Additionally, EPA assumed 250 exposure days/year based on 1,1,2-trichloroethane exposure each 8-hour working day for a typical worker schedule; it is uncertain whether this captures actual worker schedules and exposures. ***Weight of Scientific Evidence Conclusion:*** Based on these strengths and limitations, EPA has concluded that the weight of scientific evidence for this assessment is moderate for workers, and slight-to-moderate for ONUs. The confidence is reduced for ONUs due to the use of the worker central tendency value to estimate exposures.
Disposal to Incineration	Moderate (worker); slight-to-moderate (ONU)	***Evidence Found:*** For this OES, EPA used analogous inhalation data from the Manufacturing as a Byproduct OES, which was provided by a test order submission from the Vinyl Institute. Inhalation data from the Exposure Groups "maintenance technician" and "logistics technician" were used in this assessment. ***Strengths:*** The primary strength of these data is that they are PBZ and capture tasks that are expected to occur in an incineration facility. This is chemical-specific data that was collected as part of a test order process, as described above in the "Manufacturing as a Byproduct" OES weight of scientific evidence description.

OES	Confidence Rating	Weight of Scientific Evidence Conclusion in Occupational Exposure Estimates
		Limitations/Assumptions/Uncertainties: The primary limitations include: (1) the data are for workers in a manufacturing setting, rather than an incineration facility, and so the dataset may contain exposure from activities or environments that would not occur in an incineration facility; and (2) the lack of data for ONUs. Additionally, EPA assumed 250 exposure days/year based on 1,1,2-trichloroethane exposure each working day for a typical 8-hour worker schedule; it is uncertain whether this captures actual worker schedules and exposures. ***Weight of Scientific Evidence Conclusion:*** Based on these strengths and limitations, EPA has concluded that the weight of scientific evidence for this assessment is moderate for workers, and slight-to-moderate for ONUs. The confidence is reduced for ONUs due to the use of the worker central tendency value to estimate exposures.
Disposal to Landfill	Slight-to-moderate (worker); slight (ONU)	***Evidence Found:*** For this OES, EPA identified 115 area samples that were used in an assessment identified during systematic review (Harkov et al., 1985). ***Strengths:*** The Agency used 1,1,2-trichloroethane inhalation data to assess inhalation exposures, having a medium data quality rating from systematic review. The primary strength of these data is that they are directly applicable concentration data that portray the concentration of 1,1,2-trichloroethane in the air at six hazardous waste sites and one sanitary landfill. ***Limitations/Assumptions/Uncertainties:*** The primary limitations of these data are: (1) the age of the data (1985); (2) only area samples were available as opposed to PBZ air concentration data; and (3) only summary statistics were available in the study as opposed to discrete measurements. Additionally, EPA assumed 250 exposure days/year based on 1,1,2-trichloroethane exposure each working day for a typical worker schedule; it is uncertain whether this captures actual worker schedules and exposures. For ONUs, EPA did not identify data or modeling approaches applicable to estimation of ONU exposure for disposal by landfill and used a default assumption of the central tendency from the workers inhalation exposures to represent ONU inhalation exposures. ***Weight of Scientific Evidence Conclusion:*** Based on these strengths and limitations, EPA has concluded that the weight of scientific evidence for this assessment is slight-to-moderate for workers, and slight for ONUs.
Disposal to POTW/Non-POTW WWT)	Moderate (worker and ONU)	***Evidence Found:*** For this OES, EPA used analogous 1,1,2-trichloroethane manufacturing data for workers and ONUs related to wastewater treatment and surrogate data from 1,2-dichloroethane. The analogous 1,1,2-trichloroethane dataset included discrete PBZ monitoring data for workers (two samples) and ONUs (one sample) which were provided as part of the 1,1,2-trichloroethane Test Order (Stantec ChemRisk, 2024). The surrogate 1,2-dichloroethane dataset included discrete PBZ monitoring data for workers (71 samples) and ONUs (3 samples) that were used in an assessment provided by the Vinyl Institute (The Vinyl Institute, 2026) (EPA-HQ-OPPT-2018-0427-0181). ***Strengths:*** The Agency used inhalation data to assess inhalation exposures, having a high data quality rating from systematic review. The primary strength of these data is the use of applicable PBZ data obtained from workers performing work in the wastewater treatment area of a manufacturing plant. The data represent exposure due to

OES	Confidence Rating	Weight of Scientific Evidence Conclusion in Occupational Exposure Estimates
		several processes that commonly occur at wastewater treatment plants. The analogous and surrogate data were also well aligned for workers, with sample concentrations within an order of magnitude. ***Limitations/Assumptions/Uncertainties:*** The primary limitations of these data are: (1) the limited number of analogous worker and ONU samples; (2) the supplemental data are from a surrogate chemical, 1,2-dichloroethane, which also included a limited number of samples from workers. Additionally, the surrogate data had a high limit of detection (LOD) relative to potential benchmarks (LOD range: 0.024 to 0.21 ppm), and a large number of samples were below the limit of detection (35 of 70 samples below the LOD). Additionally, EPA assumed 250 exposure days/year based on 1,1,2-trichloroethane exposure each working day for a typical worker schedule; it is uncertain whether this captures actual worker schedules and exposures. ***Weight of Scientific Evidence Conclusion:*** Based on these strengths and limitations, EPA has concluded that the weight of scientific evidence for this assessment is moderate for workers and ONUs.
Dermal exposure for all OES	Moderate	***Evidence Found:*** EPA estimated dermal exposures using modeling methodologies, which are supported by moderate evidence. The Agency used the EPA Dermal Exposure to Volatile Liquids combined with Monte Carlo modeling to calculate the acute absorbed dose. EPA used empirical section 4 test order data on 1,1,2-trichloroethane for the fraction absorption parameter (Labcorp Early Development, 2023) and OES-specific data for the weight percent parameter in the model. ***Strengths:*** A strength of the Monte Carlo modeling approach is that variation in model input values and a range of potential exposure values is more likely than a discrete value to capture actual exposure at sites. ***Limitations/Assumptions/Uncertainties:*** The primary limitation is the uncertainty in the representativeness of value used in the DEVL Model for dermal loading toward the true distribution. Therefore, the weight of scientific evidence for the modeling methodologies specifically for all OES is moderate. ***Weight of Scientific Evidence Conclusion:*** Based on these strengths and limitations, the weight of scientific evidence for the modeling methodologies for all OES is moderate. Note that EPA did not assess dermal exposures to ONUs as EPA does not expect ONUs to directly handle 1,1,2-trichloroethane as part of their duties, and thus ONUs are not expected to have routine dermal exposures during the course of their work.

4.1.2 Consumer Exposures

EPA evaluated reasonably available information for consumer products containing 1,1,2-trichloroethane. The Agency did not find consumer uses from systematic review references but rather identified 1,1,2-trichloroethane containing products from market searches for products containing 1,1,2-trichloroethane. EPA identified two products that are available to consumers in the United States. These products, an epoxy plastic bonder and an acrylic-based structural adhesive paste, are generally described as structural adhesives used to repair household items including plastics like polyvinyl chloride (PVC), polycarbonate and metals such as aluminium. EPA identified four safety data sheets (SDSs) (U.S. EPA, 2026ax) for the adhesive products. The SDSs confirmed the presence of the chemical and the weight fraction at which it was present in the product. Technical specifications alongside manufacturer information allowed for the creation of low, medium, and high-end scenarios for inhalation exposures that included sensitivity analysis with the parameters of weight fraction, mass of product used, and duration of use. EPA quantified acute and chronic inhalation exposure ($\mu g/m^3$) and dermal exposures (mg/kg/day) to 1,1,2-trichloroethane.

Given the products identified and the use patterns of the products it was reasonable to conclude that ingestion by mouthing would not be an appropriate pathway of exposure to quantitatively assess. Additionally, the Agency acknowledges consumer exposure may not be chronic in nature for the adhesive product identified and evaluated for 1,1,2-trichloroethane based on rapid elimination of 1,1,2-trichloroethane from the body (<1 day) and use profile for the product. Rather, consumer exposure may be better represented as repeat acute exposures for the one product evaluated over the course of a year. The following subsections describe EPA's approach for assessing consumer exposures and provides assessment results for the single consumer COU, use of an epoxy plastic bonder and an acrylic-based structural adhesive paste containing 1,1,2-trichloroethane. The *Draft Chemistry, Fate, Release, and Exposure Assessment for 1,1,2-Trichloroethane* (U.S. EPA, 2026g) provides additional details on the development of approaches and the exposure assessment results.

To assess dermal risk, EPA applied a screening approach using the highest reported weight fraction reported along with the high-end fraction absorbed value. For dermal exposure, the calculated margins of exposure (MOEs) using the screening assessment were above the benchmarks for acute and chronic risk so no further refinement was required since lower weight fractions and fraction absorbed values would result in MOEs that were further above the benchmark (see Section 4.3.3 for the calculated MOEs).

The Agency did not assess cancer risk to consumers based on the consumer use patterns of the product identified and the scientific evidence that does not indicate a single, acute exposure would lead to cancer effects. Specifically, for cancer the consumer use pattern for the adhesive product identified has a five-minute use window and 5 to 20 minutes of inhalation exposure when used to repair items. This use profile does not align with a daily, weekly, or monthly use pattern every year for a consumer's entire lifetime. Additionally, findings from the NCI mouse study (NCI, 1978) found it took 55 weeks at the low dose of 195 mg/kg-day for 5 days per week to develop the first tumors in the liver. A later study (Milman et al., 1988) showed it took 7 weeks of exposure at a dose of 70 mg/kg/day to develop precancerous lesions in the liver when also pre-treated with a potent tumor initiator. Since these continuous, longer term, high doses do not align with the consumer use profile for the product evaluated or the relative inhaled concentration from the consumer product, the Agency determined there are no single consumer exposure scenarios expected which could lead to cancer effects identified for 1,1,2-trichloroethane and therefore did not evaluate cancer risk to consumers in this assessment.

4.1.2.1 Summary of Consumer COUs and Exposure Scenarios

EPA identified two exposure routes for consumers resulting from the use of products containing 1,1,2-trichloroethane. Consumers are primarily exposed to 1,1,2-trichloroethane through inhalation and dermal exposures during application of the adhesives/glues containing 1,1,2-trichloroethane. This includes 1,1,2-trichloroethane present in two-component adhesive products at a concentration of 0.1 to 1.0%. The two products identified as U.S.-based consumer products were an epoxy plastic bonder and an acrylic-based paste used as a structural adhesive. The epoxy plastic bonder is used to fuse and repair a wide variety of household plastic surfaces including PVC, polycarbonate, acrylic, as well as aluminum and stainless steel (U.S. EPA, 2026ax). The other product was an acrylic-based structural adhesive paste used to repair and bond plastic materials, including PVC and fiberglass (U.S. EPA, 2026ax). Both products share a similar pattern of use. They are applied directly to the surface of the intended product by the consumer usually to repair household products.

The epoxy plastic bonder consists of a two-part formula containing both resin (contains 1,1,2-trichloroethane) and hardener (does not contain 1,1,2-trichloroethane), applied with a syringe. When the syringe is used to apply the 1:1 mix of the resin only the resin is considered in this evaluation, as the hardener does not contain 1,1,2-trichloroethane. The acrylic-based structural adhesive has a similar dual dispenser syringe of resin and hardener. Resin and hardener are applied in a 1:1 mixture. Only 50% of total mass delivered would be resin. The products are directly applied to the surface of intended use via a syringe extending from the bottle/tube. This is intended for precise application of the product in hard-to-reach areas while limiting contact with users. Both products are intended for fast application with setting times reported as short as 5 minutes and intended to have full strength bonds within 25 minutes of application (U.S. EPA, 2026ax). EPA quantitatively assessed inhalation and dermal exposures to 1,1,2-trichloroethane from the use of these identified products. Due to identified use patterns of the products, exposure due to ingestion is not expected; therefore, ingestion was not assessed. EPA also focused on the lifestages of young teen (11–15 years), youth (16–20 years), and adults (21+ years). Table 4-12 presents a summary of the COUs and consumer scenarios assessed. EPA evaluated these lifestages as potential users of the product but not as bystanders because the concentration to which the user is exposed exceeds that of the bystander thus also remains health protective of bystander exposure. Further discussion is provided in Section 11 of the *Draft Chemistry, Fate, Release, and Exposure Assessment for 1,1,2-Trichloroethane* (U.S. EPA, 2026g).

Table 4-12. Summary of COUs, Exposure Scenarios, and Exposure Routes

Consumer Condition of Use	Product/ Article	Exposure Route	Media/ Exposure Pathway	Exposure Scenario[a]	Populations/ Lifestage	Analysis Type
Adhesive and sealants	Epoxy plastic bonder and acrylic-base structural adhesive paste	Inhalation	Inhalation of product during application	Inhalation exposure to 1,1,2-trichloroethane resulting from use of product containing volatile chemical	Adult (21+ years Youth (16–20 years) Young teen (11–15)	Quantitative
Adhesive and sealants	Epoxy plastic bonder and acrylic-base structural adhesive paste	Dermal	Dermal exposure to product during application	Dermal contact with product from use	Adult (21+ years Youth (16–20 years) Young teen (11–15)	Quantitative

[a] Exposure scenario model inputs were determined by CEM default, SDS, Westat Survey, or technical descriptions.

4.1.2.2 Summary of Inhalation Exposure Assessment

EPA did not identify any references during systematic review that provided additional information regarding consumer inhalation exposures to 1,1,2-trichloroethane. There were no studies that provided monitoring data for inhalation exposures to consumer or further identified any products of concern. EPA assessed inhalation exposures via modelling using the Consumer Exposure Model (CEM). The CEM Version 3.2 (U.S. EPA, 2023b) was selected for the consumer modeling as the most appropriate model based on the type of input data available for 1,1,2-trichloroethane containing products. CEM is a peer-reviewed modeling tool that accommodates the distinct inputs available for products containing 1,1,2-trichloroethane, such as weight fractions, product density, and frequency of use. CEM has capabilities to model user inhalation exposure to 1,1,2-trichloroethane from products while they are in use.

EPA used CEM embedded models to complete the inhalation assessment. The models used were E1 (Emission from Product Applied to a Surface Indoors Incremental Source), E2 (Emission from Product Applied to a Surface Indoors Double Exponential Model), and P_INH2 (Inhalation of product used in an environment). Model E1 is the more conservative emissions modeled in CEM since it assumes evaporation of products from surfaces using a higher percentage of the applied mass of product in the modeling equation. Models were generated to reflect specific use conditions as well as physical and chemical properties of identified products. Both products EPA identified fall under the adhesive and sealant consumer condition of use. They share a similar pattern of use, with application directly to the surface of the item intended for repair. The adhesive is applied through a syringe attached to the bottle/tube.

The parameterization of the inhalation assessment is described in detail Section 11 of the *Draft Chemistry, Fate, Release, and Exposure Assessment for 1,1,2-Trichloroethane* (U.S. EPA, 2026g) and some key model input parameters are summarized in Table 4-13. EPA did not find specific input parameter information during systematic review therefore EPA relied on CEM defaults for inputs like air exchange rate, interzone ventilation rate, and pre-defined room of use. EPA also used the Westat Survey Household Solvent Products: A National Survey (Westat Inc., 1987) to inform frequency of use for an adhesive and sealant. For each scenario, high-, medium-, and low-intensity use exposure scenarios the density, weight fractions, mass of product used, and duration of use were based on the reasonably available information from SDS or technical specifications or descriptions from manufacturers for the products identified to contain 1,1,2-trichloroethane.

Table 4-13. Summary of Key Parameters for Products Modeled in CEM 3.2

Product	Exposure Scenario Level [a]	Weight Fraction [b]	Duration of Use (min) [c]	Mass of Product Use (g) [c]	Density (g/cm^3)	Chronic Frequency of Use (year^{-1}) [d]	Acute Frequency of Use (day^{-1}) [d]	Use Environment; Volume (m^3) [e]	Air Exchange Rate Zone 1 and Zone 2 (h^{-1}) [e]	Interzone Ventilation Rate (m^3/h) [e]
Adhesives for small home repairs	L	0.0005	5	10	1.037	15	2	Utility Room; 20	0.45	108.978
	M	0.0025	10	25						
	H	0.005	20	50						

[a] L, M, H = low, medium, high exposure levels
Weight Fractions are half of reported value on SDS due to the resin only being half of total mass of product delivered in 1:1 mix containing hardener
[b] Parameter found from searching SDS of products containing 1,1,2-trichloroethane
[c] Professional judgement based on manufacturer product specific use patterns instructions
[d] Parmeter selected based on *Westat Survey* (Westat Inc., 1987)
[e] CEM default parameter

EPA assessed acute and chronic durations for consumer inhalation exposures to 1,1,2-trichloroethane. Acute exposures are for a 1-hour and 3-hour time-weighted average (TWA). The 3-hour TWA was selected as the more appropriate timeframe to align with the study that was used to determine acute health effects based on a 4-hour timeframe. Health effects were observed after 4 hours of inhalation. The acute point of departures (PODs) for the 1-hour timeframe and 3-hour timeframes were calculated based on Haber's Rule. The POD at the 1- and 3-hour timeframe would be 146.4 and 48.8 mg/m^3, respectively, based on a POD of 6.1 mg/m^3 (see the *Draft Human Health and Environmental Hazard Assessment for 1,1,2-Trichloroethane* for more information on the PODs and human hazard effects (U.S. EPA, 2026w)). MOEs for the modeled 1-hour and 3-hour TWAs were calculated with these acute HEC values at these timeframes. As described in Section 4.1.2, EPA assessed chronic inhalation exposure over a year acknowledging the exposure may not be chronic in nature and did not quantitatively evaluate cancer under the consumer COU. A chronic exposure was assessed based on the data from the *Westat Survey* (1987), which provides reasonable use frequencies for products that fall under this COU. The median use for similar products was 3.0 uses/year; however, the 90th percentile value was 15 uses/year which is the more appropriate assumption since uses can occur more sporadically throughout the year and equate to approximately 1.25 uses/month. For the purposes of this analysis, EPA applied 2 uses/month as a conservative estimate since 1.25 uses cannot be modeled.

Exposure estimates generated from low and medium exposure scenarios using the most conservative E1 model resulted in MOEs above the benchmark for acute effects; therefore, additional refinement was not conducted for the low or medium exposure scenarios. However, the high exposure scenario using the E1 model resulted in MOEs less than benchmark; therefore, EPA conducted refined analysis using the E2 model which is expected to be more representative of the actual exposure scenario considering the product and its use than the E1 model. The primary difference between the E1 and E2 model is the E2 model assumes only 25% of the mass applied is release because a substantial fraction of the mass becomes trapped in a cured substrate during the drying period (U.S. EPA, 2017a). Given the identified products containing 1,1,2-trichloroethane are adhesive products with quick curing time, EPA believes the E2 model is more appropriate as a refinement since it better accounts for mass of chemical that might get trapped within the cured product while the product dries. This would in turn limit the amount of the chemical emitted for potential inhalation exposure. The E2 scenario was only used to estimate the high-end scenarios because the lower intensity scenarios all resulted in MOEs above the benchmark.

4.1.2.3 Summary of Dermal Exposure Assessment

Dermal modeling was done using the fractional absorption method obtained from the *Dermal Exposure Assessment: A Summary of EPA Approaches* (U.S. EPA, 2007). This approach was identified as most appropriate for the liquid products identified as it is a finite splash-type exposure, where there is instantaneous deposition onto the skin. The approach includes the use of the film thickness in estimating the amount retained on skin. The film thickness refers to the thickness of the layer of product remaining on the skin after usage. CEM provides values for film thickness derived from experimental data. CEM default parameters were used for film thickness values used in this approach despite performing the calculations outside of CEM. Other parameters used included product density, weight fraction, and fraction absorbed (Table 4-14). EPA obtained product density directly from product SDS. The fraction absorbed value is from a high-quality guideline OECD 428 *in vitro* dermal absorption study (Labcorp Early Development, 2023). The study utilized human skin and evaluating a wide range of concentrations and vehicles (*e.g.*, 10% 1,1,2-trichloroethane solution in 1,2-dichloroethane as the vehicle and neat 1,1,2-trichloroethane). Results showed a dermal absorption range from 0.5 to 1.0% across the multiple concentrations and vehicles. Further discussion of dermal input parameters can be found in the *Draft Chemistry, Fate, Release, and Exposure Assessment for 1,1,2-Trichloroethane* (U.S. EPA, 2026g). EPA initially used a screening-level scenario to assess risk using the highest reported weight fraction and the highest reported fraction absorbed value obtained from the study. The results from this initial screening provided enough information to conclude there was no need for further refinement.

Table 4-14. Dermal Inputs for Fractional Absorption Model

Product	Film Thickness (cm) [a]	Density (ρ) g/cm^3 [b]	Amount retained on skin (Qu) (mg/cm^2-event)	Weight Fraction [b]	Fraction Absorbed (f_{abs}) [c]
Adhesives for small home repairs	0.00499	1.037 g/cm^3	5.17	0.005	0.01
Weight fractions are half of reported value on SDS because the resin only accounts for half of total mass of product delivered in 1:1 mix containing hardener. [a] CEM default parameter from appendices [b] Parameter found from searching SDS of products containing 1,1,2-trichloroethane. [c] Parmeter selected from systematic review (Labcorp Early Development, 2023).					

4.1.2.4 Weight of Scientific Evidence Conclusions for Consumer Exposure

Key sources of uncertainty for evaluating exposure to 1,1,2-trichloroethane in consumer products and strategies to address those uncertainties are described in detail in Section 11 of the *Draft Chemistry, Fate, Release, and Exposure Assessment for 1,1,2-Trichloroethane* (U.S. EPA, 2026g). Generally, designation of robust confidence suggests that supporting scientific evidence weighted against uncertainties is adequate to characterize exposures. The supporting weight of scientific evidence outweighs the uncertainties to the point where it is unlikely that the uncertainties could have a significant effect on the exposure estimate. The designation of moderate confidence suggests that the supporting evidence weighed against the uncertainties is reasonably adequate to characterize exposures. The designation of slight confidence is assigned when the weight of scientific evidence may (1) not be adequate to characterize the scenario, and (2) in the absence of complete information and there are additional uncertainties that may need to be considered. The designation of slight-to-moderate confidence suggests that some aspects of the analysis are reasonably adequate but other aspects are not adequate or well enough understood to characterize the exposure.

EPA acknowledges some uncertainty remains in this analysis due to potential variations in product formulation, patterns of consumer use, frequency or duration of use, variable environmental conditions

where a product is used, and application methods. EPA also acknowledges the consumer exposures estimated in this assessment are conservative and may overestimate the actual exposures a consumer may experience. However, that conservatism provides the Agency robust confidence that the consumer exposures assessed for 1,1,2-trichloroethane are protective of both users and bystanders. Because the approaches applied in this assessment evaluate consumer exposures across a range of exposure scenarios, EPA also has robust confidence this assessment captures the range of potential consumer exposures under the COUs evaluated and alleviates several uncertainties identified. The Agency has robust confidence that the refined E2 model presents an exposure estimate that is more representative of high-end exposure given the differences between the E1 and E2 models. Considering the uncertainties identified, conservative estimates, and evaluating across a range of exposure scenarios the overall confidence in this consumer assessment for 1,1,2-trichloroethane is robust. Therefore, EPA has robust confidence in the decision to use the exposure results from the respective tiers of analysis to derive risk estimates and characterize risks under the COUs evaluated.

Table 4-15. Weight of Scientific Evidence Per Consumer COU

Consumer COU Category and Subcategory	Weight of Scientific Evidence	Overall Confidence
Adhesive and sealants	One scenario was assessed under this COU for 2 identified products: an epoxy plastic bonder and an acrylic-based paste used as a structural adhesive. It was appropriate to use 1 scenario because the use patterns were the same. The products shared similar weight fractions (0.0005–0.005) based on the SDS provided for each product. Inhalation and dermal exposures were quantitatively assessed. Ingestion was not assessed because would have low exposure potential given the use pattern of the products. The overall confidence in this consumer inhalation exposure estimate is robust. The screening approach uses the highly conservative E1 model as a first tier estimation that assumes all of the mass of the product applied contributes to the resulting concentrations. The E2 model was used to refine the high-end scenario. With the other input parameters remaining at the high intensity value, there is no MOE below benchmark; therefore, additional refinement is not needed. The SDS provided actual weight fractions and the Westat Survey (Westat Inc., 1987) provided real-world use patterns for frequency of use. The manufacturer websites also provided information to inform the total mass used that validated CEM input values along with providing reasonable information for actual duration of use given the "working time" of the products. For dermal exposure, EPA used the fractional absorption approach to estimate 1,1,2-trichloroethane exposure based on *in-vitro* dermal absorption study utilizing human skin that provided a dermal absorption range of 0.5-1.0%. The screening approach used 1.0% as the dermal absorption value and the highest weight fraction of 0.005 as conservative inputs. The study from which the dermal absorption value was derived was assigned a high-quality rating from systematic review. The product density used in the model was provided directly from product SDS with the film thickness value provided by CEM for similar products. Other inputs into the dermal modeling are based on survey data. EPA has robust overall confidence that the dermal exposures modeled represent an upper bound of likely dermal exposure to the consumer.	Inhalation – Robust Dermal – Robust

4.1.2.5 Strength, Limitations, Assumptions, and Key Sources of Uncertainty for the Consumer Exposure Assessment

Product Formulation and Composition

Variability in the formulation of consumer products, including changes in ingredients, concentrations and chemical forms, can introduce uncertainty in exposure assessments. However, for the purpose of this assessment there was enough data on weight fractions to inform values of weight fractions used in the models. EPA obtained weight fractions directly from material safety data sheets of the products identified. These safety data sheets provided a range for the weight fractions (0.0005–0.005) of 1,1,2-trichloroethane in the products. The lowest value was used in low exposure scenario, the highest value in the high exposure scenario, and the average of those values in the medium exposure scenario compounding each intensity use scenario with respective high, medium, and low inputs. The screening assessment for the dermal assessment was highly dependent on the weight fraction as a model input; therefore, EPA assessed dermal exposure using the high-end weight fraction as a screening-level approach. Overall, weight fraction confidence is robust since both products provided the same range for weight fraction values.

Product Use Patterns

Consumer use patterns such as frequency of use, duration of use, methods of application, and skin contact surface area are expected to differ. EPA used information from the Westat Survey (Westat Inc., 1987) (n = 2,681) to select values for parameters for acute and chronic frequency of use model inputs. EPA reduced uncertainty by selecting use pattern inputs that represent product descriptions for duration of use and furthermore capture a range of high- to low-intensity use scenarios for this parameter. Exposure and risk estimates are considered representative of product use patterns and well characterized. There is robust overall confidence in the product use patterns.

CEM

CEM Version 3.2 has three different activity patterns: stay-at-home, part-time out of home, and full-time out of the home. The activity patterns were developed based on the Consolidated Human Activity Database (CHAD). For the products modeled, the stay-at-home activity pattern was chosen as it is the most health protective assumption.

Confidence in the model used considers whether the model has been peer-reviewed and whether it was applied in a manner appropriate to its design and objectives. The model for the inhalation assessment (CEM Version 3.2) has been peer reviewed (ERG, 2016), is publicly available, and has been applied in the manner intended by estimating exposures associated with household products. This use also considers the default values data sources such as building and room volumes, interzonal ventilation rates and air exchange rates. Overall confidence in the proper use of CEM for consumer exposure modeling is robust.

Dermal Modeling of 1,1,2-Trichloroethane Exposure

EPA used the fractional absorption method to calculate dermal exposure. The spreadsheet used was developed outside of CEM but parameters for some inputs were based on CEM default parameters given the category of the consumer products identified. The value for product density was obtained directly from product SDS (U.S. EPA, 2026ax) while the film thickness value was the CEM default value for consumer products identified under the glues and adhesive product category found in Table B-3 of the *CEM User Guide Appendices* (U.S. EPA, 2023b). The surface area to body weight ratios (SA/BW) used in the dermal modeling was from CEM defaults for each lifestage assessed. EPA identified a high-rated study that provided experimental data relating to the dermal absorption of 1,1,2-trichloroethane (Labcorp Early Development, 2023). The weight fractions identified were also used directly from

material safety data sheets for the products. EPA has robust confidence in the exposure estimates present in the dermal assessment for the products identified.

4.1.3 General Population Exposures

EPA considers both modeling and monitoring information when evaluating general population exposures and associated risk estimates in this *Draft Risk Evaluation for 1,1,2-Trichloroethane* (U.S. EPA, 2026ag). Details on all the approaches and methodologies used for general population exposures are presented in the *Draft Chemistry, Fate, Release and Exposure Assessment for 1,1,2-Trichloroethane* (U.S. EPA, 2026g).

EPA applies the best available science and a tiered approach to evaluate general population exposures to 1,1,2-trichloroethane for each of the media and pathways evaluated. Initial tiers of analysis incorporate conservative or high-end assumptions and model inputs to ensure potential high-end exposures are not missed and to capture potential exposures to PESS and sentinel populations. Due to the conservative nature of the initial tiers of analysis, when findings from initial tiers of analysis indicate there are no exposures which result in calculated risk estimates below/above relative benchmarks for a given hazard effect, EPA can conclude with robust confidence those pathways are not likely to result in general population exposures and associated risks for the hazard effects evaluated. However, when initial tiers of analysis indicate there are exposures which result in calculated risk estimates below/above relative benchmarks for a given hazard effect, the tiering process informs the need for additional, more refined analyses (higher tiers) prior to developing a final exposure and risk characterization. Higher tiers of analysis may include the use of additional, higher tier, or advanced models, refinements to inputs used, or refined exposure scenarios modeled relative to previous tiers. The goal of each higher tier of analysis is to evaluate more representative exposure scenarios, spatially and temporally aligned model inputs and outputs, and other factors that provide increased confidence in the overall findings and inform the final exposure/risk characterization. Details on the tiered approaches used for 1,1,2-trichloroethane are provided in the *Draft Chemistry, Fate, Release and Exposure Assessment for 1,1,2-Trichloroethane* (U.S. EPA, 2026g). Although multiple tiers of analysis are applied to several media for general population and environmental exposures, only the final results from the highest tier of analysis completed for that media and exposed population are relied on in this evaluation to derive risk estimates.

Overview of General Population Exposures

This evaluation quantitatively evaluates general population exposures and associated risks for the following pathways. These are visually presented in Figure 4-2.

- Ambient Air Pathway (Section 4.1.3.1): Inhalation route
- Ambient Surface Water Pathway (Section 4.1.3.2): Incidental dermal route
- Ambient Surface Water Pathway (Section 4.1.3.3): Incidental oral route
- Drinking Water Pathway (Section 4.1.3.3): Oral Route
    - Surface Water
    - Facility Specific
    - Generic Scenarios

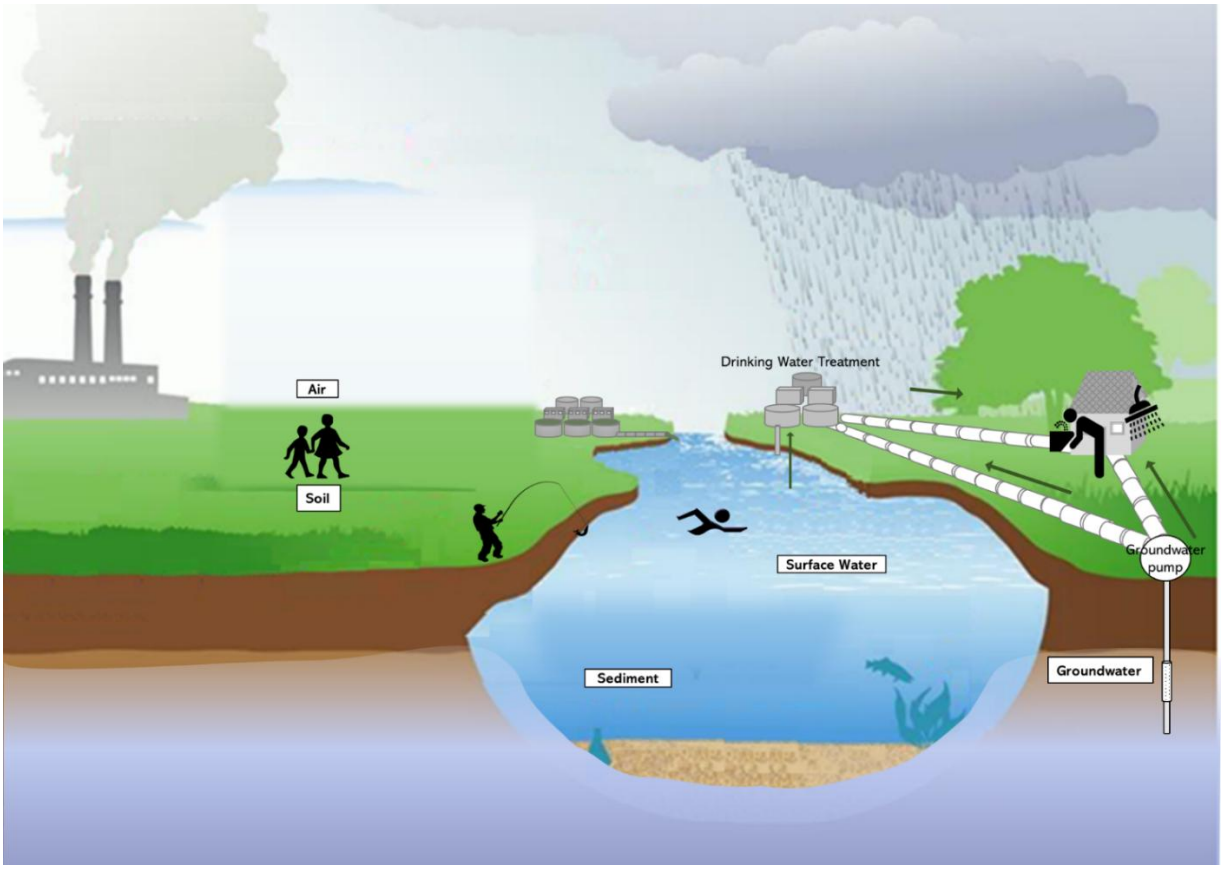

Figure 4-2. Potential Human Exposure Pathways to 1,1,2-Trichloroethane for the General Population

4.1.3.1 Summary of Inhalation Exposure Assessment

Inhalation exposures of the general population to 1,1,2-trichloroethane are primarily due to industrial releases of 1,1,2-trichloroethane to the ambient air from manufacturing, processing, use, and disposal activities. Some additional inhalation exposures are due to industrial releases of 1,1,2-trichloroethane as a byproduct of other chemical manufacturing processes (primarily other chlorinated chemical manufacturing). Industrial releases of 1,1,2-trichloroethane from each of these activities, including as a byproduct, are evaluated for inhalation exposures of the general population in this evaluation.

EPA relied on modeling and a tiered approach described in detail in the *Draft, Chemistry, Fate, Release and Exposure Assessment for 1,1,2-Trichloroethane* (U.S. EPA, 2026g) to assess inhalation exposure of the general population and wildlife populations to 1,1,2-trichloroethane attributable to COUs via the ambient air pathway. General population, for this inhalation exposure assessment, includes the sub-set of the total population in the United States who reside or frequent locations in proximity to releasing facilities where inhalation exposures to 1,1,2-trichloroethane via the ambient air pathway are likely, including fenceline communities and PESS. Wildlife population, for this inhalation exposure assessment, refers to a population of terrestrial animals that may encounter industrial facilities releasing 1,1,2-trichloroethane to the ambient air resulting in inhalation of 1,1,2-trichloroethane by that terrestrial animal. Proximity refers to locations within 30 to 50,000 m (0.02–31 miles) from a releasing facility. Tier 1 and Tier 2 modeling analyses for this inhalation exposure assessment used EPA's Integrated Indoor/Outdoor Air Calculator Model (IIOAC)[2] while the Tier 3 modeling analyses used EPA's Human

[2] https://www.epa.gov/tsca-screening-tools/iioac-integrated-indoor-outdoor-air-calculator (accessed July 21, 2026)

Exposure Model (HEM)[3]. This inhalation exposure assessment evaluates exposures and associated risks for acute and chronic non-cancer as well as cancer effects.

Monitoring data from EPA's Ambient Monitoring Technology and Information Center (AMTIC) archive are used to further contextualize concentrations of 1,1,2-trichloroethane in the ambient air and ground truth modeled concentrations and discussed in detail in the *Draft Chemistry, Fate, Release and Exposure Assessment for 1,1,2-Trichloroethane* (U.S. EPA, 2026g). Monitoring data from AMTIC are not used to estimate exposures or derive risk estimates because monitoring data cannot be attributed to a specific COU.

Based on the physical and chemical properties, fate, and transport of 1,1,2-trichloroethane described in Section 2 (including vapor pressure, persistence in air and volatilization from surface soils), reported releases to ambient air described in Section 3, and available ambient air monitoring data described in the *Draft Chemistry, Fate, Release and Exposure Assessment for 1,1,2-Trichloroethane* (U.S. EPA, 2026g), inhalation is expected to be a primary route of exposure for the general population. Neither deposition nor inhalation of 1,1,2-trichloroethane contaminated dust or soil is evaluated in this inhalation exposure assessment.

A summary of the results and decision tree for refined analyses based on the tiered approach applied for inhalation exposures to the general population is presented in Table 4-16 and to wildlife populations Table 4-17 (applied in Section 5.3.4.1). Following the summary tables is a narrative summary of the exposure findings described in detail and presented in the *Draft Chemistry, Fate, Release and Exposure Assessment for 1,1,2-Trichloroethane* (U.S. EPA, 2026g) and associated supplemental files.

[3] https://www.epa.gov/fera/risk-assessment-and-modeling-human-exposure-model-hem (accessed July 21, 2026)

Table 4-16. Inhalation Exposure Results and Decision Tree from Tiered Analysis – General Population

Analysis Tier	Hazard Endpoint	Calculated MOE	Calculated Cancer Risk Estimate	Next Step	Results Relied on for Risk Estimates in Draft Risk Evaluation?
Tier 1	Acute non-cancer	> benchmark of 100	N/A	No further refinement necessary	Yes
	Chronic non-cancer	< benchmark of 300	N/A	Tier 2-refined analysis	No
	Cancer	N/A	> benchmark of 1E−06 [a]	Tier 2-refined analysis	No
Tier 2	Chronic non-cancer	< benchmark of 300 (11 IS)	N/A	Tier 3-refined analysis	No
	Cancer	N/A	> benchmark of 1E−06 [a] (21 ISs)	Tier 3-refined analysis	No
Tier 3-radial distances	Chronic non-cancer	< benchmark of 300 (5 OES)	N/A	Tier 3-facility specific census block analysis	Yes
	Cancer	N/A	> benchmark of 1E−06 [a] (5 OESs)	Tier 3-facility specific census block analysis	Yes
Tier 3-facility specific census block	Chronic non-cancer	> benchmark of 300 (5 OES)	N/A	No further refinement necessary	Yes
	Cancer	N/A	> benchmark of 1E−06 [a] (1 OESs)	Tier 3-multi facility aggregate census block analysis	Yes
Tier 3-multi-facility aggregate census block	Cancer	N/A	> benchmark of 1E−06 [a] (2 OESs)	No further refinement necessary	Yes

IS = industry sector; MOE = margin of exposure; OES = occupational exposure scenario
[a] EPA uses the 1E−06 benchmark for purposes of informing whether additional, more refined analyses are necessary or warranted. However, EPA considers the range of cancer risks between 1E−04 and 1E−06 for purposes of calculating risk estimates and risk characterization in this draft risk evaluation.

Table 4-17. Inhalation Exposure Results and Decision Tree from Tiered Analysis – Wildlife Population

Analysis Tier	Hazard Endpoint	Calculated RQ	Next Step	Results Relied on for Risk Estimates in the Draft Risk Evaluation?
Tier 1	Acute non-cancer	<1	No further refinement necessary	Yes
	Chronic non-cancer	<1	No further refinement necessary	Yes
RQ = risk quotient				

4.1.3.1.1 Acute Non-Cancer Exposure

The highest daily average modeled concentration from the most conservative Tier 1 analysis was 34 µg/m^3. This highly conservative exposure did not result in calculated risk estimates less than the benchmark of 100 for acute effects in humans. Therefore, EPA did not further evaluate inhalation exposure of the general population to 1,1,2-trichloroethane beyond the Tier 1 analysis for acute non-cancer effects. Additionally, EPA relied on the results from the Tier 1 analysis for purposes of deriving risk estimates and characterizing risks for acute non-cancer effects to the general population from inhalation of industrial releases of 1,1,2-trichloroethane to the ambient air. EPA also relied on the results from the Tier 1 analysis to derive acute risk estimates and characterize risks for the general population from inhalation of industrial releases of 1,1,2-trichloroethane to the ambient air. Calculated risk estimates for acute non-cancer effects to general population are provided in Section 4.3.4.1.1.

4.1.3.1.2 Chronic Non-Cancer Exposure

The highest annual average modeled concentrations from the Tier 1 and Tier 2 analyses resulted in calculated risk estimates less than the benchmark of 300 for chronic non-cancer effects in humans. Therefore, EPA conducted Tier 3 analyses for chronic non-cancer effects.

The Tier 3 analysis included site specific evaluations for 29 facilities using the TRI release dataset (2019–2023 reporting years) and captures exposures to the general population, fenceline communities, and PESS. The Tier 3 radial distance analysis found modeled concentrations which resulted in calculated risk estimates less than the benchmark of 300 for chronic non-cancer effects as far as 250 m (0.2 miles) from release points modeled. Further refinements to the Tier 3 analysis at the facility specific census block level found the highest maximum annual average modeled concentrations in a populated census block across the five OESs evaluated ranged from 0.0007 to 0.49 µg/m^3. These modeled concentrations did not result in calculated risk estimates less than the benchmark of 300 for chronic non-cancer effects. This indicates that while there are exposures (and associated risk estimates) at radial distances out to 250 m from the release points modeled, the 2020 census data integrated into the HEM indicates there is no general population residing or frequenting locations at those distances from the TRI facilities evaluated. Therefore, EPA did not further evaluate inhalation exposures of the general population to 1,1,2-trichloroethane beyond the Tier 3-facility specific census block analysis for chronic non-cancer effects. EPA relied on the results from the Tier 3 analysis for purposes of deriving risk estimates and characterizing risks for chronic non-cancer effects to the general population from inhalation of industrial releases of 1,1,2-trichloroethane to the ambient air. Calculated risk estimates for acute non-cancer effects to general population are provided in Section 4.3.4.1.2.

4.1.3.1.3 Cancer Exposure

The highest annual average modeled concentrations from the Tier 1 and Tier 2 analyses resulted in calculated risk estimates greater than the benchmark of 1 in 1 million[4] for cancer effects in humans. Therefore, EPA conducted Tier 3 analyses for cancer effects.

The Tier 3 analysis included site specific evaluations for 29 facilities using the TRI release dataset (2019–2023 reporting years). The Tier 3 radial distance analysis found the highest annual average modeled concentrations did result in calculated risk estimates greater than the benchmark of 1×10^{-6} for cancer effects as far as 1,000 m from a release point. Further refinements to the Tier 3 analysis at the facility specific census block level found the highest maximum annual average modeled concentrations across the five OESs evaluated ranged from 0.0007 to 0.49 µg/m^3. All but one (0.49 µg/m^3) of these modeled concentrations result in calculated risk estimates less than the benchmark of 1×10^{-6} for cancer effects for general population. Therefore, no additional investigation or refined analyses were pursued for the four OES. The 0.49 µg/m^3 modeled concentration resulted in calculated risk estimates greater than the benchmark of 1×10^{-6} for general population, which could lead to cancer effects. This modeled concentration is associated with the 2019 TRI reporting year and a single TRI facility (and the only TRI facility) within the OES: Open-Top Vapor Degreasing (COU: Use of solvents [Cleaning and degreasing]). However, further investigation and EPA outreach to the facility found the facility discontinued using 1,1,2-trichloroethane after 2019 for business reasons (EPA-HQ-OPPT-2018-0421-0051). Discontinued use of 1,1,2-trichloroethane removed the exposures (and associated risk estimates) for this OES/COU. Therefore, EPA determined additional analysis for inhalation exposures of the general population to 1,1,2-trichloroethane beyond the Tier 3-facility specific census block analysis was not necessary or warranted for cancer effects. Nonetheless, to ensure higher potential exposures were not missed, limited additional, refined Tier 3 analysis using the top 10 NEI releasing facilities from the 2017 and 2020 NEI release datasets were conducted. Results from the NEI dataset analyses were compared to the findings from the analysis using the TRI release dataset and did not change the conclusions reached with the Tier 3 analysis using the TRI release dataset.

4.1.3.1.4 Multi-Facility Aggregate Exposure

The Tier 3 analysis included a multi-facility aggregate census block analysis for cancer effects based on the 29 TRI facilities evaluated for the facility specific census block analyses. The purpose of this multi-facility aggregate analysis was to capture total exposures from all facilities impacting a given census block or general population exposure rather than a single facility impact based on the radial distance or facility-specific census block analyses.

The multi-facility aggregate census block analysis findings showed three census blocks where maximum modeled concentrations resulted in calculated risk estimates greater than or equal to the benchmark of 1×10^{-6} for general population which could lead to cancer effects. Two[5] of the census blocks are associated with the same single facility where exposures (and associated risk estimates) were identified with the facility specific census block analysis and no other TRI facilities are in proximity. Modeled concentrations at the centroid of these two census blocks were 0.35 and 0.49 µg/m^3. Because this facility

[4] EPA used an inhalation cancer risk 1×10^{-6} for purposes of informing whether additional, more refined analyses are necessary or warranted. However, EPA considers 1×10^{-6} to 1×10^{-4} as an acceptable cancer risk range for general population exposures. These values provide a range for evaluating risk but do not constitute a bright-line.

[5] This is based on TRI-reported latitude and longitude for this facility, which was located 2,000 m north of the actual facility location. When NEI reported latitude and longitude were used (which are representative of the actual facility location), 16 census blocks had estimated exposures resulting in preliminary risk. However, because no other facilities are located in proximity, the aggregate estimates remain for the single facility contribution. See the *Draft Chemistry, Fate, Release, and Exposure Assessment for 1,1,2-Trichloroethane* (U.S. EPA, 2026g) for more details.

discontinued use of 1,1,2-trichloroethane after 2019, EPA did not further evaluate or investigate this facility.

The third census block identified in the multi-facility aggregate census block analysis had a modeled concentration of 0.34 µg/m^3 at the centroid of the census block, which resulted in a calculated risk estimate equal to the benchmark for general population. This census block is associated with two facilities, both under the OES: Manufacturing as a Byproduct at Chemical Manufacturing Facilities. The 0.34 µg/m^3 concentration is based on modeling the highest fugitive and stack releases reported for each facility across the 5 years of TRI release data evaluated. However, a review of the releases modeled found while they aligned spatially (from the same, respective facilities) they did not align temporally (occur the same years). Therefore, EPA conducted a refined analysis for these two facilities which aligned releases for each of the 5 years both spatially and temporally. Results from the refined analysis found the highest maximum modeled concentrations in a populated census block across the 5 years of releases modeled ranged from 0.25 to 0.32 µg/m^3. All five maximum modeled concentrations resulted in calculated risk estimates less than the benchmark of 1×10^{-6} for general population. Therefore, EPA did not further evaluate multi-facility aggregate exposures associated with cancer effects for inhalation exposures of the general population to 1,1,2-trichloroethane beyond this refined multi-year Tier 3 multi-facility aggregate census block analysis.

4.1.3.1.5 Weight of Scientific Evidence Conclusions for Inhalation Exposures

Overall, EPA has robust confidence in the conclusions reached in this general population inhalation exposure assessment for the ambient air pathway. EPA also has robust confidence in the decision to use the exposure results from the respective "final" tiers of analysis to derive risk estimates and characterize risk.

EPA has robust confidence high-end releases and associated exposures are not missed for general population and PESS or wildlife populations in the lower tiers of analysis because Tier 1 and Tier 2 analyses results are highly conservative, upper bounding exposure estimates. EPA also has robust confidence that the Tier 1 results relied on to derive acute non-cancer risk estimates (general population and wildlife populations) and chronic non-cancer risk estimates (wildlife populations) are protective of all receptors—including fenceline communities and PESS.

EPA has robust confidence high-end releases and associated exposures are not missed for general population in the Tier 3 analyses because those analyses retain some conservative assumptions while evaluating multiple datasets and multiple years of releases. EPA also has robust confidence that results from the Tier 3 analyses provide representative exposures to general population and PESS because the Tier 3 analyses retain some conservative assumptions but are refined based on facility-specific reported releases (*i.e.,* additional radial distances nearer and farther than the Tier 1 or Tier 2 to account for nearer exposed populations and potential long-range transport; local meteorology, population, and elevation to consider topographic and terrain effects; and populated census blocks). Furthermore, the Agency has robust confidence that the Tier 3 results relied on for derivation of chronic non-cancer and cancer risk estimates for general population are protective of all receptors, including fenceline communities and PESS.

Consideration of real-time monitoring data from the AMTIC archive and an alternate receptor analysis using the HEM as described in the *Draft Chemistry, Fate, Release and Exposure Assessment for 1,1,2-Trichloroethane* (U.S. EPA, 2026g) provides EPA robust confidence in the modeled concentrations. The AMTIC archive data and alternate receptor analysis results demonstrate whereas modeled

concentrations are conservative, are not overly conservative, and provide support for the use of the modeled concentrations to derive risk estimates and characterize risks for each of the hazards evaluated.

4.1.3.2 Summary of Incidental Dermal Exposure Assessment via Swimming

The general population may have incidental dermal exposures while swimming in surface waters (streams and lakes) that are affected by 1,1,2-trichloroethane. Surface water concentrations were modeled for both facility specific releases and generic scenario releases to assess potential general population dermal exposures while swimming. As a screening-level exercise for facility specific releases, the facility in each OES resulting in the highest estimated surface water concentration for that OES was used to represent a high-end estimate of potential concentrations across the entire OES, as any facilities with lower surface water concentrations would result in lower general population exposures. Surface water concentrations were estimated most often using the receiving water body 30Q5 (lowest 30 consecutive days of flow over a 5-year period) flow for each facility. For generic scenario releases, the high-end release scenario combined with a 10th percentile flow was used for each OES. In both cases, modeled surface water concentrations are representative of conservative, higher-end concentrations expected to occur in receiving water bodies at or near the point of discharge. Following estimation of surface water concentrations for each OES, acute doses (ADR) were calculated for all potential age groups, although results are presented for adult (21+ years); youth (11–15 years); and children (6–10 years) within the *Draft Chemistry, Fate, Release, and Exposure Assessment for 1,1,2-Trichloroethane* (U.S. EPA, 2026g).

Acute doses associated with facility specific releases ranged from 5.5×10^{-7} to 3.2×10^{-4} mg/kg-day across age groups with the highest doses modeled for Manufacturing as a Byproduct OES. Across the three modeled generic scenario OESs, acute doses ranged from 6.4×10^{-9} to 2.2×10^{-5} mg/kg-day with highest doses modeled for the Formulation of Adhesives and Sealants OES. Discussion and characterization of potential risk associated with these exposures is in Section 4.3.4.2.

Full description of the approach for modeling these exposures and presentation of estimated dermal doses is in the *Draft Chemistry, Fate, Release, and Exposure Assessment for 1,1,2-Trichloroethane* (U.S. EPA, 2026g), with additional information on inputs and other age groups in *Draft General Population Surface Water Pathway Exposure Estimates for 1,1,2-Trichloroethane* supplemental file (U.S. EPA, 2026v).

Weight of Scientific Evidence for Incidental Dermal Exposure

Overall, EPA has robust confidence that the modeled surface water concentrations presented for both the facility-specific releases and generic scenarios represent higher-end estimated concentrations, and that these concentrations are reasonably applied for estimation of potential incidental dermal exposure. EPA's Swimmer Exposure Assessment Model provided detailed information on the skin surface areas for dermal exposure and potential swimming exposure times for the evaluated age groups given as high-end default durations for the evaluated age groups (U.S. EPA, 2015b). Furthermore, estimated concentrations are representative of those expected near the point of discharge to receiving water bodies and a more conservative estimate of expected exposures. Concentrations would be expected to dilute and/or degrade with time and movement downstream. The use of a tiered approach where exposures were refined when necessary offers additional confidence and robustness in estimated exposures. Therefore, EPA has robust confidence that presented estimates of exposure are representative of higher-end exposure estimates for incidental dermal exposure per OES and are appropriate to derive preliminary final risk estimates and characterize risk as discussed in Section 4.3.4.2.

4.1.3.3 Summary of Incidental Oral Exposures Assessment via Swimming

The general population may have incidental oral ingestion while swimming in surface waters (streams and lakes) that are affected by 1,1,2-trichloroethane. Surface water concentrations were modeled for both facility-specific and generic scenario releases to assess potential general population oral exposures while swimming. As a higher-end estimation of exposure resulting from facility specific releases, the facility in each OES resulting in the highest estimated surface water concentration for that OES was used as a higher-end estimate of potential concentrations across the entire OES as any facilities with lower surface water concentrations would result in lower general population exposures. Surface water concentrations were estimated using the receiving water body 30Q5 flow for each facility. For generic scenario releases, the high-end release scenario combined with a P10 flow percentile was used for each OES. In both cases, modeled surface water concentrations are representative of conservative, higher-end concentrations expected to occur in receiving water bodies at or near the point of discharge. Following estimation of surface water concentrations for each OES, acute doses (ADR) were calculated for all potential age groups, although results are presented for adult (21+ years); youth (11–15 years); and children (6–10 years) within the *Draft Chemistry, Fate, Release, and Exposure Assessment for 1,1,2-Trichloroethane* (U.S. EPA, 2026g).

Acute doses associated with facility-specific releases of 1,1,2-trichloroethane ranged from 8.6×10^{-7} to 4.2×10^{-4} mg/kg-day across age groups with the highest doses modeled for Manufacturing as a Byproduct OES from a 30Q5 surface water concentration of 78 µg/L. Across the three modeled generic scenario OESs, acute doses ranged from 1.0×10^{-8} to 1.3×10^{-5} mg/kg-day across age groups, with highest doses modeled for the Formulation of Adhesives and Sealants OES from a 30Q5 surface water concentration of 2.4 µg/L. Discussion and characterization of potential risk associated with these exposures is in Section 4.3.4.3.

A full description of the approach for modeling these exposures and presentation of estimated incidental oral ingestion doses is provided in the *Draft Chemistry, Fate, Release, and Exposure Assessment for 1,1,2-Trichloroethane* (U.S. EPA, 2026g). Additional information on inputs and other age groups in is available in the *Draft General Population Surface Water Pathway Exposure Estimates for 1,1,2-Trichloroethane* supplemental file (U.S. EPA, 2026v).

Weight of Scientific Evidence for Incidental Oral Exposure

Overall, EPA has robust confidence that the modeled surface water concentrations presented for both the facility-specific releases and generic scenarios represent higher-end estimated concentrations, and that these concentrations are reasonably applied for estimation of potential incidental oral exposure. EPA's Swimmer Exposure Assessment Model provided detailed information on potential swimming exposure times for the evaluated age groups given as high-end default durations for evaluated age groups (U.S. EPA, 2015b). Additionally, age group-specific ingestion rates are selected from EPA's *Exposure Factors Handbook* as upper percentile values while swimming (U.S. EPA, 2019b). Furthermore, estimated concentrations are representative of those expected at or near the point of discharge to receiving water bodies and a more conservative estimate of expected exposures. Concentrations would be expected to dilute and/or degrade with time and movement downstream. The use of a tiered approach where 1,1,2-trichloroethane exposures were refined when necessary offers additional confidence and robustness in estimated exposures. Therefore, EPA has robust confidence that presented estimates of exposure are representative of higher-end exposure estimates for incidental oral exposure per OES and are appropriate to derive final risk estimates and characterize risk as discussed in Section 4.3.4.3.

4.1.3.4 Summary of Drinking Water Exposure

Potential drinking water exposures were calculated using a tiered approach for a variety of lifestages from infants to adults for both facility-specific and generic scenario releases, although exposures for bottle-fed infants (<1 year), toddlers (1–5 years) and adults (21+ years) are presented within the *Draft Chemistry, Fate, Release, and Exposure Assessment for 1,1,2-Trichloroethane* (U.S. EPA, 2026g). A full explanation of all age groups is available in the *Draft General Population Surface Water Pathway Exposure Estimates for 1,1,2-Trichloroethane* supplemental file (U.S. EPA, 2026v). By including infant exposure estimates, the Agency is considering PESS and protecting this susceptible subpopulation.

EPA used a tiered approach where possible toward assessment of drinking water. This approach intended to identify potential preliminary risk at each tier and assist in evaluating potential refinements or higher tier evaluations that better characterize potential drinking water exposures and risk. For evaluation of drinking water exposures to the general population, acute, chronic non-cancer and chronic cancer exposures and associated doses are calculated from modeled surface water concentrations. Acute exposures are informed by 30Q5 flow surface water concentrations while harmonic mean surface water concentrations are used to assess chronic exposures. The potential acute dose (ADR_{POT}) and potential average daily dose (ADD_{POT}) are used for evaluating acute and chronic non-cancer drinking water exposures respectively, while the potential lifetime average daily dose ($LADD_{POT}$) and potential lifetime average daily concentration ($LADC_{POT}$) are used for estimating cancer exposures from drinking water. Calculated doses were used to inform whether additional tiers of analysis including evaluation of proximity to drinking water sources and potential degree of dilution were warranted.

4.1.3.4.1 Facility-Specific Exposures

The evaluation of potential drinking water exposures from facility-specific releases followed a multi-tier evaluation process with the estimation of exposures and identification of preliminary risks leading to potential further assessment and refinement at higher tiers that is discussed here and in Section 4.3.4.4.1 when discussing potential risk for facility-specific releases.

Table 6-5 in Section 6.2.1.1 of the *Draft Chemistry, Fate, Release, and Exposure Assessment for 1,1,2-Trichloroethane* (U.S. EPA, 2026g) shows estimated 30Q5 and harmonic mean (HM) flow surface water concentrations from facility-specific releases following Tier 2 evaluation. These concentrations were used to estimate drinking water doses as shown in Table 6-21 in Section 6.4.3 of *Draft Chemistry, Fate, Release, and Exposure Assessment for 1,1,2-Trichloroethane* (U.S. EPA, 2026g) for bottle-fed infants (<1 year), toddlers (1–5 years), and adults (21+ years). Acute doses associated with represented facility-specific releases ranged from 1.1×10^{-5} to 1.1×10^{-2} mg/kg-day across age groups, average daily doses ranged from 7.4×10^{-7} to 1.2×10^{-3} across age groups, and lifetime average daily doses ranged from 2.4×10^{-8} to 3.3×10^{-4} across age groups, with the highest doses modeled for Manufacturing as a Byproduct OES from a 30Q5 flow surface water concentration of 78 µg/L and harmonic mean flow concentration of 43 µg/L following a Tier 2 drinking water evaluation (U.S. EPA, 2026g). As further described in Section 4.3.4.4.1, exposures below relevant benchmarks were not identified for acute or chronic non-cancer drinking water exposures whereas exposures above benchmark were identified for 10 facilities across the following 5 OESs for chronic cancer drinking water exposures:

- Manufacturing as a Byproduct;
- OES Unable to be Mapped;
- Processing as a Reactant;
- Waste Handling, Disposal and Treatment (Non-POTW WWT); and
- Waste Handling, Disposal and Treatment (POTW).

Based on identified above benchmark exposures for chronic cancer, a subsequent Tier 3 evaluation of potential drinking water exposures was conducted by mapping facility releases and identifying their proximity to drinking water intakes and potential dilution downstream with full description of this evaluation provided in Section 6.4.3 of *Draft Chemistry, Fate, Release, and Exposure Assessment for 1,1,2-Trichloroethane* (U.S. EPA, 2026g). Of the 10 facilities evaluated for downstream drinking water intake analysis based on preliminary identification of risk (See Section 4.3.4.4.1), 4 had identified downstream drinking water intakes whereas 6 had no downstream drinking water intakes within 250 km following Tier 3 analysis (see Table 6-12 in *Draft Chemistry, Fate, Release, and Exposure Assessment for 1,1,2-Trichloroethane* (U.S. EPA, 2026g)). For those four facilities with drinking water intakes downstream, no intakes were located less than 70 km downstream and all releases were diluted to less than 0.1% of their initial concentration. Therefore, facilities either did not have drinking water intakes downstream or those that did were far downstream, resulting in significant reductions of estimated 1,1,2-trichloroethane concentrations. Full characterization of potential risk from drinking water exposures resulting from facility-specific releases is described in Section 4.3.4.4.1.

4.1.3.4.2 Generic Scenario Exposures

Generic scenario drinking water exposures similarly followed a multi-tier process where the estimation of exposures and identification of preliminary risks during initial evaluation leads to potential further assessment and refinement at higher tiers that is discussed here and in Section 4.3.4.4.2 for generic scenario releases.

Acute doses associated with high-end release scenarios modeled using the P10 flow percentile ranged from 1.3×10^{-7} to 3.3×10^{-4} mg/kg-day across age groups, average daily doses ranged from 2.4×10^{-8} to 5.7×10^{-5} across age groups, and lifetime average daily doses ranged from 7.8×10^{-10} to 1.6×10^{-5} across age groups with the highest doses modeled for the Formulation of Adhesives and Sealants OES from a 30Q5 flow surface water concentration of 2.4 µg/L and harmonic mean flow concentration of 2 µg/L (Table 6-22 in *Draft Chemistry, Fate, Release, and Exposure Assessment for 1,1,2-Trichloroethane* (U.S. EPA, 2026g)). Discussion and characterization of potential risk associated with these exposures is provided in Section 4.3.4.4.2.

4.1.3.4.3 Weight of Scientific Evidence for Drinking Water Exposure

Overall, there is robust confidence that the modeled surface water concentrations presented for both the facility-specific releases and generic scenario releases represent higher-end concentrations, and that these concentrations are reasonably applied for identification of drinking water exposure across the evaluated age groups. The use of a tiering structure to evaluate and, where possible and necessary, refine these estimates, offered increasing confidence and robustness in predicted drinking water exposures. For example, higher tier evaluation and refinement of those facility-specific releases showing potential risks to the general population following Tier 2 evaluation incorporate proximity to drinking water intakes and magnitude of potential dilution of 1,1,2-trichloroethane at Tier 3. These refinements provided additional support and confidence in estimating potential exposures encountered by the general population from facility-specific releases. Although it is difficult to directly compare monitored values to potential modeled releases due to measured concentrations oftentimes not being temporally or geographically close to known releases of 1,1,2-trichloroethane, the ample monitoring data of 1,1,2-trichloroethane in drinking water across multiple reporting cycles due to it being a regulated drinking water contaminant broadly confirmed modeled results. Available monitoring data showed that 1,1,2-trichloroethane is infrequently detected in drinking water and when measured, most measured concentrations are low and similar in magnitude to the modeled facility and generic scenario estimates. Therefore, EPA has robust confidence that presented estimates of exposure are representative of

drinking water exposure per OES and are appropriate to derive final risk estimates characterize risk discussed in Section 4.3.4.4.

4.1.3.5 Summary of Land Pathway Concentrations and Exposure

EPA searched peer-reviewed literature, gray literature, and databases of environmental monitoring data for concentrations of 1,1,2-trichloroethane in media that encompass the land pathways (*e.g.,* biosolids, wastewater sludge, agricultural soils, landfills, landfill leachate).

EPA did not identify any data on concentrations of 1,1,2-trichloroethane in landfills during systematic review. The Agency did identify one study conducted in 1984 reporting groundwater concentrations of 7.7 to 31 µg/L at sites located near municipal solid waste landfills in Minnesota, indicating that 1,1,2-trichloroethane can migrate to groundwater from landfills (detection limits and non-detects were not reported) (NCBI, 2020b; Sabel and Clark, 1984). However, given that EPA only identified two current consumer uses in adhesives (Section 4.1.2) and 1,1,2-trichloroethane's designation as a hazardous chemical by the Resource Conservation and Recovery Act (RCRA), 1,1,2-trichloroethane is unlikely to be present in municipal landfills based on its current uses. 1,1,2-Trichloroethane could be present in municipal landfills due to the biodegradation of other chlorinated ethanes, such as 1,1,1,2-tetrachloroethane (Section 2.2). EPA is therefore assuming that exposure of 1,1,2-trichloroethane to the general population from municipal solid waste landfills will be low.

For the reporting years of 2019 to 2023, TRI land releases ranged from 6 to 25,040 kg/year. The two highest annual releases (5,279 kg in 2022; 25,033 kg in 2023) were categorized in TRI as "off-site–other landfills." These releases were transfers to a waste handling facility that also reports to TRI. In 2022 and 2023, the waste handling facility reported that greater than 99% of the total 1,1,2-trichloroethane received was incinerated, with only up to 2 lb being categorized in TRI as "total off-site disposal to Class I underground Injection Wells, RCRA Subtitle C landfills, and other landfills."

4.1.3.5.1 Measured Concentrations in Biosolids

EPA did not identify any concentrations of 1,1,2-trichloroethane in biosolids during its systematic review process. In addition to peer reviewed literature, EPA also searched for biosolids concentrations in the National Sewage Sludge Surveys and biennial review (U.S. EPA, 2009) and did not identify any reported concentrations above the detection limit (detection limits were not provided).

4.1.3.5.2 Air Deposition to Soil

Given its Henry's Law constant (8.42×10^{-4} atm·m^3/mol) and low-to-moderate affinity for organic carbon (log K_{OC} = 2.06), flux of 1,1,2-trichloroethane from air to soil is expected to be low; therefore, air deposition to soil is not expected to be an exposure pathway for 1,1,2-trichloroethane that will contribute significantly to dermal or ingestion risks for the general population or terrestrial organisms. Additionally, partitioning analyses and fugacity modeling show that when releases are at steady state and primarily to air, 1,1,2-trichloroethane is expected to partition primarily to air. Additional fugacity modeling done using the OECD LRTP Screening Tool shows that 1,1,2-trichloroethane has an estimated transport efficiency of 21%. The transport efficiency is the percentage of emission flux that is deposited to the soil and water of a hypothetical region adjacent to the region receiving emissions. Overall, the evidence suggests that deposition of 1,1,2-trichloroethane to soil is likely to be low; therefore, EPA did not estimate soil concentrations due to deposition. See the *Draft Chemistry, Fate, Release, and Exposure Assessment for 1,1,2-Trichloroethane* (U.S. EPA, 2026g) for more information on the fugacity modeling.

4.1.3.5.3 Evidence Integration for Soil

EPA identified limited data on concentrations of 1,1,2-trichloroethane in soils. The Agency searched for soil concentrations in studies conducted in the United States as well as state and national environmental monitoring databases from 2015 to 2025. The only identified soils concentrations above the detection limit were from the State of Washington's Environmental Information Management database (reporting limits ranged from 3.2×10^{-4} to 2,900 mg/kg). These detectable concentrations were mostly associated with historic contamination from underground petroleum storage tanks. Although EPA acknowledges that additional states have environmental monitoring databases, for 1,1,2-trichloroethane, the Agency determined that the data presented are sufficient to characterize exposures via soil. Overall, the monitoring data suggest that for its current uses 1,1,2-trichloroethane is not likely to be present in soils from landfills, biosolids, or air deposition. These monitoring data results agree with the expectations based on the physical and chemical properties of the chemical. The K_{OW} and K_{OC} suggest that 1,1,2-trichloroethane will have moderate to high mobility in soils and will migrate to groundwater. The Henry's Law constant further suggests that 1,1,2-trichloroethane can volatilize from surface soil. Additionally, the fugacity modeling suggests that air deposition is not likely to be a significant pathway for exposure. 1,1,2-trichloroethane is not expected to sorb to biosolids based on its K_{OC} and K_{OW}, with volatilization expected to be the major removal mechanism in WWTPs. Furthermore, based on its current uses, 1,1,2-trichloroethane is not expected to be disposed of in significant quantities in non-hazardous landfills; however, it can be present in landfills due to biodegradation of other chlorinated ethanes, such as 1,1,1,2-tetrachloroethane.

Overall, EPA has moderate confidence that 1,1,2-trichloroethane will be present at low concentrations in soils based on the monitoring data, physical and chemical properties, and release data. EPA therefore did not conduct a quantitative exposure assessment for land pathways for either humans or the environment.

4.1.3.6 Groundwater

1,1,2-Trichloroethane can potentially be in groundwater due to legacy disposal, as a result of biodegradation of 1,1,1,2-tetrachloroethane and other chlorinated ethanes as well as through ongoing uses of 1,1,2-trichloroethane. For the evaluation of groundwater, EPA reviewed available monitoring and release data. The available data support doing a qualitative assessment of exposures via groundwater. The Agency searched peer-reviewed literature, gray literature, and databases of environmental monitoring data to obtain concentrations of 1,1,2-trichloroethane in groundwater. These monitoring data are used to provide context, where possible, for the Agency's decision not to pursue this pathway quantitatively in this draft risk evaluation.

Monitoring data show that 1,1,2-trichloroethane is a commonly detected groundwater pollutant across the United States. Based on state data from California and Washington, EPA has reason to assume that the highest levels of 1,1,2-trichloroethane in groundwater for those states are due to previous contamination—not primarily associated with continuing uses. Such legacy disposals are not within the scope of this assessment. EPA acknowledges that there are other state databases that were not queried as a part of this evaluation; however, the data that have been collected provide strong evidence that the highest levels groundwater contamination are not due to ongoing uses of 1,1,2-trichloroethane. Therefore, EPA determined that querying of other state databases was not necessary for this assessment. Overall, EPA has moderate confidence that exposure to 1,1,2-trichloroethane via groundwater is not likely to occur due to ongoing uses. See the *Draft Human Health and Environmental Hazard Assessment for 1,1,2-Trichloroethane* (U.S. EPA, 2026g) for more detail on the monitoring data considered. Based on the overall weight of evidence, EPA is not considering groundwater exposure to the general population as part of this assessment based on the available data that can be linked directly to ongoing uses of 1,1,2-trichloroethane.

4.1.4 Summary of Exposure via Human Breast Milk for the Oral/Ingestion Route

Infants are a potentially susceptible lifestage because of their higher exposure per body weight, immature metabolic systems, and the potential for chemical toxicants to disrupt sensitive developmental processes. EPA considered exposure and human health hazard information, as well as pharmacokinetic models, to determine how to evaluate infant exposure to 1,1,2-trichloroethane from human milk ingestion. Studies and biomonitoring data demonstrating the presence of 1,1,2-trichloroethane in human or rodent milk have not been identified. Although 1,1,1-trichloroethane has been detected in mother's milk, only the number of incidences were reported—not the concentrations (Pellizzari et al., 1982). While some animal studies indicated developmental toxicity following maternal exposure, no studies have evaluated only lactational exposure from quantified levels of 1,1,2-trichloroethane in milk. In the absence of biomonitoring data and for chemicals with log p values less than 4, such as 1,1,2-trichloroethane (log p = 1.89), milk concentrations are assumed to be driven only by passive transport. There is substantial uncertainty around the assumption of passive transport of 1,1,2-trichloroethane in the absence of data, but in this scenario, additional modeling based on available data and default assumptions will not provide new information or address data gaps.

Similarly, no human or animal physiologically based pharmacokinetic (PBPK) models exist for 1,1,2-trichloroethane with lactation as a route of exposure. Due to this lack of human parameter values, the Sapphire Group PPBK Model was only utilized for oral-to-inhalation route-to-route extrapolation for rats and EPA lacks the appropriate data needed to add and evaluate a lactation route of exposure to infants and validate the modeled results. Additionally, uncertainties arise pertaining to the toxic moiety in infants and whether the model can capture that behavior. 1,1,2-Trichloroethane is lipophilic and distributes preferentially into lipid-rich tissues and would likely partition into breast milk, but the relationship between lipophilicity and milk transfer is not linear. 1,1,2-Trichloroethane also has some water solubility to also partition to the blood and the whole-body half-life is 49.3 minutes in rodents (Takahara, 1986). Furthermore, it is also rapidly metabolized and exhaled; as such, breast milk levels are time-dependent and not reliably predictable without empirical data. Using surrogate parameters from related solvents would introduce compounded structural and parametric uncertainty due to metabolic and partitioning differences. Thus, using a PBPK model to estimate breast milk levels is not feasible in a scientifically robust way and would likely increase uncertainty rather than reduce it.

4.1.4.1 Aggregate and Sentinel Exposure

This assessment evaluated aggregate exposure due to multi-facility contributions to general population exposures. The analysis is discussed in Section 4.1.3.1.4 whereas aggregate risk is discussed in Section 4.3.4.1.4.

4.2 Summary of Human Health Hazard

This section summarizes the human health hazards of 1,1,2-trichloroethane. Additional information on the human health hazards and characterization for 1,1,2-trichloroethane is provided in the *Draft Human Health and Environmental Hazard Assessment for 1,1,2-Trichloroethane* (U.S. EPA, 2026w) and the *Draft Data Quality Evaluation Information for Human Health Hazard Epidemiology for 1,1,2-Trichloroethane* (U.S. EPA, 2026q).

EPA quantitatively evaluated the non-cancer and cancer hazards via the inhalation, oral, and dermal exposure routes for acute, intermediate, and chronic durations through systematic review of reasonably available animal toxicology data; the Agency qualitatively considered human evidence. The Agency rated the data quality of each individual study as high, medium, low, or uninformative for dose-response for 1,1,2-trichloroethane. EPA considered studies that received medium or high overall quality determinations for hazard identification, integration evidence streams (animal, human, mechanistic), and

dose-response analysis. Information from studies of low or uninformative for dose-response quality were considered qualitatively on a case-by-case basis for hazard identification and evidence integration but not utilized quantitatively for dose-response analysis.

Previous human health hazard assessments were conducted by Agency for Toxic Substances and Disease Registry (ATSDR) in 2021 (ATSDR, 2021), EPA Integrated Risk Information System (IRIS) in 1987 (U.S. EPA, 1987), and EPA Provisional Peer-Reviewed Toxicity Values (PPRTV) in 2011 (U.S. EPA, 2011b). This draft TSCA assessment is generally consistent with these authoritative assessments for the regulatory hazard endpoints, toxicology studies, and PODs, as shown below in Table 4-18. The cancer inhalation unit risk value (IUR) has been refined via the application of the PBPK model by The Sapphire Group (Sapphire Group, 2004b) utilizing oral to inhalation route extrapolation based on the oral cancer study results by NCI (NCI, 1978). ATSDR did not assess the chronic scenarios due to the lack of chronic non-cancer studies. The POD is based on the general population exposures of 7 days per week and 24 hours per day. The POD for workers converts this 7 day per week POD value to the 40 hour per week basis.

Table 4-18. Comparison of EPA 2026, ATSDR 2021, and PPRTV 2011 Endpoints and PODs

Scenario	EPA 2026 POD, Study, Rating	ATSDR 2021 POD, Study	PPRTV 2011 POD (Study)	IRIS 1987 POD (Study)
Acute Oral/Dermal	NOAEL HED = 12.6 mg/kg based on neurotoxicity (24–76% decreased motor activity) (WIL Research, 2004), High; A similar study POD NOAEL HED = 11.0 mg/kg is based on liver pathology (increased serum transaminase levels) (Tyson et al., 1983); Total uncertainty factor (UF) = 30	NOAEL HED = 11.0 mg/kg based on liver pathology based on increased serum transaminase levels (Tyson et al., 1983), Medium; Total UF = 100	N/A	WIL Research neurotoxicity study performed after 1987
Intermediate Oral/Dermal	NOAEL HED = 0.52 mg/kg/day based on immunotoxicity (over 40% decrease in hemagglutination titers, biologically and statistically significant) LOAEL = 44 mg/kg NOAEL = 3.9 mg/kg (Sanders et al., 1985), High; Total UF = 30	NOAEL HED = 0.51 mg/kg/day based on immunotoxicity LOAEL = 44 mg/kg NOAEL = 3.9 mg/kg (Sanders et al., 1985) High; Total UF = 100	LOAEL = 44 mg/kg NOAEL = 3.9 mg/kg based on immunotoxicity (Sanders et al., 1985) High; Total UF = 1,000	N/A
Chronic Oral/Dermal	NOAEL HED = 0.52 mg/kg/day based on immunotoxicity LOAEL = 44 mg/kg NOAEL = 3.9 mg/kg (Sanders et al., 1985), High; Total UF = 300	N/A	LOAEL = 44 mg/kg NOAEL = 3.9 mg/kg based on immunotoxicity (Sanders et al., 1985) High; Total UF = 1,000	LOAEL = 44 mg/kg NOAEL = 3.9 mg/kg based on immunotoxicity (Sanders et al., 1985) High; Total UF = 1,000
Acute Inhalation	LOAEC = 316 mg/m^3 (58 ppm) based on nasal necrosis in 4 hours whole body exposure	LOAEC = 316 mg/m^3 (58 ppm) based on nasal necrosis (WIL Research, 2001), High; Total UF = 270	N/A	N/A WIL Research inhalation studies

Scenario	EPA 2026 POD, Study, Rating	ATSDR 2021 POD, Study	PPRTV 2011 POD (Study)	IRIS 1987 POD (Study)
	(WIL Research, 2001), High; Total UF = 100			performed after IRIS 1987
Intermediate Inhalation	$BMCL_{10}$ HEC = 0.62 mg/m^3 (0.11 ppm) based on nasal lesions in a subchronic study (6 hours per day, 5 days per week for 13 weeks) demonstrating progression of toxicity from the acute study POD (WIL Research, 2002), High; Total UF = 30	$BMCL_{10}$ HEC = 0.38 mg/m^3 (0.07 ppm) based on nasal lesions (WIL Research, 2002), High; Total UF = 30	$BMCL_{10}$ HEC = 0.51 mg/m^3 (0.09 ppm) based on nasal lesions (WIL Research, 2002), High; Total UF = 300	N/A WIL Research inhalation studies performed after IRIS 1987
Chronic Inhalation	$BMCL_{10}$ HEC = 0.62 mg/m^3 (0.11 ppm) based on nasal lesions, (WIL Research, 2002), High; Total UF = 300	N/A	$BMCL_{10}$ HEC = 0.51 mg/m^3 (0.09 ppm) based on nasal lesions, (WIL Research, 2002), High; Total UF = 3,000	N/A WIL inhalation studies performed after IRIS 1987
Oral/Dermal Cancer Slope Factor	0.0348 per mg/kg/day based on liver tumors and animal body weights in the study (NCI, 1978), Medium	N/A	0.057 per mg/kg/day based on liver tumors and default animal body weights (NCI, 1978)	0.057 per mg/kg/day based on liver tumors and default animal body weights (NCI, 1978)
Cancer Inhalation Unit Risk	2.98E−06 per µg/m^3 based on liver tumors Oral data PBPK Model Refinement (NCI, 1978), Medium	N/A	1.6E−05 per µg/m^3 based on liver tumors Extrapolation from oral data (NCI, 1978), Medium	1.6E−05 per µg/m^3 based on liver tumors Extrapolation from oral data (NCI, 1978), Medium

ATSDR = Agency for Toxic Substances and Disease Registry; BMC = benchmark concentration; BMCL = lower bound of the benchmark concentration; HEC = human equivalent concentration; HED = human equivalent dose; IRIS = Integrated Risk Information System; LOAEC = lowest-observed-adverse-effect concentration; LOAEL = lowest-observed-adverse-effect level; NOAEL = no-observed-effect level; PB = physiologically-based; PK = pharmacokinetics; POD = point of departure; PPRTV = provisional peer reviewed toxicity values; UF = uncertainty factor

4.2.1 1,1,2-Trichloroethane Absorption, Distribution, Metabolism, Excretion (ADME)

See the *Draft Human Health and Environmental Hazard Assessment for 1,1,2-Trichloroethane* TSD (U.S. EPA, 2026w) for a complete description of pharmacokinetics describing the absorption, distribution, metabolism, and excretion (ADME) of 1,1,2-trichloroethane.

Absorption

1,1,2-Trichloroethane is lipophilic and fat-soluble, indicating that it can be readily absorbed (Reed et al., 1988). Human data show that 1,1,2-trichloroethane is absorbed after inhalation with more than 90% of dose retained in the body within 50 minutes (Morgan et al., 1972, 1970) as cited in (ATSDR, 2021). Animal inhalation and oral studies confirm tissue uptake. Rats exposed to oral 70 mg/kg and mice exposed to oral 300 mg/kg absorbed more than half of the oral dose (Mitoma et al., 1985). 1,1,2-Trichloroethane has a log K_{OW} of 1.89 and water solubility of 4.59 g/L. When mice and rats were exposed to 1,1,2-trichloroethane orally in periodic drinking water, the absorption rate for mice was almost double that than the absorption rate for rats; however, rats were shown to absorb 1,1,2-trichloroethane faster than mice when exposed via corn oil gavage (Sapphire Group, 2002). Studies of

inhalation uptake of similar solvents such as trichloroethylene in species including humans, beagle dogs, rats, and mice suggest that inhalation of 1,1,2-trichloroethane vapors would be about 50% (Raabe, 1986). The high-quality guideline OECD 428 *in vitro* dermal absorption and dermal permeability coefficient (K_p) study utilizing human skin evaluating a wide range of conditions of use (concentrations and vehicles) was performed as a result of a TSCA test order. This study indicated a dermal absorption range of 0.5 to 1.0% for 10% 1,1,2-trichloroethane solution in 1,2-dichloroethane as the vehicle and neat 1,1,2-trichloroethane, respectively (Labcorp Early Development, 2023). A study by Tsuruta (1975) measured a 1,1,2-trichloroethane dermal absorption rate of 130 nmole/min-cm^2 of skin. Per OEHHA (2006), these results were used to estimate a 13.9 mg/minute retention rate in humans exposed to 1,1,2-trichloroethae contact with both hands (Tsuruta, 1975).

Distribution

Inhalation exposures in mice indicated that 1,1,2-trichloroethane has lipid affinity and preferentially distributes into fat, followed by liver and kidney, blood and brain, and other tissues (*e.g.,* spleen, lungs) (Battelle, 2001; Gargas et al., 1989). Limited oral studies confirm 1,1,2-trichloroethane distribution to the liver; detectible levels of the compound were found in livers of rats and mice exposed to single oral doses of 70 and 300 mg/kg 1,1,2-trichloroethane, respectively (Mitoma et al., 1985). 1,1,2-Trichloroethane undergoes extensive metabolism and binds to hepatic proteins in the liver, which can have relevance to the liver damage that might lead to liver tumors (Mitoma et al., 1985). Due to its low molecular weight and lipophilic nature in conjunction with animal studies, 1,1,2-trichloroethane can diffuse into the bloodstream and distributes preferentially to organs and tissues with high fat content (Reed et al., 1988).

Metabolism

Metabolism of 1,1,2-trichloroethane occurs primarily in the liver by cytochrome P-450 and oxidative de-chlorination releases hydrochloric acid (Reed et al., 1988). Metabolic capacity differs between species. Rats and mice metabolized identical proportions (81%) of an oral dose; the absolute amount was higher in mice because their maximum tolerated dose was 4.3% times higher than that of rats (Mitoma et al., 1985). Metabolic studies indicate the production of chloroacetic acid (from 2-chloroacetaldehyde), S-carboxymethylcysteine, and thiodiacetic acid as primary metabolites (Mitoma et al., 1985). However, reactive intermediates are also produced, including an acyl chloride, 2-chloroacetaldehyde, and a free radical, which may bind to proteins and nucleic acids and are considered potentially cytotoxic, genotoxic, and carcinogenic (Mazzullo et al., 1986). Cheever and colleagues published that decreased oxidation of the 2-chloroacetaldehyde metabolite by aldehyde dehydrogenase-2 increases the tumor incidence and increases the blood levels of a similar solvent 1,2-dichloroethane (Cheever et al., 1990).

Excretion

Studies reveal that rodents excrete most of the unchanged 1,1,2-trichloroethane through urinary metabolites and exhaled breath, due to its volatility. Three days after mice were exposed to intraperitoneal 1,1,2-trichloroethane, 73 to 87% of dose was found in urine, 0.1 to 2% in feces, and 16 to 22% in expired air, while 1 to 3% remained in the animal (Yllner, 1971). In another study, 48 hours after rats and mice were exposed to oral 1,1,2-trichloroethane, 72 to 76% of the oral dose was found in the urine, 6.8 to 9.5% was in expired air, and 2.3 to 3.9% remained in the bodies of the rodents (Mitoma et al., 1985). Humans exposed to approximately 5 mg of inhaled [^{38}Cl] 1,1,2-trichloroethane eliminated about 3% of the dose in exhaled breath; less than 0.01% dose per minute was excreted in urine within the first hour after administration, corresponding to an estimated urinary half-life of approximately 70 minutes (Morgan et al., 1970). Overall, despite initial distribution into lipid-rich tissues, 1,1,2-trichloroethane is rapidly cleared and not expected to accumulate in tissues (water solubility of 4.59 g/L).

Physiologically Based Pharmacokinetic (PBPK) Model of 1,1,2-Trichloroethane

A PBPK model for 1,1,2-trichloroethane was initially developed by (Sapphire Group, 2002) under the Final Enforceable Consent Agreement for 1,1,2-Trichloroethane and Accompanying Testing Consent Order, signed by EPA on June 7, 2000. This model was developed under an Enforceable Consent Agreement (Federal Register 65 FR 37550) by the Hazardous Air Pollutants Task Force. EPA re-evaluated the PBPK model and utilized it for oral-to-inhalation route extrapolation. The PBPK model can predict inhalation PODs for rats and mice by extrapolating between oral and inhalation exposure routes and durations associated with exposure scenarios used in the risk evaluation; *i.e.,* predicting the inhalation concentrations necessary to reach internal doses causing hazard resulting from the oral exposure for each toxicity study. The PBPK methods can model inhalation exposures that would equal oral doses for the same liver effect. Thus, the oral toxicology data can be utilized to model the inhalation exposures on a route-to-route basis in animals. The model was validated against available rodent data and utilized with parameters describing rodent physiology, ADME, and biochemistry. Extension of the model to support quantitative animal-to-human extrapolation was not performed due to the lack of data for critical human kinetic parameters, including metabolic parameters to describe saturable metabolism and validated descriptions of metabolic pathways. As a result, because 1,1,2-trichloroethane is metabolically active and internal dose characterization relies on accurate metabolism parameters, development of a human PBPK model would introduce unverified assumptions that could increase model uncertainty and reduce confidence in internal dose metrics.

In lieu of chemical-specific human pharmacokinetic data, HECs were derived from PODs using a regional gas dose ratio (RGDR) value based on inhalation dosimetric modeling across species (U.S. EPA, 1994). PBPK-based oral-to-inhalation route-to-route extrapolation PODs were derived for both cancer and non-cancer endpoints, but non-cancer inhalation PODs were ultimately based on the portal of entry hazard identified in the animal inhalation study (WIL Research, 2001), which was not modeled using PBPK. Thus, it is uncertain whether the inhalation study PODs for portal of entry effects would be human health-protective for systemic effects for other hazards via inhalation exposures and considering that several reactive metabolites are generated in the liver with concerns for genotoxicity (*i.e.,* hydrochloric acid, 2-chloroacetaldehyde, an acyl halide and an akyl free radical). The cancer HEC however, was PBPK-derived utilizing metabolism information. EPA concluded that using the PBPK model for route-to-route extrapolation was preferable to relying on default approaches for the cancer endpoint to estimate inhalation PODs because disposition of 1,1,2-trichloroethane can be characterized better by a PBPK model that accounts for complex ADME profiles vs. default route-to-route assumptions due to the inclusion of chemical-specific information. Furthermore, EPA determined the PBPK model performs well based on model fits to empirical pharmacokinetic data. Thus, utilizing the PBPK methodology is the best available science for route-to-route extrapolation for 1,1,2-trichloroethane and there is robust confidence in its use. See the *Draft PBPK Model Review for 1,1,2-Trichloroethane* (U.S. EPA, 2026ad) for a full description of the model, modeling approach, and sensitivity and uncertainty analysis.

Figure 4-3 shows a plot predicting the log-transformed 1,1,2-trichloroethane blood concentration observations against the simulated 1,1,2-trichloroethane blood concentrations for both the oral and inhalation studies. The model performance was measured using the root mean squared log error (RMSLE). The inhalation model predicted similarly for both mice and rats, with an average RMSLE of 0.33 for both species. The overall oral model RMSLE was 0.22 across both species; the average water vehicle model RMSLE was 0.035 across species while the average corn oil vehicle model RMSLE was 0.3 across species.

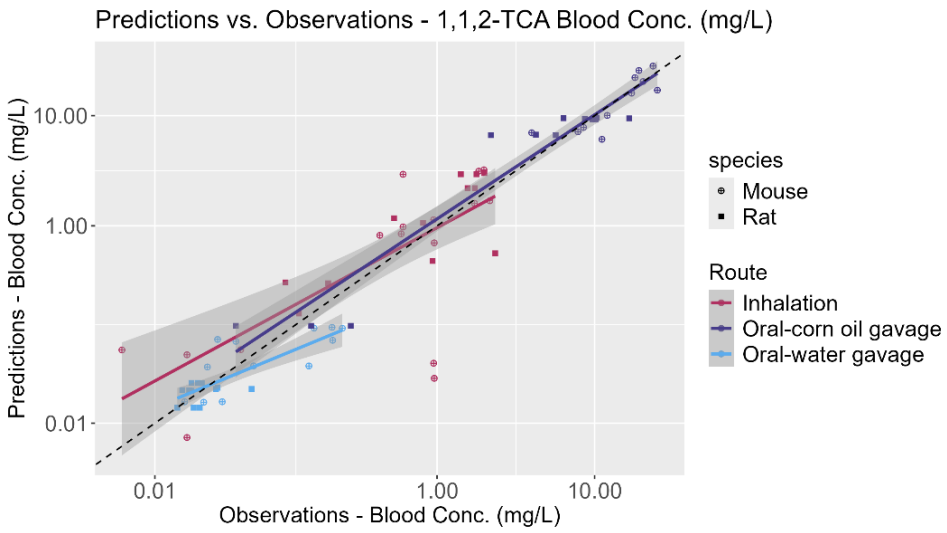

Figure 4-3. Observed vs. Predicted 1,1,2-Trichloroethane Venous Blood Concentrations (mg/L)
Results grouped by route of exposure and species and shown on log-transformed scale. Inhalation exposure in both rats and mice: 100 ppm 1,1,2-trichloroethane for 6 hours a day, 5 days a week, for 4 weeks; blood was collected on days 1, 3, and 5 of week 4. Oral exposure occurred via gavage for 5 days: rats were exposed to 1,1,2-trichloroethane doses of 365.5 mg/kg/day in corn oil or 1.6 mg/kg/day in water and mice were exposed to 1,1,2-trichloroethane doses of 94.2 mg/kg/day in corn oil and 9.7 mg/kg/day in water. All experimental data is from (Battelle, 2001). The predictions are simulations from the PBPK model used for each exposure scenario. The dashed line is the identity line; points that fall on this line have been predicted completely while points that fall above the line have over-predicted and points below the line have under predicted. Shaded regions are 95% confidence bands.

4.2.2 Background

EPA conducted systematic review of the literature covering up to 2025 to identify hazards and PODs for 1,1,2-trichloroethane. Existing authoritative assessments were also considered, such as the 2021 ATSDR assessment (ATSDR, 2021), 1987 IRIS (U.S. EPA, 1987) and the 2011 U.S. EPA PPRTV report (U.S. EPA, 2011b). EPA considered studies of various data quality with high and medium quality data for dose-response POD selection but discussed lower quality studies and studies that are uninformative for dose-response as needed for weight of the scientific evidence and qualitative hazard narratives (U.S. EPA, 2026w). For 1,1,2-trichloroethane, medium- and high-quality animal data were utilized for POD selection because no epidemiology studies were suitable for dose response. For the dermal route, data was extrapolated from oral route applying a dermal absorption factor derived utilizing human skin from a guideline OECD 428 study. Benchmark dose (BMD) analysis was conducted to refine PODs from the no-observed-adverse-effect level (NOAEL) and lowest-observed-adverse-effect level (LOAEL) values as feasible. For the cancer slope factor calculation for the oral and dermal routes, a medium-quality oral cancer study from the National Cancer Institute was utilized based on dose-responsive liver tumors in both sexes of mice (NCI, 1978). For the inhalation unit risk cancer calculation, a peer-reviewed robust PBPK model from The Sapphire Group (Sapphire Group, 2004b) was utilized for the oral to inhalation route extrapolation refinement using data from a medium-quality oral exposure NCI cancer study.

EPA utilized systematic review processes to search, screen, evaluate, extract, and integrate reasonably available information to make conclusions about relevant adverse health effects from 1,1,2-trichloroethane exposure for the oral, dermal, and inhalation routes for the acute, intermediate, and chronic exposure durations. Following evidence integration, EPA performed dose-response analysis to derive hazard endpoint and POD values for use in risk characterization. EPA then evaluated the weight

of scientific evidence for each aspect of the assessment and determined overall confidence ratings for each critical hazard outcome utilizing the best available science as described in Section 4.2.3. The generalized process for conducting human health hazard assessments under TSCA is presented in Section 4.2.3

4.2.3 Weight of Scientific Evidence Conclusions for Human Health Hazards

EPA has confidence in the hazard endpoints and POD values for 1,1,2-trichloroethane which are utilized for risk estimation. This confidence is based on the weight of scientific evidence considering evidence integration across data sources considered in the systematic review, selection of the critical endpoint and study, study quality, relevance to exposure scenarios, dose-response considerations, analogy to other chlorinated solvents, *in vitro* data, *in vivo* data, modeling, statistical analysis, and PESS. Furthermore, the hazard values are based on medium and high-quality toxicology studies from the literature or guideline toxicology studies. BMD modeling and the robust PBPK model by The Saphire Group (Sapphire Group, 2002) provided additional refinement to this assessment (*i.e.,* ADME data in rats and mice in both males and females in the PBPK model for the oral and inhalation routes).

A high-quality guideline OECD 428 *in vitro* dermal absorption study (Labcorp Early Development, 2023) from a TSCA Test Order utilizing human skin allowed the application of oral PODs for the dermal exposure route. This study evaluated a range of conditions of use (4 concentrations and 2 vehicles). There are no route-specific dermal toxicology studies, which leads to some uncertainty in the hazard assessment, such that the medium- to high-quality oral studies are the best available science for the oral-to-dermal route extrapolation, in conjunction with the high-quality dermal absorption study data. The animal study POD values were converted into the human equivalent doses (HEDs) and human equivalent concentrations (HECs) for the appropriate evaluation of human risks for the oral/dermal and inhalation routes, respectively. The acute oral POD is based on route-specific and duration-specific acute oral data from a guideline study with a high systematic review rating based on a common hazard of neurotoxicity for solvents. Therefore, it is the best available science for the acute oral scenario.

The intermediate oral POD is based on a route- and duration-specific subchronic oral data from a study with a high systematic review rating; thus, it is the best available science for the intermediate and chronic oral scenarios. The acute inhalation POD is based on route- and duration-specific acute inhalation data from a guideline study with a high systematic review rating; it is the best available science for the acute inhalation scenario based on a common endpoint of nasal hazards for solvents. The intermediate inhalation POD is based on a route- and duration-specific subchronic inhalation data from a guideline study with a high systematic review rating; it is the best available science for the intermediate and chronic inhalation scenarios based on a common endpoint of nasal hazards for solvents.

The oral cancer slope factor is derived from route-, endpoint-, and duration-specific data with a medium systematic review rating; it is the best available science conducted by NCI based on a common endpoint of liver tumors for the solvents. Although route extrapolation has some uncertainty, the cancer inhalation unit risk is based on the same NCI cancer study data utilizing the best available science, in conjunction with the robust PBPK model by the Sapphire Group for the oral to inhalation route extrapolation. Overall, there is confidence that the endpoint and POD selections are appropriate and human health protective for other hazards identified from the best available science. A summary of the confidence ratings for the studies selected for POD derivation are listed in Table 4-19.

The non-cancer hazard endpoints identified for 1,1,2-trichloroethane were neurotoxicity, respiratory tract pathology, immunotoxicity as measured by hemagglutination titers/antibody forming cells, altered thymus weights, decreased white blood cells, liver pathology, irritation (GHS category 2 dermal

irritation), male reproductive toxicity, body weight changes, and mortality. The cancer endpoint was based on liver tumors in mice in both sexes from an NCI study (NCI, 1978) and supported by 22 positive genotoxicity studies. The hazards utilized for POD selection are listed in Section 4.2.3. The full details on all evaluated health outcomes from all key studies are based on the systematic review documented in *Draft Data Quality Evaluation Information for Human Health Hazard Epidemiology for 1,1,2-Trichloroethane* (U.S. EPA, 2026q), the *Draft Data Quality Evaluation Information for Human Health Hazard Animal Toxicology for 1,1,2-Trichloroethane* (U.S. EPA, 2026p), and the *Draft Human Health and Environmental Hazard Assessment for 1,1,2-Trichloroethane* (U.S. EPA, 2026w).

EPA concluded that 1,1,2-trichloroethane likely causes hazards in the upper respiratory tract (olfactory tissue necrosis and lesions) under relevant exposure circumstances based on evidence in animals from high-quality guideline inhalation studies for the acute duration (WIL Research, 2001) and subchronic duration (WIL Research, 2002), as well as metabolism studies supporting the generation of reactive metabolites. These route-specific studies provide the best available science for inhalation POD selection. These robust guideline inhalation studies (TSCA 799.9135 and TSCA 799.9346) utilized as the basis for dose response includes exposures for both males and females supporting that the portal of entry hazards to the olfactory tissue is the endpoint that is protective for all other hazards identified following inhalation exposures evaluated across a wide range of air concentrations from 0 to 1,527 ppm across both studies.

EPA concluded that 1,1,2-trichloroethane likely causes neurotoxicity based on an OECD 424 acute neurotoxicity guideline gavage study in both male and female rats which had a high-quality rating by the OPPT systematic review process (WIL Research, 2004). There was a 24 to 76% decrease in motor activity within 30 minutes at doses of 95 mg/kg or greater. The study provided a reliable POD for the risk evaluation of the acute oral and dermal routes based on neurotoxicity which is a common hazard for solvents and is supported by the rapid absorption and clearance of 1,1,2-trichloroethane observed in rats, for which peak blood and brain concentrations were reached within an hour, coinciding with rapid effects on motor activity (WIL Research, 2004). The neurotoxicity endpoint is protective for all other acute hazards identified via the oral route. Neurotoxicity hazards were also observed in other 1,1,2-trichloroethane studies such as the optokinetic test alterations (Niklasson et al., 1993) and sedation (White et al., 1985). The indicator of neurotoxicity based on decreased motor activity was also observed for another chlorinated solvent, 1,2-dichloroethane (Zhong et al., 2022). Thus, there is confidence in the study endpoint and POD; therefore, it is the best available science for evaluating the acute oral and dermal scenarios for workers and the general population for 1,1,2-trichloroethane.

EPA concluded that 1,1,2-trichloroethane likely causes intermediate and chronic hazards in the immune system under relevant exposure circumstances based on evidence in animals from a high-quality mouse immunotoxicity study (Sanders et al., 1985). The humoral immunosuppression response to 1,1,2-trichloroethane was measured both by the T-cell 1324 dependent antigen response (TDAR) from blood serum samples based on the hemagglutination titer method and TDAR antibody forming cells (AFC) method based on spleen tissue utilizing sheep red blood cells as the antigen in both assays (Sanders et al., 1985). The subchronic Sanders and colleagues (90-day oral drinking water dosing) study showed a large decrease of the immune response at doses of 44 mg/kg/day or higher (>40% consistently in both sexes) as measured by the specific serum hemagglutination titer assay, which is one method for measuring humoral immunity via the TDAR utilizing sheep red blood cells as the antigen. The TDAR was also shown to be decreased by the secondary TDAR method by 31% in male mice with a shorter 14-day dosing via gavage at the lower dose of 38 mg/kg/day and decreased by 23% at 3.8 mg/kg/day, utilizing the spleen antibody forming cell (AFC) assay that is widely used. The T-cell dependent antigen response is considered a reliable immunotoxicity metric (Luster et al., 1988) and for 1,1,2-

trichloroethane immunosuppression was indicated by both the antibody forming cells assay and the hemagglutination titer assay for measuring TDAR (Sanders et al., 1985). The Sanders study was utilized as the basis for dose-response, which includes exposures for both males and females and is the best available science for the intermediate and chronic POD selection. The immunosuppression endpoint is protective for all other hazards identified following intermediate oral exposures. Other indicators of immune system adverse effects by 1,1,2-trichloroethane are decreased white blood cells in dogs in an inhalation study (Hobara et al., 1984) and the changes in thymus weights in an oral study in mice at 38 mg/kg/day (White et al., 1985).

EPA concluded that 1,1,2-trichloroethane likely causes hazards to the liver based on findings in a literature study by Tyson (Tyson et al., 1983) based on increased serum alanine transaminase (ALT) and aspartate transaminase (AST) levels at 92 mg/kg, which was utilized for the acute oral POD by ATSDR (ATSDR, 2021). Additionally, the high-quality EPA study (Milman et al., 1988) indicated that in the presence or absence of a tumor inducer, subchronic oral gavage dosing of 1,1,2-trichloroethane at 70 mg/kg/day produced abnormal liver histopathology in rats after 7 weeks of dosing as measured by gamma-glutamyltransferase (GGT) staining. In a chronic cancer study (NCI, 1978) liver tumors were produced with linear dose response in both sexes in mice.

EPA concluded that 1,1,2-trichloroethane is likely genotoxic. EPA identified that studies indicate more positive genotoxicity findings than negative findings, which is supported by the mechanistic information in authoritative reports such as the 2021 ATSDR assessment (ATSDR, 2021) and the Sapphire PBPK model (Sapphire Group, 2004a). Overall, 22 genotoxicity studies were positive for 1,1,2-trichloroethane in both *in vitro* and *in vivo* systems as described in the *Draft Human Health and Environmental Hazard Assessment for 1,1,2-Trichloroethane* (U.S. EPA, 2026w). There is robust evidence that 1,1,2-trichloroethane is genotoxic in eukaryotic species, including mammals. Most *in vitro* genotoxicity assays based on eukaryotic models were positive (11 of 15 studies). Most *in vivo* studies were positive for genotoxicity (6 of 10 studies), which is the best available science to represent humans. However, most *in vitro* genotoxicity assays dosed in a water-based system in procaryotic bacterial systems were negative, whereas humans are eukaryotes and worker exposures are typically not water based (*i.e.,* the vehicle in the dermal absorption testing COU is 1,2-dichloroethane).

The database supports that several *in vivo* 1,1,2-trichloroethane rat studies dosed in water also missed important toxicology endpoints (brain, thymus, testes, liver tumor foci, decreased motor activity hazards) observed in gavage studies at lower doses (WIL Research, 2004; Milman et al., 1988; White et al., 1985). These uninformative studies include the reproduction study in rats with a LOAEL of 82.2 mg/kg/day as the highest dose tested (DuPont, 2006), the subchronic neurotoxicity study in rats with a NOAEL of 86 mg/kg/day as the highest dose tested (Dow Chemical, 2005), whereas the developmental study in rats had a study NOAEL of 111 mg/kg/day as the highest dose tested (WIL Research, 2005), which were dosed in water and rated by systematic review as uninformative for dose-response. The maximum tolerated dose in rats was reported to be 100 or 71 mg/kg/day on a continuous 7-day/week basis (Milman et al., 1988). There were concerns for decreased water consumption/dehydration as confounding factors and dose uncertainty in these rat studies. The acute neurotoxicity study with gavage dosing also provided an acute endpoint and POD that is protective for others identified (WIL Research, 2004). The subchronic neurotoxicity in rats with drinking water dosing did not detect decreased motor activity by 24 to 76% in the acute neurotoxicity study in rats with similar doses by gavage. Thus, there is evidence that dosing in water-based systems has decreased sensitivity for this volatile chemical because the drinking water studies in rats missed multiple endpoints detected at lower doses in gavage studies and uncertainty in the actual dose consumed (*i.e.,* decreased water consumption, internal dose < calculated dose).

There was decreased water consumption and dehydration that confounded the dose response thus uninformative for dose-response by systematic review. Similarly, some ecological testing in water based systems measured less than 20% 1,1,2-trichloroethane content on Day 0 (Smithers, 2023). These uninformative studies still had qualitative value for contribution to the weight of scientific evidence for 1,1,2-trichloroethane. However, in mice, the drinking water PODs were similar to the gavage PODs. For example in mice, the LOAEL for immunotoxicity was 44 to 46 mg/kg/day with drinking water dosing (Sanders et al., 1985) and the LOAEL for brain, thymus and testes weight changes was 38 mg/kg/day with gavage dosing (White et al., 1985), with the doses that decreased water consumption were higher than the LOAEL value. With the guideline study dermal absorption results (Labcorp Early Development, 2023), these oral studies can be utilized to assess the dermal exposure risks.

Under the *Guidelines for Carcinogen Risk Assessment* (U.S. EPA, 2005), 1,1,2-trichloroethane is considered "Likely to be Carcinogenic to Humans" based on evidence of increased tumor incidences in both sexes of one species (mice) in the liver and adrenal gland in a medium-quality cancer bioassay (NCI, 1978) and inadequate human evidence of carcinogenicity in two case-control studies (Dosemeci et al., 1999; Kernan et al., 1999). 1,1,2-Trichloroethane qualitatively produced tumors in several tissues in two species, mice and rats, and quantitatively produced tumors in male and female mice in two tissues. Tumors are caused by 1,1,2-trichloroethane quantitatively based on hepatocellular carcinomas and adrenal pheochromocytomas findings in both male and female mice from a well-conducted chronic gavage cancer study by NCI (NCI, 1978). PPRTV (U.S. EPA, 2011b), IRIS (U.S. EPA, 1987) and OEHHA (OEHHA, 2006) also utilized this NCI study to characterize and calculate the oral, dermal and inhalation cancer slope factors for 1,1,2-trichloroethane. Additionally, pre-neoplastic liver foci were found in a high-quality EPA subchronic study in rats dosed via gavage (Milman et al., 1988). The 22 positive genotoxicity results and the immunosuppression findings in separate studies support concern for the tumorigenicity of 1,1,2-trichloroethane via gavage dosing, both recognized mechanisms for tumor formation published by EPA (Hilton et al., 2022). The 22 positive genotoxicity findings as well as the linear dose response for the liver tumors in both male and female mice (linear correlation R of 0.99) both support the linear, low dose approach to the cancer assessment for 1,1,2-trichloroethane.

Note that the cancer study (NCI, 1978) high dose (390 mg/kg/day oral gavage for mice) is above the point at which PBPK model predictions of CYP liver metabolism start to deviate from linearity (approximately 300 mg/kg/day). The lower doses from the cancer study (NCI, 1978) (approximately 195 mg/kg/day) did not saturate metabolism with 33 to 37% liver tumor incidence and the cancer slope factor is based on the standard linear low dose extrapolation. However, the study authors initially dosed mice with 300 mg/kg/day but concluded that this quantity did not exceed the maximum tolerated dose because mice body weights were not markedly affected by treatment. The high dose was subsequently increased from 300 to 400 mg/kg/day for the remaining weeks because the initial dose was insufficient. The NCI study authors concluded that the high dose of 400 mg/mg/day did not exceed the maximum tolerated dose in mice, which is supported by the linear liver tumor dose response. It should also be noted that the cumulative liver cytochrome P450 metabolism of 1,1,2-trichloroethane predicted by the PBPK model is a partial metric and does not capture the complexity of the cancer mechanism of action, including the involvement of other enzymes participating in the clearance of 1,1,2-trichloroethane metabolites (*i.e.,* 2-chloroacetaldehyde by aldehyde dehydrogenase-2) and their role in DNA damage and adduct formation are not explicitly accounted for in the model. The PBPK model identified the amount of 1,1,2-trichloroethane metabolized in the liver as the appropriate model metric which supports the use of the liver tumor findings to calculate the oral slope factor. Overall, this information does not preclude the use of a linear cancer slope factor because the exact metabolite and dose metric for carcinogenicity is uncertain. There is confidence in the 1,1,2-trichloroethane tumor dose response and the cancer slope factor calculations across EPA assessments (U.S. EPA, 2011b, 1987).

Other hazards identified in the 1,1,2-trichloroethane toxicology database include dermal irritation (GHS category 2) and dermal edema (Dow Chemical, 1956), kidney pathology (Plaa and Larson, 1965), decreased body weight, decreased water consumption and decreased food consumption (DuPont, 2006). Additional information on the human health hazards and characterization for 1,1,2-trichloroethane are provided in the *Draft Human Health and Environmental Hazard Assessment for 1,1,2-Trichloroethane* (U.S. EPA, 2026w).

2577 **Table 4-19. Confidence Summary for Selection of the PODs for 1,1,2-Trichloroethane Human Health Hazard Assessment**

Exposure Scenario	Acute			Intermediate			Chronic			Cancer		
	Oral	Inhalation	Dermal	Oral	Inhalation	Dermal	Oral	Inhalation	Dermal	Oral	Inhalation	Dermal
Study and OQD	(WIL Research, 2004), High	(WIL Research, 2001) High	(WIL Research, 2004), High	(Sanders et al., 1985), High	(WIL Research, 2002), High	(Sanders et al., 1985), High	(Sanders et al., 1985), High	(WIL Research, 2002), High	(Sanders et al., 1985), High	(NCI, 1978), Medium	(NCI, 1978), Medium	(NCI, 1978), Medium
POD	NOAEL= 55 mg/kg LOAEL=95 mg/kg Neurotoxicity as decreased motor activity in a guideline acute neurotoxicity study	LOAEC = 316 mg/m^3 (58 ppm) Olfactory tissue necrosis	NOAEL= 55 mg/kg LOAEL=95 mg/kg Neurotoxicity as decreased motor activity in a guideline acute neurotoxicity study	NOAEL = 3.9 mg/kg LOAEL = 44 mg/kg Immunotoxicity as decreased hemagglutination titers	$BMCL_{10}$ = 22.11 mg/m3 (4.05 ppm) BMC_{10} = 31.15 mg/m^3 (5.71 ppm) Olfactory tissue lesions Model selected provided adequate fit	NOAEL = 3.9 mg/kg LOAEL = 44 mg/kg Immunotoxicity as decreased hemagglutination titers	From intermediate duration	From intermediate duration	From intermediate duration	BMDL = 2.87 mg/kg/day BMD = 3.72 mg/kg/day Model selected provided adequate fit	BMCL= 33.54 mg/m^3 BMC = 73.30 mg/m^3 Model selected provided adequate fit	BMDL=2.87 mg/kg/day BMD=3.72 mg/kg/day Model selected provided adequate fit
HED/ HEC/ CSF/ IUR	NOAEL HED = 12.6 mg/kg	LOAECadj HEC = 6.1 mg/m^3 (1.1 ppm)	NOAEL HED = 12.6 mg/kg	NOAEL HED = 0.52 mg/kg/day	BMCL10 HEC = 0.62 mg/m^3 (0.11 ppm)	NOAEL HED = 0.52 mg/kg/day	From intermediate duration	From intermediate duration	From intermediate duration	0.0348 per mg/kg/day	2.98×10^{-6} per $\mu g/m^3$	0.0348 per mg/kg/day
Route-to-route extra-polation	Route-specific data	Route-specific data	From acute oral data	Route-specific data	Route-specific data	From intermediate duration oral	Route-specific data	Route-specific data	From intermed. duration oral data	Route-specific data	From oral data using PBPK model refinement	From oral data
Interspecies consideration	Allometric ¾ BW scaling (PK = 1×, PD = 3×)	Dosimetrically adjusted (PK = 1×, PD = 3×)	Allometric ¾ BW scaling (PK = 1×, PD = 3×)	Allometric ¾ BW scaling (PK = 1×, PD = 3×)	Dosimetrically adjusted (PK = 1×, PD = 3×)	Allometric ¾ BW scaling (PK = 1×, PD = 3×)	Allometric ¾ BW scaling (PK = 1×, PD = 3×)	Dosi-metrically adjusted (PK = 1×, PD = 3×)	Allometric ¾ BW scaling (PK = 1×, PD = 3×)	N/A	N/A	N/A
Intraspecies consideration	Default 10× factor	Default 10× factor	Default 10× factor	Default 10× factor	Default 10× factor	Default 10× factor	Default 10× factor	Default 10× factor	Default 10× factor	N/A	N/A	N/A
Other UFs	N/A	UFL=3	N/A	N/A	N/A	N/A	UFs = 10	UFs = 10	UFs = 10	N/A	N/A	N/A

Exposure Scenario	Acute			Intermediate			Chronic			Cancer		
	Oral	**Inhalation**	**Dermal**	**Oral**	**Inhalation**	**Dermal**	**Oral**	**Inhalation**	**Dermal**	**Oral**	**Inhalation**	**Dermal**
Overall confidence comment	Robust confidence in the duration- and route-specific POD from a study of high OQD	Robust confidence in the duration- and route-specific POD from a study of high OQD	Moderate-to-robust confidence in the POD from a study of high OQD using a default extrapolation approach and applying route-to route extrapolation. A high quality guideline dermal absorption study on human skin was utilized.	Robust confidence in the duration- and route-specific POD from a study of high OQD	Robust confidence in the duration- and route-specific POD from a study of high OQD	Moderate-to-robust confidence in the POD from a study of high OQD using a default extrapolation approach and applying route-to route extrapolation. A high quality guideline dermal absorption study on human skin was utilized.	Moderate-to-robust confidence in the POD from a study of high OQD using a default extrapolation approach and applying a duration extrapolation	Moderate-Robust confidence in the POD from a study of high OQD using a default extrapolation approach	Moderate confidence in the POD from a study of high OQD using a default extrapolation approach and applying a duration extrapolation	Moderate confidence in a duration specific and route-specific data from a study of medium OQD	Moderate confidence in the duration-specific POD from a study of medium OQD using a high quality PBPK model for route to route extrapolation from the oral data.	Slight-to-moderate confidence in the POD from a duration specific study of medium OQD using a default extrapolation approach and applying route-to route extrapolation from oral data. A high quality guideline dermal absorption study on human skin was utilized.

ATSDR = Agency for Toxic Substances and Disease Registry; BMC = benchmark concentration; BMCL = lower bound of the benchmark concentration; BMD = benchmark dose; BMDL = lower bound of the benchmark dose; BW = body weight; CSF = cancer slope factor; HEC = human equivalent concentration; HED = human equivalent dose; IRIS = Integrated Risk Information System; IUR = inhalation unit risk; LOAEC = lowest-observed-adverse-effect concentration; LOAEL = lowest-observed-adverse-effect level; NOAEL = no-observed-effect level; OQD = overall study quality determination; PB = physiologically-based; PD = pharmacodynamics; PK = pharmacokinetics; POD = point of departure; PPRTV = provisional peer reviewed toxicity values; UF_L = LOAEL-to-NOAEL uncertainty factor; UFs = subchronic-to-chronic duration extrapolation

2578

4.2.4 Human Health Hazard Values

The various hazards and PODs utilized in the 1,1,2-trichloroethane risk evaluation are listed below for the acute, intermediate and chronic durations for the oral, dermal and inhalation routes (Table 4-20 and Table 4-22). Guideline studies or medium or high-quality literature studies were utilized for endpoint and POD selection.

Table 4-20. Inhalation Scenarios Endpoints and PODs for 1,1,2-Trichloroethane

Duration	Hazard Effect	Study POD	POD	Uncertainty Factors	Reference, Species, Duration, Route, Study Quality	Confidence Summary
Acute	Olfactory epithelium necrosis	LOAEC = 316 mg/m^3 (58 ppm) in 4 hours	LOAECadj = 52.7 mg/m^3 (9.7 ppm) LOAECadj HEC = 6.1 mg/m^3 (1.1 ppm)	UF_A = 3 UF_H = 10 UF_L = 3 Total = 100	(WIL Research, 2001) F-344 Rats 4 hours, whole body inhalation, Guideline Study TSCA 799.9135 High	Robust
Intermediate	Lesions in olfactory epithelium	BMC_{10} = 31.15 mg/m^3 (5.71 ppm) $BMCL_{10}$ = 22.11 mg/m^3 (4.05 ppm)	$BMCL_{10}$ = 3.95 mg/m^3 (0.72 ppm) $BMCL_{10}$ HEC = 0.62 mg/m^3 (0.11 ppm)	UF_A = 3 UF_H = 10 Total = 30	(WIL Research, 2002) F-344 Rats 13 weeks, 6 hours/day, 5 days/week, whole body inhalation, Guideline Study TSCA 799.9346, High	Robust
Chronic	Lesions in olfactory epithelium	BMC_{10} = 31.15 mg/m^3 (5.71 ppm) $BMCL_{10}$ = 22.11 mg/m^3 (4.05 ppm)	$BMCL_{10}$ = 3.95 mg/m^3 (0.72 ppm) $BMCL_{10}$ HEC = 0.62 mg/m^3 (0.11 ppm)	UF_A = 3 UF_H = 10 UF_S = 10 Total = 300	(WIL Research, 2002) F-344 Rats 13 weeks, 6 hours/day, 5 days/week, whole body inhalation, Guideline Study TSCA 799.9346, High	Moderate-to-robust

BMC = benchmark concentration; BMCL = benchmark concentration lower bound; ppm = parts per million; HEC = human equivalent concentration; LOAEC = lowest observed adverse effect concentration; POD = point of departure; UF_A = interspecies uncertainty factor; UF_H = intraspecies uncertainty factor; UF_L = LOAEL-to-NOAEL uncertainty factor; UF_S = subchronic-to-chronic uncertainty factor

For the acute inhalation scenario, the rat study LOAEC of 58 ppm ($LOAEC_{adj}$ HEC = 6.1 mg/m^3 or 1.1 ppm, total UF = 100) was utilized from the inhalation study by WIL Research (WIL Research, 2001) based on olfactory tissue necrosis (Figure 4-4), for nasal regions IV, V, and VI combined (study page 30). It was selected because it was conducted in a route-specific guideline study with a high-quality rating and this endpoint and POD are protective for all other acute non-cancer hazards identified via the inhalation route and it was determined to represent the best available science for this exposure scenario. The olfactory tissue necrosis incidence was 0 of 10 for the control group, 7 of 10 at 58 ppm and 10 of 10 at 181 ppm also produced a LOAEC value of 58 ppm (nasal level IV results for combined male and female rats). The male and female data was combined because there were only five animals per sex

tested. The data was not amenable to benchmark dose modeling since at the lowest concentration the necrosis far exceeded benchmark response of 10% incidence. The total UF is 100 due to the utilization of a LOAEC value for the POD. The UF_L was reduced to 3 by EPA due to the hazards being considered at minimal effect levels at the LOAEC concentration which was also the conclusion by ATSDR (ATSDR, 2021). Olfactory tissue hazards were also observed in other 1,1,2-trichloroethane inhalation studies (WIL Research, 2002) and in a high-quality study for another chlorinated solvent 1,2-dichloropropane (Dow Chemical, 1983).

Overall, there is robust confidence in this endpoint and POD selection based on a weight of scientific evidence across toxicology studies, chemicals, study quality and authoritative assessments. The conversion of the oral toxicology studies systemic PODs to the corresponding inhalation PODs by the PBPK model (Sapphire Group, 2002) were not as protective as PODs based on the portal of entry hazard identified in the acute WIL study (WIL Research, 2001) which accounts for local effects as well as systemic effects. Furthermore, the PBPK model did not assess portal of entry effects. There were no epidemiology studies identified which supplied dose response information for POD derivation for the acute inhalation scenario.

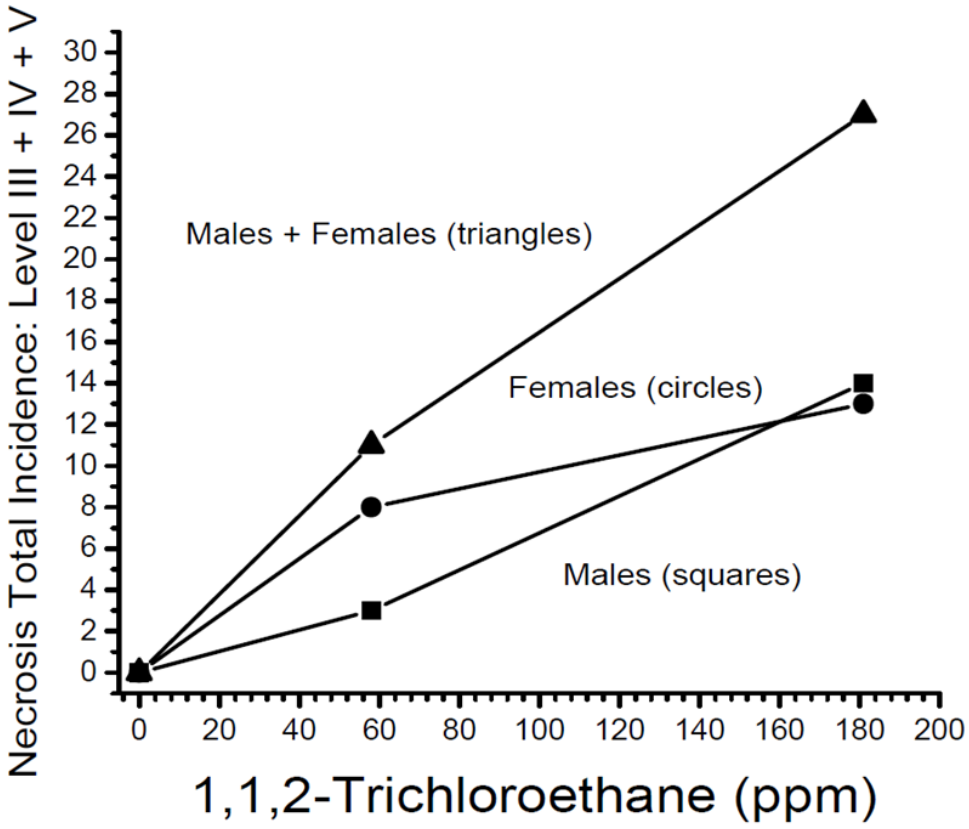

Figure 4-4. Nasal Necrosis Dose Response in Acute Inhalation Study (0–181 ppm)

For the intermediate and chronic inhalation scenarios, the rat study $BMCL_{10}$ = 22.11 mg/m^3 or 4.05 ppm ($BMCL_{10}$ HEC = 0.62 mg/m^3 or 0.11 ppm) was utilized as the POD from a subchronic inhalation study by WIL Research (WIL Research, 2002) based on olfactory tissue vacuolization/cysts (Table 4-21). It was selected because it was conducted in a route-specific guideline study with a high-quality rating and this endpoint and POD are protective for all other non-cancer intermediate hazards identified via the inhalation route and was determined to represent the best available science for this exposure scenario.

The POD in this subchronic study is lower than the POD in the acute inhalation study demonstrating progression of toxicity. The total UF for the intermediate and chronic scenarios are 30 and 300, respectively. The POD is based on the combined olfactory tissue lesions in male and female rats. This intermediate duration inhalation study also had nasal tissue damage as observed in the 1,1,2-trichloroethane acute inhalation study (WIL Research, 2001) and in a high-quality study for another chlorinated solvent 1,2-dichloropropane (Dow Chemical, 1988).

Table 4-21. Incidences of Histopathological Lesions in the Nasal Olfactory Epithelium in Rats Exposed to 1,1,2-Trichloroethane by Inhalation for 90 Days

Nasal Turbinate Lesion	Concentration (ppm)			
	0	15	40	100
Male rats				
Metaplasia	0/10 [a]	1/10	1/10	3/10
Atrophy	0/10	0/10	6/10 [b]	7/10 [b]
Vacuolization/cyst	1/10	2/10	6/10	10/10 [b]
Female rats				
Metaplasia	0/10	0/10	1/10	5/10 [b]
Atrophy	0/10	0/10	7/10 [b]	10/10 [b]
Vacuolization/cyst	1/10	4/10	4/10	8/10 [b]

Source: (WIL Research, 2002)
[a] Number of animals affected/number examined; 6 sections evaluated for each animal.
[b] Statistically significantly different from control ($p < 0.05$) by Fisher's Exact test performed by (U.S. EPA, 2011b).

Overall, there is robust confidence for this hazard and POD selection based on the weight of scientific evidence across toxicology studies, chemicals, study quality and authoritative assessments. The conversion of the oral toxicology studies systemic PODs to the corresponding inhalation PODs by the PBPK model (Sapphire Group, 2002) were not as protective as PODs based on the portal of entry hazard identified in the WIL study (WIL Research, 2002). The PBPK model did not assess portal of entry effects. There were no epidemiology studies identified which supplied dose response information for POD derivation for the intermediate and chronic inhalation scenarios.

Table 4-22. Oral and Dermal Scenario Endpoints and PODs for 1,1,2-Trichloroethane

Duration	Effect	Study POD	NOAEL HED	Uncertainty Factors	Reference, Species, Duration, Route, Study Quality	Confidence Summary
Acute	Neurotoxicity, decreased acute motor activity in rats	LOAEL = 95 mg/kg NOAEL = 55 mg/kg	NOAEL HED = 12.6 mg/kg	UF_A = 3 UF_H = 10 Total = 30	(WIL Research, 2004) Sprague-Dawley Rats Oral, Acute Neurotoxicity Guideline Study OECD 424, High	Oral – Robust Dermal – Moderate-to-Robust
Intermediate	Immunotoxicity, decreased hemagglutination titers in mice	LOAEL = 44 mg/kg/day NOAEL = 3.9 mg/kg/day	NOAEL HED = 0.52 mg/kg/day	UF_A = 3 UF_H = 10 Total = 30	(Sanders et al., 1985) CD-1 Mice 90 days Oral, High	Oral – Robust Dermal – Moderate-to-Robust
Chronic	Immunotoxicity, decreased hemagglutination titers in mice	LOAEL = 44 mg/kg/day NOAEL = 3.9 mg/kg/day	NOAEL HED = 0.52 mg/kg/day	UF_A = 3 UF_H = 10 UF_S = 10 Total = 300	(Sanders et al., 1985) CD-1 Mice 90 days Oral, High	Oral – Moderate-to-Robust Dermal – Moderate

HED = human equivalent dose; LOAEL = lowest-observed-adverse-effect level; NOAEL = no-observed-adverse-effect level; POD = point of departure; UF_A = interspecies uncertainty factor; UF_H = intraspecies uncertainty factor; UF_L = LOAEL-to-NOAEL uncertainty factor; UF_S = subchronic-to-chronic uncertainty factor

For the acute oral and dermal scenarios, the rat study NOAEL of 55 mg/kg (LOAEL = 95 mg/kg, NOAEL HED =12.6 mg/kg, total UF = 30) was utilized from the neurotoxicity study by WIL Research (WIL Research, 2004) based on large acute decreases in motor activity (Figure 4-5). It was selected because it was conducted in an OECD 424 guideline study with a high-quality rating and it is the best available science for these exposure scenarios. This endpoint and POD are protective for all other non-cancer acute hazards identified via the oral and dermal routes. The data was not amenable to benchmark dose analysis due to the shape of the dose response curve. Neurotoxicity hazards were also observed in other 1,1,2-trichloroethane studies such as sedation and optokinetic test alterations ((Niklasson et al., 1993; White et al., 1985), respectively) and for another chlorinated solvent such as 1,2-dichloroethane also having decreased motor activity (Zhong et al., 2022). Overall, there is robust confidence in this hazard selection and POD based on the weight of scientific evidence across toxicology studies, chemicals, study quality and authoritative assessments for the oral route and moderate-to-robust confidence for the dermal route. The acute oral literature study by Tyson (Tyson et al., 1983) has a similar NOAEL of 46 mg/kg and similar LOAEL of 92 mg/kg based on increased serum ALT and AST transaminase levels. There were no epidemiology studies identified which supplied dose response information for POD derivation for the acute oral/dermal scenarios.

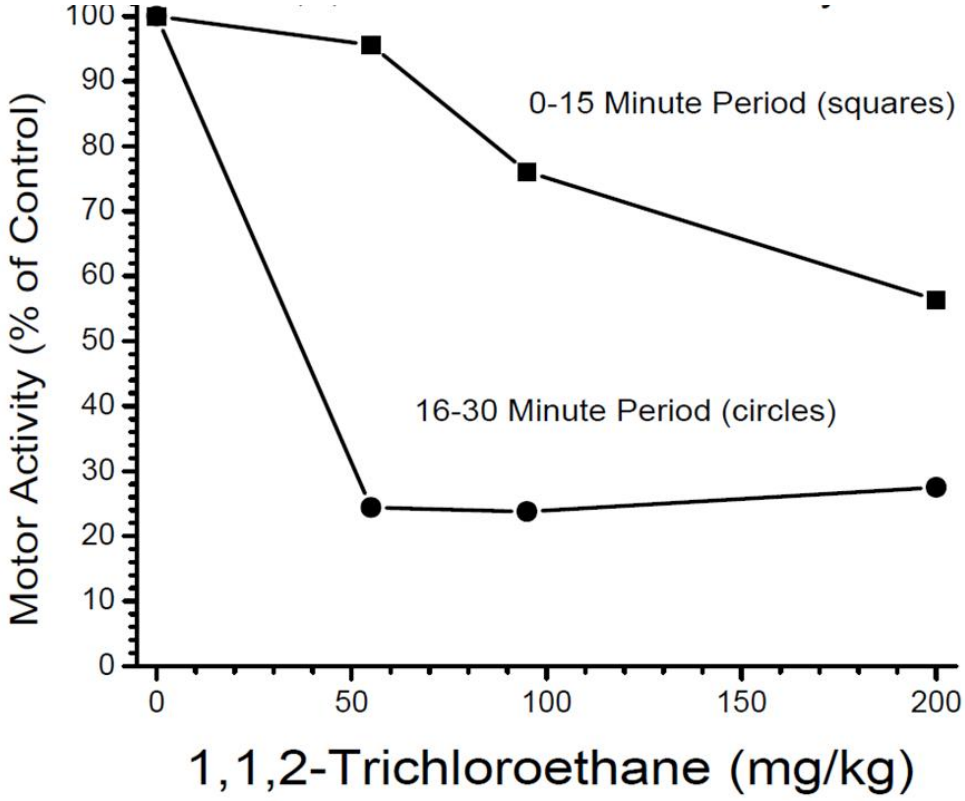

Figure 4-5. Motor Activity in Male Rats, Acute Neurotoxicity Study for 1,1,2-Trichloroethane

For the intermediate and chronic oral/dermal scenarios, the NOAEL was 3.9 mg/kg/day (NOAEL HED = 0.52 mg/kg/day, LOAEL=44 mg/kg/day) was utilized as the POD from a subchronic mouse immunotoxicity study based on decreased hemagglutination titers by over 40% (Sanders et al., 1985) evaluated in both sexes (Figure 4-6). It was selected because it was conducted in a study with a high-quality rating and this endpoint is the best available science and this POD is protective for all other non-cancer intermediate hazards identified via the oral and dermal routes. This intermediate duration POD is lower than the acute duration POD. The White study (White et al., 1985) POD was based on changes in brain, testes and thymus weight effects at a similar dose of 38.0 mg/kg/day and a similar NOAEL value of 3.8 mg/kg/day. The subchronic study (Sanders et al., 1985) with the next ranking oral POD was based on decreased body weight and decreased water consumption in mice at a much higher LOAEL of 305 mg/kg/day and a NOAEL of 46 mg/kg/day. The most sensitive non-cancer chronic study was the reproduction study (DuPont, 2006) with an oral POD based on decreased body weight, decreased food and water consumption in rats at a much higher LOAEL of 82.2 mg/kg/day and a NOAEL of 40.6 mg/kg/day; however, it was uninformative for dose response by the OPPT systematic review. The total UF for the intermediate and chronic scenarios are 30 and 300, respectively. The POD based on immunotoxicity in mice (decreased hemagglutination titers) was also utilized by ATSDR 2021 (ATSDR, 2021) and PPRTV 2011 (U.S. EPA, 2011b) for confidence in this hazard and POD selection as the best available science.

Other supporting indicators of immune system adverse effects by 1,1,2-trichloroethane are the changes in thymus weights in mice at a similar oral gavage dose of 38 mg/kg/day (White et al., 1985) study and decreased white blood cells in dogs in an inhalation study (Hobara et al., 1984). Immunosuppression was also identified in a high-quality study for another chlorinated solvent *trans*-dichloroethylene (Shopp et al., 1985). Overall, for the oral route there is robust confidence in this hazard selection and POD based on the weight of scientific evidence across toxicology studies, chemicals, study quality and authoritative

assessments and that it is protective for other hazards observed at higher doses for the intermediate scenario and moderate-to-robust confidence for the oral chronic scenario. For the dermal route, there is moderate-to-robust confidence for the intermediate scenario and moderate confidence for the chronic scenario. There are no epidemiology studies identified which supplied dose response information for POD derivation for the intermediate and chronic oral/dermal scenarios.

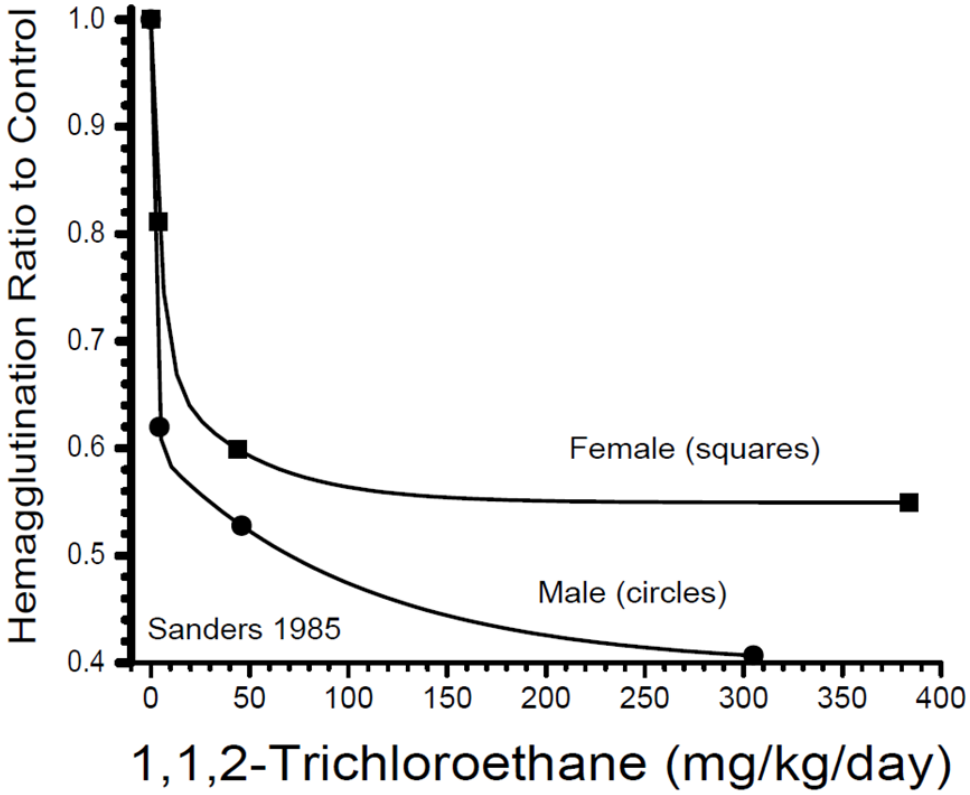

Figure 4-6. Hemagglutination Titers Ratio to Control Values Immunotoxicity in Mice Exposed to 1,1,2-Trichloroethane

EPA used an overall interspecies uncertainty factor (UF_A) of 3 vs. the default value of 10 to account for any toxicodynamic differences across species due to the calculation of human equivalent dose (HED) and human equivalent concentrations (HEC) for POD values. To account for both toxicokinetic and toxicodynamic variation in sensitivity within human populations (which was not accounted for by the PBPK model with animal data), EPA uses a default UF_H of 10 due to limited information regarding the degree to which human variability may impact the kinetics disposition of or impact the hazard response to 1,1,2-trichloroethane and its metabolites, which is consistent with the 95th percentile value published in recent literature (Schneider et al., 2022). The 2-chloroacetaldehyde metabolite of 1,1,2-trichloroethane is a DNA crosslinker (OECD, 2015b) and has been shown to be cleared by aldehyde dehydrogenase-2 (Sharpe and Carter, 1993). In support for 1,1,2-trichloroethane, the reactive 2-chloroacetaldehyde metabolite can be a susceptibility consideration for the subpopulation with the aldehyde dehydrogenase-2 polymorphism with decreased clearance for reactive aldehydes (Gross et al., 2015) and there is no 1,1,2-trichloroethane toxicology or ADME data utilizing an animal model for this polymorphism (U.S. EPA, 2025b).

The subchronic-to-chronic uncertainty factor (UF_S) was set to the default value of 10 due to the lack of 1,1,2-trichloroethane empirical data to calculate another value. This value is consistent within the range of UF_S values published (Dankovic et al., 2015). There are no suitable chronic studies to estimate a

refined UFs value below a factor of 10 to account for extrapolating from data obtained in a study with less-than lifetime (short-term/subchronic) exposure to lifetime (chronic) exposure. For the chronic scenarios, this UF_S was applied to the PODs identified for the intermediate oral and inhalation subchronic studies. As chronic studies from the 1,1,2-trichloroethane database were not identified as suitable for the chronic duration POD, the assumption that effects from a given compound in a subchronic study occur at a 10-fold higher concentration than in a corresponding (but absent) chronic study was applied. This assumption is informed by U.S. EPA (U.S. EPA, 2002). The lack of suitable chronic studies prevented POD selection from a chronic study as well as prevented the estimation of a refined UF_S value. As the chronic oral and dermal scenarios PODs were based on a 90-day subchronic study, the application of the UF_S of 10 for the subchronic-to-chronic duration was considered reasonable and appropriate. The oral and dermal PODs decreased from the acute to the intermediate duration. As the chronic inhalation scenario was based on a 13-week subchronic study the application of the UF_S of 10 for the subchronic-to-chronic duration was considered appropriate and within the range published in the literature (Dankovic et al., 2015). The inhalation POD did decrease from the acute to the intermediate duration based on olfactory tissue hazards (portal of entry effects with minimal ADME factors, 316 vs. 31 mg/m^3 adverse doses). The data indicates that exposures as little as 4 hours can disrupt the olfactory epithelium so the sense of smell warning of hazard is diminished for 1,1,2-trichloroethane. It is uncertain whether the subchronic POD would be protective for chronic exposures and Haber's Rule indicates that a lower POD is supported at longer durations. As the subchronic study POD is being applied to a chronic exposure duration, lowering of the uncertainty factor does not seem justifiable without empirical data to refine this value (U.S. EPA, 2025b).

The LOAEL to NOAEL uncertainty factor (UF_L) was set to 3 instead of the default of 10 for the acute inhalation scenario since the nasal necrosis at the LOAEC was considered to be minimally adverse, as also concluded in the ATSDR report (ATSDR, 2021). The nasal histopathology was considered adverse at the LOAEC, but the study authors considered the effect to be minimal to mild, so it was concluded that an equivalent no-observed-adverse-effect concentration (NOAEC) value would be represented by a concentration three-fold lower. The UF_L was set to 1 for scenarios utilizing a NOAEL, NOAEC, BMDL, or BMCL values.

For the chronic oral/dermal cancer scenarios, the cancer slope factor of 0.0348 per mg/kg/day is utilized based on liver tumors in male mice from a chronic gavage cancer study from NCI (NCI, 1978) (Figure 4-7, Table 4-23). It was chosen for the cancer slope factor since it is a medium quality study based on based on a targeted study monitoring cancer endpoints that represents the best available science. The male cancer slope factor was used since metabolism studies indicate suicide inhibition of metabolism to limit the reactive metabolites in female mice. Thus, the cancer slope factor in male mice is protective for female mice. The inhalation unit risk value of 2.98×10^{-6} per $\mu g/m^3$ was derived from this oral study based on the oral to inhalation route refinement by the robust Sapphire Group PBPK Model (Sapphire Group, 2002) (Table 4-24). The use of a PBPK model factoring in chemical-specific ADME is considered the best available science for oral to inhalation route extrapolation relative to default approaches not having chemical-specific information. This well-conducted NCI study evaluated cancer in multiple tissues in both male and female mice dosed for 78 weeks (NCI, 1978). The incidences of hepatocellular carcinoma in male mice were 2 of 17, 2 of 20, 18 of 49, and 37 of 49 for the untreated control, vehicle control, low-dose, and high-dose groups, respectively. The incidences of hepatocellular carcinomas in female mice were 2 of 20, 0 of 20, 16 of 48, and 40 of 45 for the untreated control, vehicle control, low-dose, and high-dose groups, respectively. In both male and female mice, the liver tumor dose response was linear with statistical significance (*i.e.,* linear correlation coefficient R is 0.99 with R = 1.0 being perfect, $p < 0.001$). This mouse study also found adrenal pheochromocytomas in both sexes.

In support, the high-quality Milman study (Milman et al., 1988) indicated that 1,1,2-trichloroethane produced pre-cancerous liver foci in rats dosed for 7 weeks at 70 mg/kg/day, in the presence or absence of a tumor inducer. A similar chlorinated solvent 1,2-dichloropropane also found liver tumors in a high-quality oral cancer study by the National Toxicology Program (NTP, 1986). Overall, for the oral route there is moderate confidence in this hazard selection and cancer slope factors based on the weight of scientific evidence across toxicology studies, chemicals, study quality and authoritative assessments. For the inhalation route, there is moderate confidence in the inhalation unit risk value utilizing the robust Sapphire Group PBPK model for the oral to inhalation route extrapolation. For the dermal route, there is low to moderate confidence in the cancer slope factor since the PBPK model did not assess the dermal compartment. There were no epidemiology studies identified which supplied dose response information for POD derivation for the cancer scenarios.

Table 4-23. Oral and Dermal Cancer Slope Factors for 1,1,2-Trichloroethane

Mouse Tumor	Oral and Dermal Slope Factor	BMD	BMD_L	Confidence Summary
Male liver, HED input	0.0348 per mg/kg/day	3.72 mg/kg/day	2.87 mg/kg/day	Oral – Moderate
				Dermal – Slight-to-Moderate
BMD = benchmark dose; BMD_L = benchmark dose lower bound; HED = human equivalent dose				

Table 4-24. Cancer Inhalation Unit Risk Values for 1,1,2-Trichloroethane

Mouse Tumor	IUR	BMC	BMC_L	Confidence Summary
Male liver, PBPK HEC input in mg/m^3 from oral data	2.98E−06 per $\mu g/m^3$	73.30 mg/m^3	33.54 mg/m^3	Moderate
Male liver, PBPK HEC input in ppm from oral data	0.0163 per ppm	13.48 ppm	6.14 ppm	
BMC = benchmark concentration; BMC_L = benchmark concentration lower bound; HEC = human equivalent concentration; IUR = inhalation unit risk; ppm = parts per million; ; PBPK = physiologically based pharmacokinetic				

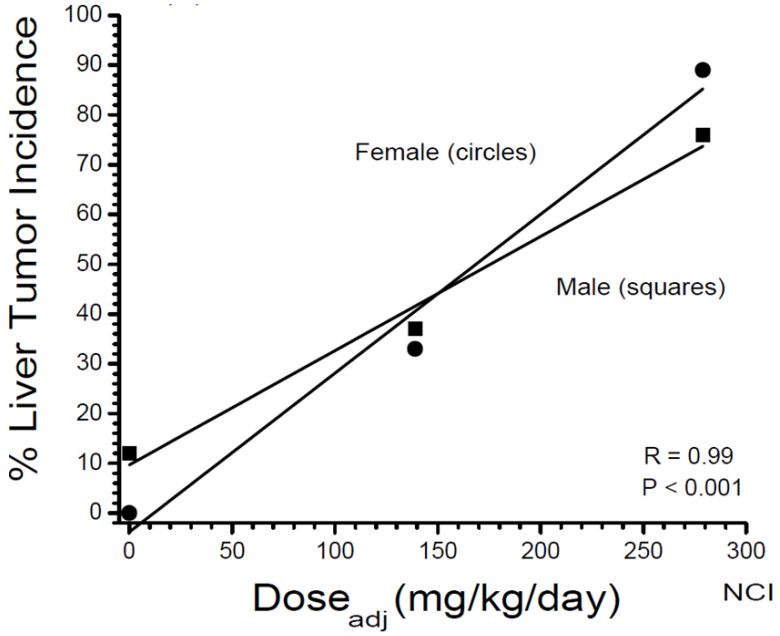

Figure 4-7. Liver Tumor Dose Response in Mice for 1,1,2-Trichloroethane

4.3 Human Health Risk Characterization

4.3.1 Risk Assessment Approach

The exposure scenarios, populations of interest, and toxicological endpoints used for evaluating risks from acute, intermediate, and chronic/lifetime exposures are summarized in Table 4-25.

Table 4-25. Use Scenarios, Populations of Interest, and Toxicological Endpoints Used for Acute and Chronic Exposures

Population of Interest and Exposure Scenario	***Workers*** Male and female adolescents and adults (16+ years) directly working with 1,1,2-trichloroethane under light activity (breathing rate of 1.25 m^3/hour); for further details see the *Draft Human Health and Environmental Hazard Assessment for 1,1,2-Trichloroethane* (U.S. EPA, 2026g) *Exposure Durations* • Acute – 8 hours for a single workday • Intermediate – 8 hours per workday for up to 22 working days • Chronic – 8 hours per workday for up to 250 days per year for 31 or 40 working years, or utilizing industry specific data where applicable *Exposure Routes* – Inhalation and dermal
	Occupational Non-Users Male and female adolescents and adults (16+ years) indirectly exposed to 1,1,2-trichloroethane within the same work area as workers (breathing rate of 1.25 m^3/hour); for further details see the *Draft Human Health and Environmental Hazard Assessment for 1,1,2-Trichloroethane* (U.S. EPA, 2026g) *Exposure Durations* • Acute, Intermediate, and Chronic – Same as workers *Exposure Route* – Inhalation
	Consumers Young teens (11–15 years), teenagers (16–20 years), and adults (21+ years) exposed to 1,1,2-trichloroethane through article use; for further details see the *Draft Human*

	Health and Environmental Hazard Assessment for 1,1,2-Trichloroethane (U.S. EPA, 2026g) *Exposure Durations* • Acute – 1 day exposure • Intermediate – 30 days per year • Chronic – 365 days per year *Exposure Routes* – Inhalation and dermal
	General Population Infants, children, and adults exposed to 1,1,2-trichloroethane through drinking water, ambient water, ambient air, soil, and fish ingestion; for further details see the *Draft Human Health and Environmental Hazard Assessment for 1,1,2-Trichloroethane* (U.S. EPA, 2026g) *Exposure Durations* • Acute – Exposed to 1,1,2-trichloroethane continuously for a 24-hour period • Chronic – Exposed to 1,1,2-trichloroethane continuously up to 78 years *Exposure Routes* – Inhalation, dermal, and oral (depending on exposure scenario)
Health Effects, Hazard Values, and Benchmarks	***Non-Cancer POD*** See Section 4.2.4, Table 4-17, Table 4-18, Table 4-20, Table 4-22, and Table 4-23 for acute and intermediate/chronic non-cancer HECs and HEDs and UFs for each route of exposure and for unoccluded/occluded conditions for the dermal route.[a]
	Most Protective and Robust Non-Cancer Health Effects [b] Protective oral/dermal health effect for the acute scenario: Neurotoxicity HED NOAEL = 12.6 mg/kg; dermal and oral exposure routes Total UF (Benchmark MOE, acute) = 30 (UF_A = 3; UF_H = 10) Protective oral/dermal health effect for intermediate and chronic scenarios: Immunotoxicity HED NOAEL = 0.52 mg/kg/day; dermal and oral exposure routes Total UF (Benchmark MOE, intermediate) = 30 (UF_A = 3; UF_H = 10) Total UF (Benchmark MOE, chronic) = 300 (UF_A =3, UF_H =10, UF_S = 10) Protective inhalation health effect for the acute scenario: Nasal necrosis LOAEC = 316 mg/m^3; inhalation route Total UF (Benchmark MOE, acute) = 100 (UF_A = 3; UF_H = 10; UF_L = 3) Protective inhalation health effect for the intermediate/chronic scenarios: Nasal lesions $BMCL_{10}$ HEC= 0.62 mg/m^3; inhalation route Total UF (Benchmark MOE, intermediate) = 30 (UF_A = 3; UF_H = 10) Total UF (Benchmark MOE, chronic) = 300 (UF_A = 3; UF_H = 10; UF_S = 10)
[a] All values are adjusted for continuous exposure (24 hours/day for inhalation, 7 days/week for all exposure routes).	

4.3.1.1 Estimation of Non-Cancer Risks

EPA used an MOE approach to identify potential non-cancer risks. The MOE is the ratio of the non-cancer hazard value (or point of departure (POD) divided by a human exposure dose. The chronic MOEs for non-cancer inhalation risks were calculated using Equation 4-2.

Equation 4-2. Margin of Exposure Calculation

$$MOE = \frac{Non-cancer\ Hazard\ Value\ (POD)}{Human\ Exposure}$$

Where:

MOE	=	Margin of exposure for acute, short-term, or chronic risk comparison (unitless)
Non-cancer Hazard Value (POD)	=	Human equivalent concentration (HEC, µg/m^3)
Human Exposure	=	Exposure estimate (µg/m^3)

MOE risk estimates may be interpreted in relation to benchmark MOEs. Benchmark MOEs are typically the total uncertainty factor for each non-cancer POD. The MOE estimate is interpreted as a starting point for evaluating human health risk of concern if the MOE estimate is less than the benchmark MOE (*i.e.,* the total UF) for the lowest tier of analysis and can be refined following further analysis. If the MOE estimate is equal to or exceeds the benchmark MOE, the exposure pathway is not analyzed further. Typically, the larger the MOE, the more unlikely it is that a non-cancer adverse effect occurs relative to the benchmark. When determining whether a chemical substance presents unreasonable risk to human health or the environment, calculated risk estimates are not "bright-line" indicators of unreasonable risk, and EPA has the discretion to consider other risk-related factors in addition to risks identified in the risk characterization.

4.3.1.2 Estimation of Cancer Risks

Extra cancer risks for repeated exposures to a chemical were estimated using Equation 4-3.

Equation 4-3.

$$Lifetime\ Cancer\ Risk = Human\ Exposure \times IUR$$

or

$$Dermal\ or\ Oral\ Cancer\ Risk = Human\ Exposure \times \mathrm{CSF}$$

Where:

Human Exposure	=	Exposure estimate (LADC in ppm or µg/m^3; LADD in mg/kg-day)
IUR	=	Inhalation unit risk (risk per unit of exposure (ppm or µg/m^3)
CSF	=	Cancer slope factor (risk per mg/kg-day)

Estimates of extra cancer risks are interpreted as the incremental probability of an individual developing cancer over a lifetime following exposure (*i.e.,* incremental or extra individual lifetime cancer risk). EPA considers a range of extra cancer risk from 1×10^{-4} to 1×10^{-6} to be relevant benchmarks for risk assessment (U.S. EPA, 2017b). Consistent with NIOSH guidance (Whittaker et al., 2016), under TSCA EPA typically applies a 1×10^{-4} benchmark for occupational scenarios in industrial and commercial workplace environments subject to OSHA requirements. EPA typically considers the general population and consumer benchmark for cancer risk to be within the range of 1×10^{-4} to 1×10^{-6}. Again, it is important to note that these benchmarks are not bright-lines and EPA uses discretion, based on all the available information, to determine whether unreasonable risks are likely based on other risk-related considerations. Exposure-related considerations (*e.g.,* duration, magnitude, population exposed) can affect EPA's estimates of the excess lifetime cancer risk.

4.3.2 Risk Estimates for Workers

This section presents the preliminary risk estimates associated with the levels of occupational inhalation and dermal exposure that have been estimated. EPA evaluated risk for acute, intermediate, chronic non-cancer, and cancer effects and risk estimates for each are included. The risk estimates are presented in Section 4.3.2.1.

Where possible, EPA has considered reasonably available information on PPE (*e.g.,* respirators, gloves) in characterizing the risk estimates for workers. EPA notes that OSHA and NIOSH recommend employers utilize the hierarchy of controls to address hazardous exposures in the workplace. The hierarchy of controls strategy outlines, in descending order of priority, the use of elimination, substitution, engineering controls, administrative controls, and lastly PPE (such as respirators or gloves). The hierarchy of controls prioritizes the most effective measures first which is to eliminate or substitute the harmful chemical (*e.g.,* use a different process, substitute with a less hazardous material), thereby preventing or reducing exposure potential. Following elimination and substitution, the hierarchy recommends engineering controls to isolate employees from the hazard (*e.g.,* source enclosure), followed by administrative controls (*e.g.,* do not open machine doors when running), or changes in work practices (*e.g.,* maintenance plan to check equipment to ensure no leaks) to reduce exposure potential. Administrative controls are policies and procedures instituted and overseen by the employer to limit worker exposures (additional information is included in the *Draft Chemistry, Fate, Release, and Exposure Assessment for 1,1,2-Trichloroethane* (U.S. EPA, 2026g)). The use of PPE should be the last means of control to reduce exposures.

4.3.2.1 Occupational Inhalation Exposure Risk Characterization

This section provides a summary table of preliminary inhalation risk estimates (Table 4-27), as well as a discussion of the risk characterization per OES. Table 4-27 provides occupational inhalation MOEs with and without PPE. Additionally, this table provides a potential minimum assigned protection factor (APF) required for an MOE to be above the non-cancer benchmark or below the cancer benchmark (depending on the expected workplace activity). In addition to the use of respirators that achieve a minimum APF, these benchmarks may be met by implementation of other exposure controls (*e.g.*, engineering controls) that may be equally or more effective in reducing worker exposure.

The Agency gathered information on PPE applicable to the OESs assessed in this draft risk evaluation that was available in sources such as test orders, EPA-developed GSs and OECD ESDs, NIOSH HHEs, and SDSs. EPA provided a summary and analysis of reasonably available information on PPE by OES in Sections 4.3.2.1.1 through 4.3.2.1.13. Additional information on respiratory protection and APFs is provided below.

Discussion of Respirator Assigned Protection Factors (APFs)

OSHA's Respiratory Protection Standard (29 CFR 1910.134) requires employers in certain industries to address workplace hazards by implementing engineering control measures and, if these are not feasible, provide respirators that are applicable and suitable for the purpose intended. Respirator selection provisions are provided in 1910.134(d) and require that appropriate respirators are selected based on the respiratory hazard(s) to which the worker will be exposed and workplace and user factors that affect respirator performance and reliability. Assigned APFs are provided in Table 1 under 1910.134(d)(3)(i)(A) (see also Table 4-26 below) and refer to the level of respiratory protection that a respirator or class of respirators is expected to provide to employees when the employer implements a continuing, effective respiratory protection program according to the requirements of OSHA's Respiratory Protection Standard.

Table 4-26. Assigned Protection Factors (APFs) for Respirators in OSHA Standard 29 CFR 1910.134

Type of Respirator	Quarter Mask	Half Mask	Full Facepiece	Helmet/ Hood	Loose-Fitting Facepiece
1. Air-Purifying Respirator	5	10	50	–	–
2. Power Air-Purifying Respirator (PAPR)	–	50	1,000	25/1,000	25
3. Supplied-Air Respirator (SAR) or Airline Respirator					
• Demand mode	–	10	50	–	–
• Continuous flow mode	–	50	1,000	25/1,000	25
• Pressure-demand or other positive-pressure mode	–	50	1,000	–	–
4. Self-Contained Breathing Apparatus (SCBA)					
• Demand mode	–	10	50	50	–
• Pressure-demand or other positive-pressure mode (*e.g.*, open/closed circuit)	–	–	10,000	10,000	–
Source: 29 CFR 1910.134(d)(3)(i)(A)					

Table 4-27. Occupational Inhalation Risk Summary Table

COU		OES	Exposure Group	Exposure Level	Acute Non-Cancer (Benchmark MOE = 100)		Intermediate Non-Cancer (Benchmark MOE = 30)		Chronic Non-Cancer (Benchmark MOE = 300		Chronic Cancer (Benchmark = 1E−04) [a]	
Life Cycle Stage	Category/ Subcategory				MOE – No PPE [b]	MOE – APF [c]	MOE – No PPE [b]	MOE – APF [c]	MOE – No PPE [b]	MOE – APF [c]	No PPE [b]	APF [c]
Manufacturing	Domestic manufacture / Domestic manufacture	Manufacturing as a Byproduct in Chemical Manufacturing	Operator / Process Technicians [d]	CT	353	–	48	–	**51**	515 (APF 10)	4.0E−06	–
				HE	**18**	178 (APF 10)	**2.4**	61 (APF 25)	**2.6**	2,602 (APF 1,000)	**2.9E−04**	2.9E−05 (APF 10)
			Laboratory technicians [e]	CT	9,757	–	1,330	–	1,424	–	1.4E−07	–
				HE	**50**	499 (APF 10)	**6.8**	68 (APF 10)	**7.3**	364 (APF 50)	**1.0E−04**	1.0E−05 (APF 10)
			Logistics / Distribution Technicians [f]	CT	3,142	–	429	–	459	–	4.4E−07	–
				HE	**43**	430 (APF 10)	**5.9**	59 (APF 10)	**6.3**	314 (APF 50)	**1.2E−04**	1.5E−05 (APF 10)
			Maintenance technicians [g]	CT	1.1E04	–	1,480	–	1,585	–	1.3E−07	–
				HE	**6.1**	153 (APF 25)	**0.83**	42 (APF 50)	**0.89**	891 (APF 1,000)	**8.5E−04**	8.5E−05 (APF 10)
			ONU	CT	1.4E04	–	1,853	–	1,984	–	3.6E−07	–
				HE	420	–	57	–	**61**	614 (APF 10)	1.5E−05	–
Manufacturing	Import	Repackaging for Laboratory Chemical Use (Modeled)	Worker	CT	**33**	325 (APF 10)	**5.5**	55 (APF 10)	**5.9**	5,899 (APF 1,000)	**1.1E−04**	1.1E−05 (APF 10)
				HE	**5.3**	133 (APF 25)	**0.89**	45 (APF 50)	**0.95**	953 (APF 1,000)	**7.4E−04**	7.5E−05 (APF 10)
Processing	Repackaging		ONU	CT	**33** [h]	325 (APF 10)	**5.5** [h]	55 (APF 10)	**5.9** [i]	5,899 (APF 1,000)	**1.1E−04**	1.1E−05 (APF 10)

COU		OES	Exposure Group	Exposure Level	Acute Non-Cancer (Benchmark MOE = 100)		Intermediate Non-Cancer (Benchmark MOE = 30)		Chronic Non-Cancer (Benchmark MOE = 300		Chronic Cancer (Benchmark = 1E−04) [a]	
Life Cycle Stage	Category/ Subcategory				MOE – No PPE [b]	MOE – APF [c]	MOE – No PPE [b]	MOE – APF [c]	MOE – No PPE [b]	MOE – APF [c]	No PPE [b]	APF [c]
Processing	Processing – As a reactant / Intermediate in: Plastic manufacturing Intermediate in: Petro-chemical manufacturing Intermediate in: All other chemical product manufacturing Recycling	Processing as a Reactant (Non-Isolated Byproduct)	Operator / Process Technicians	CT	353	–	48	–	51	515 (APF 10)	1.4E−05	–
				HE	**18**	178 (APF 10)	**2.4**	61 (APF 25)	**2.6**	2,602 (APF 1,000)	**3.5E−04**	3.5E−05 (APF 10)
			Laboratory technicians	CT	9,757	–	1,330	–	1,424	–	5.0E−07	–
				HE	**50**	499 (APF 10)	**6.8**	68 (APF 10)	**7.3**	364 (APF 50)	**1.3E−04**	1.3E−05 (APF 10)
			Logistics / Distribution Technicians	CT	3,142	–	429	–	459	–	1.5E−06	–
				HE	**43**	430 (APF 10)	**5.9**	59 (APF 10)	**6.3**	314 (APF 50)	**1.5E−04**	1.5E−05 (APF 10)
			Maintenance technicians	CT	1.1E04	–	1,480	–	1,585	–	4.5E−07	–
				HE	**6.1**	153 (APF 25)	**0.83**	42 (APF 50)	**0.89**	891 (APF 1,000)	**1.0E−03**	4.1E−05 (APF 25)
			ONU	CT	1.4E04	–	1,853	–	1,984	–	3.6E−07	–
				HE	420	–	57	–	**61**	614 (APF 10)	1.5E−05	–
Processing	Incorporation into a formulation, mixture, or reaction product / Formulation of adhesives and sealants	Formulation of Adhesives and Sealants	Operator / Process Technicians	CT	353	–	48	–	**51**	515 (APF 10)	4.0E−06	–
				HE	**18**	178 (APF 10)	**2.4**	61 (APF 25)	**2.6**	2,602 (APF 1,000)	**2.9E−04**	2.9E−05 (APF 10)
			Laboratory Technicians	CT	9,757	–	1,330	–	1,424	–	1.4E−07	–
				HE	**50**	499 (APF 10)	**6.8**	68 (APF 10)	**7.3**	364 (APF 50)	**1.0E−04**	1.0E−05 (APF 10)
			Logistics / Distribution Technicians	CT	3,142	–	429	–	459	–	4.4E−07	–
				HE	**43**	430 (APF 10)	**5.9**	59 (APF 10)	**6.3**	314 (APF 50)	**1.2E−04**	1.5E−05 (APF 10)
			Maintenance technicians	CT	1.1E04	–	1,480	–	1,585	–	1.3E−07	–
				HE	**6.1**	153 (APF 25)	**0.83**	42 (APF 50)	**0.89**	891 (APF 1,000)	**8.5E−04**	8.5E−05 (APF 10)
			ONU	CT	1.4E04	–	1,853	–	1,984	–	3.6E−07	–
				HE	420	–	57	–	**61**	614 (APF 10)	1.5E−05	–

COU		OES	Exposure Group	Exposure Level	Acute Non-Cancer (Benchmark MOE = 100)		Intermediate Non-Cancer (Benchmark MOE = 30)		Chronic Non-Cancer (Benchmark MOE = 300		Chronic Cancer (Benchmark = 1E−04) [a]	
Life Cycle Stage	Category/ Subcategory				MOE – No PPE [b]	MOE – APF [c]	MOE – No PPE [b]	MOE – APF [c]	MOE – No PPE [b]	MOE – APF [c]	No PPE [b]	APF [c]
Industrial Use	Adhesives and sealants / Adhesives and sealants	Industrial Use of Adhesives and Sealants	Worker	CT	**1.1**	1,078 (APF 1,000)	**0.15**	147 (APF 1,000)	**0.16**	1,574 (APF 10,000)	**4.5E−03**	9.0E−05 (APF 50)
				HE	**0.12**	124 (APF 1,000)	**1.7E−02**	170 (APF 10,000)	**1.8E−02**	N/A [j]	**5.1E−02**	5.1E−05 (APF 1,000)
			ONU	CT	**5.4**	135 (APF 25)	**0.74**	37 (APF 50)	**0.79**	787 (APF 1,000)	**9.0E−04**	9.0E−05 (APF 10)
				HE	**4.9**	123 (APF 25)	**0.67**	33 (APF 50)	**0.72**	715 (APF 1,000)	**1.3E−03**	5.1E−05 (APF 25)
Commercial Use	Adhesives and Sealants / Adhesives and Sealants	Use of Adhesives and Sealants (1:1)	Worker	CT	**1.1**	1,078 (APF 1,000)	**0.15**	147 (APF 1,000)	**0.16**	1,574 (APF 10,000)	**4.5E−03**	9.0E−05 (APF 50)
				HE	**0.12**	124 (APF 1,000)	**1.7E−02**	170 (APF 10,000)	**1.8E−02**	N/A [j]	**5.1E−02**	5.1E−05 (APF 1,000)
			ONU	CT	**5.4**	135 (APF 25)	**0.74**	37 (APF 50)	**0.79**	787 (APF 1,000)	**9.0E−04**	9.0E−05 (APF 10)
				HE	**4.9**	123 (APF 25)	**0.67**	33 (APF 50)	**0.72**	715 (APF 1,000)	**1.3E−03**	5.1E−05 (APF 25)
		Use of Adhesives and Sealants (9:1)	Worker	CT	**9.5**	237 (APF 25)	**1.3**	32 (APF 25)	**1.4**	1,386 (APF 1,000)	**5.1E−04**	5.1E−05 (APF 10)
				HE	**1.1**	1,105 (APF 1,000)	**0.15**	151 (APF 1,000)	**0.16**	1,614 (APF 10,000)	**5.7E−03**	5.7E−06 (APF 1,000)
			ONU	CT	**49**	485 (APF 10)	**6.6**	66 (APF 10)	**7.1**	354 (APF 50)	**1.0E−04**	1.0E−05 (APF 10)
				HE	**44**	437 (APF 10)	**6.0**	60 (APF 10)	**6.4**	319 (APF 50)	**1.4E−04**	1.4E−05 (APF 10)
		Use of Adhesives and Sealants (5:1)	Worker	CT	**5.3**	132 (APF 25)	**0.72**	0.72 (APF 36)	**0.77**	770 (APF 1,000)	**9.2E−04**	9.2E−05 (APF 10)
				HE	**0.61**	614 (APF 1,000)	**8.4E−02**	84 (APF 1,000)	**9.0E−02**	897 (APF 10,000)	**1.0E−02**	1.0E−05 (APF 1,000)
			ONU	CT	**27**	270 (APF 10)	**3.7**	37 (APF 10)	**3.9**	3,935 (APF 1,000)	**1.8E−04**	1.8E−05
				HE	**24**	243 (APF 10)	**3.3**	233 (APF 10)	**3.5**	3,541 (APF 1,000)	**2.6E−04**	2.6E−05 (APF 10)

COU		OES	Exposure Group	Exposure Level	Acute Non-Cancer (Benchmark MOE = 100)		Intermediate Non-Cancer (Benchmark MOE = 30)		Chronic Non-Cancer (Benchmark MOE = 300		Chronic Cancer (Benchmark = 1E−04) [a]	
Life Cycle Stage	Category/ Subcategory				MOE – No PPE [b]	MOE – APF [c]	MOE – No PPE [b]	MOE – APF [c]	MOE – No PPE [b]	MOE – APF [c]	No PPE [b]	APF [c]
Industrial Use	Solvents (for cleaning and degreasing) / Solvents (for cleaning and degreasing)	Use of Cleaning and Degreasing Solvents (Open-Top Vapor Degreasing)	Worker	CT	**0.77**	770 (APF 1,000)	**0.11**	105 (APF 1,000)	**0.11**	1,124 (APF 10,000)	**6.3E−03**	6.3E−06 (APF 1,000)
				HE	**5.8E−02**	578 (APF 10,000)	**7.9E−03**	79 (APF 10,000)	**8.4E−03**	N/A [j]	**0.11**	1.1E−05 (APF 10,000)
			ONU	CT	**77**	770 (APF 10)	**11**	105 (APF 10)	**11**	562 (APF 50)	6.3E−05	–
				HE	**0.90**	898 (APF 1,000)	**0.12**	123 (APF 1,000)	**0.13**	1,312 (APF 10,000)	**7.0E−03**	7.0E−06 (APF 1,000)
		Use of Cleaning and Degreasing Solvents (Cold Cleaning)	Worker	CT	**0.53**	534 (APF 1,000)	**7.3E−02**	73 (APF 1,000)	**7.8E−02**	780 (APF 10,000)	**9.1E−03**	9.1E−06 (APF 1,000)
				HE	**0.32**	317 (APF 1,000)	**4.3E−02**	43 (APF 1,000)	**4.6E−02**	463 (APF 10,000)	**2.0E−02**	2.0E−05 (APF 1,000)
			ONU	CT	**0.53** [h]	534 (APF 1,000)	**7.3E−02** [h]	73 (APF 1,000)	**7.8E−02** [i]	780 (APF 10,000)	**9.1E−03**	9.1E−06 (APF 1,000)
Commercial Use	Other use / Laboratory chemical	Use of Laboratory Chemicals	Worker	CT	4,146	–	565	–	605	–	1.2E−06	–
				HE	**21**	213 (APF 10)	**2.9**	73 (APF 25)	**3.1**	3,106 (APF 1,000)	**3.0E−04**	3.0E−05 (APF 10)
			ONU	CT	4,146 [h]	–	565 [h]	–	605 [i]	–	1.2E−06	–

COU		OES	Exposure Group	Exposure Level	Acute Non-Cancer (Benchmark MOE = 100)		Intermediate Non-Cancer (Benchmark MOE = 30)		Chronic Non-Cancer (Benchmark MOE = 300		Chronic Cancer (Benchmark = 1E−04) [a]	
Life Cycle Stage	Category/ Subcategory				MOE – No PPE [b]	MOE – APF [c]	MOE – No PPE [b]	MOE – APF [c]	MOE – No PPE [b]	MOE – APF [c]	No PPE [b]	APF [c]
Disposal	Disposal / Disposal	Disposal to Incineration – Logistics technician	Worker	CT	3,142	–	429	–	459	–	1.5E−06	–
				HE	**43**	430 (APF 10)	**5.9**	59 (APF 10)	**6.3**	314 (APF 50)	**1.5E−04**	1.5E−05 (APF 10)
			ONU	CT	3,142 [h]	–	429 [h]	–	459 [i]	–	1.5E−06	–
		Disposal to Incineration – Maintenance technician	Worker	CT	1.1E04	–	1,480	–	1,585	–	4.5E−07	–
				HE	**6.1**	153 (APF 25)	**0.83**	42 (APF 50)	**0.89**	891 (APF 1,000)	**1.0E−03**	4.1E−05 (APF 25)
			ONU	CT	1.1E04 [h]	–	1,480 [h]	–	1,585 [i]	–	4.5E−07	–
		Disposal to Landfill	Worker	CT	1.1E06	–	1.6E05	–	1.7E05	–	4.3E−09	–
				HE	3.1E05	–	4.2E04	–	4.5E04	–	2.0E−08	–
			ONU	CT	1.1E06	–	1.6E05	–	1.7E05	–	4.3E−09	–
		Disposal to POTW, Non-POTW WWT (1,1,2-Trichloroethane Specific)	Worker	CT	**75**	750 (APF 10)	**10**	100 (APF 10)	**11**	550 (APF 50)	6.5E−05	–
				HE	**38**	380 (APF 10)	**5.2**	52 (APF 10)	**5.5**	5,550 (APF 1,000)	**1.7E−04**	1.7E−05 (APF 10)
			ONU	CT	2.0E04	–	2,749	–	2,943	–	2.4E−07	–
				HE	2.0E04	–	2,749	–	2,943	–	3.1E−07	–
		Disposal to POTW, Non-POTW WWT (Surrogate)	Worker	CT	**40**	400 (APF 10)	**5.4**	54 (APF 10)	**5.8**	5,800 (APF 1,000)	**1.2E−04**	1.2E−05 (APF 10)
				HE	**7.7**	770 (APF 10)	**1.1**	55 (APF 50)	**1.1**	1,100 (APF 1,000)	8.2E−04	8.2E−05 (APF 10)
			ONU	CT	121	–	**16**	160 (APF 10)	**18**	900 (APF 50)	4.0E−05	–
				HE	**43**	430 (APF 10)	**5.8**	58 (APF 10)	**6.2**	310 (APF 50)	**1.5E−04**	1.5E−04 (APF 10)

APF = assigned protection factor; CT = central tendency; HE = high-end; MOE = margin of exposure; PPE = personal protective equipment
"–" = inhalation APF not needed, N/A = not applicable
[a] For the Manufacturing as a Byproduct OES, EPA calculated the cancer estimates using Vinyl Institute provided data on years of service for workers at manufacturing facilities (8.9 years central tendency; 33 years high-end) (EPA-HQ-OPPT-2018-0427-0181). For all other OES, EPA calculated cancer estimates using working years from the Bureau of Labor Statistics (BLS) data (31 years central tendency; 40 years high-end) (U.S. Census Bureau, 2019; U.S. BLS, 2014).
[b] Risk estimates that exceed the benchmark (*i.e.,* non-cancer risks less than the risk benchmark and cancer risks exceeding the cancer risk benchmark) are **bolded and shaded**.
[c] APF listed in parentheses is the level of protection needed for estimated MOEs to be above benchmark.
[d] The test order generally indicated that operators wore half-face air purifying respirators during open loop sample tasks (APF 10), and full-face air purifying respirators during other tasks (APF 50). Use of a respirator was documented for only a subset of workers monitored in the test order study. Additional details are provided in Section 4.3.2.1.1.

COU		OES	Exposure Group	Exposure Level	Acute Non-Cancer (Benchmark MOE = 100)		Intermediate Non-Cancer (Benchmark MOE = 30)		Chronic Non-Cancer (Benchmark MOE = 300		Chronic Cancer (Benchmark = 1E−04) [a]	
Life Cycle Stage	Category/ Subcategory				MOE – No PPE [b]	MOE – APF [c]	MOE – No PPE [b]	MOE – APF [c]	MOE – No PPE [b]	MOE – APF [c]	No PPE [b]	APF [c]

[e] The test order generally indicated that laboratory technicians wore full-face air-purifying respirators during handling and disposing of hazardous waste (APF 50). Use of a respirator was documented for one worker monitored in the test order study; other samples were not associated with the waste disposal task. Additional details are provided in Section 4.3.2.1.1.
[f] The test order generally indicated that logistics technicians wore half- or full-face respirators during loading or offloading tasks which required connecting and disconnecting process lines to railcars, barges, and trucks (APF 10 or 50). Use of a respirator was documented for a subset of workers monitored in the test order study, including workers with the highest full-shift and task-based exposures. Additional details are provided in Section 4.3.2.1.1.
[g] The test order generally indicated that maintenance technicians wore full-face airline respirators of APF 1,000 during major maintenance tasks (*e.g.,* line breaks and other equipment openings). Use of a respirator was documented for a subset of workers monitored in the test order study. Additional details are provided in Section 4.3.2.1.1.
[h] Where EPA was not able to estimate ONU inhalation exposure from monitoring data or models, ONU inhalation exposures were assumed to be equivalent to the central tendency experienced by workers for the corresponding OES.
[i] High-end and central tendency exposure days are the same for the following OES: Processing (repackaging), Use of cleaning and degreasing solvents (cold cleaning), Commercial laboratory use, and Waste handling, treatment, and disposal (250 days/year); therefore, chronic non-cancer exposure estimates are the same.
[j] Risk relative to benchmarks was still indicated when the highest potential APF was applied (10,000).

2889

4.3.2.1.1 OES for Manufacturing as a Byproduct in Chemical Manufacturing

Inhalation Exposure Estimates

As described in Section 4.1.1.1.2, EPA estimated inhalation exposure based on inhalation monitoring data provided to EPA via a test order submission from the Vinyl Institute, which includes manufacturers of 1,1,2-trichloroethane (Stantec ChemRisk, 2024). The monitoring was collected across four manufacturing facilities where 1,1,2-trichloroethane is produced as an unintended, non-isolated byproduct during the manufacture of another chemical. Because the Vinyl Institute Consortium did not identify any companies that manufacture 1,1,2-trichloroethane intentionally, it was not assessed by EPA as an OES. The monitoring was conducted according to an EPA approved study plan and exposure data was collected for four worker SEGs as well as for ONUs.

The test order monitoring study included 116 full-shift PBZ worker samples. Of these, 21 full-shift samples were below the limit of detection (range from $<6\times10^{-5}$ ppm to $<7\times10^{-5}$ ppm). The number of full-shift samples (and number of non-detects) for each SEG was as follows: 49 operators (0 non-detects [NDs]), 29 laboratory technicians (1 ND), 15 logistic technicians (4 ND), and 23 maintenance technicians (7 ND). For the ONUs, there were 29 full-shift samples with 11 as non-detects. In all cases, non-detects were assessed at the LOD/2. EPA notes that while some SEGs had a high percentage of non-detects (27–38%), the limit of detection [LOD] is well below the occupational exposure value (OEV, 0.001 ppm, Appendix G). EPA considered utilizing different methods for replacing values below the LOD, but various methods to replace values below the LOD had no impact on the 50th and 95th percentile inhalation estimates (see Appendix H for additional discussion).

Additionally, the test order monitoring study included 95 task length samples collected across all worker SEGs; sample duration ranged from 8 to 352 minutes. Results of these samples were not utilized quantitatively for risk evaluation purposes, as full-shift samples were available for all SEGs, and are most appropriate for use in the risk assessment based on the identified health effects (as described in Section 4.2). EPA also notes that OSHA and NIOSH have not identified or set a short term occupational exposure limit for 1,1,2-trichloroethane (for additional information on occupational exposure limits see Appendix G). Task-based samples were considered qualitatively, as these provide additional context for the results of the full-shift monitoring data. For example, EPA considered information on the frequency and duration of tasks, and whether these tasks drive the results of the full-shift exposure. EPA also considered the use of respiratory protection during specific tasks (including high exposure tasks), and how this may potentially impact the full-shift exposure monitoring. Task-based samples were not collected for ONUs.

EPA rated the weight of scientific evidence as robust for this OES. The primary strengths include the use of personal breathing zone samples directly applicable to this OES, which are preferrable to other assessment approachers and the high number of samples available for workers and ONUs. EPA used full-shift PBZ air concentration data to assess inhalation exposures, with the data source having a high data quality rating from the systematic review process. Another strength is that the data used from Vinyl Institute were 1,1,2-trichloroethane specific from multiple facilities that manufacture the chemical as a byproduct. Additionally, monitoring data was collected for multiple SEGs.

EPA assumed up to 250 days/year of exposure for each SEG based on test order data which indicated that each of the SEGs had tasks that could be performed “daily” combined with assumptions of 50 weeks per year and 5 days per week. The actual maximum number of exposure days for an individual worker within an SEG may be less than 250 days, and there is evidence from the inhalation monitoring

study that not all tasks with high exposure potential are performed with a daily frequency during the working year.

In calculating cancer risks, EPA utilized estimates of working years utilizing industry provided data on length of service (years) for workers at the facilities monitored as part of the test order (central tendency [also "CT"] of 8.9 years and high-end ["HE"] of 33 years).

For this OES, generally EPA considers that high-end exposure and risk estimates are most appropriate for consideration of shorter duration exposures (acute intermediate), while central tendency values are more representative for chronic exposures. The Agency has lower confidence that high-end inhalation exposures are representative for chronic non-cancer and cancer inhalation exposure estimates, because it is unlikely that a worker would experience the high-end concentration repeatedly across days and years. Inhalation monitoring data was available for each SEG and indicate that workers in an exposure group experience a range of potential exposure concentrations, and that not all high exposure tasks are performed daily during the working year. EPA utilized information on specific worker tasks, including the results of task-based monitoring data as well as information on frequency and duration of tasks and use of respiratory protection during specific tasks, to provide context to the risk estimates. This is discussed below in the "Distribution of Inhalation Monitoring Data within Specific SEGS" and "Information on Use of Respiratory Protection" sections.

Estimates of occupational inhalation risks are presented in Table 4-27. Where the estimated MOE is below the benchmark value, an indication of the respiratory APF needed to mitigate risk is also provided. In the case of test orders, there is information available on the use of respiratory protection work by workers during the inhalation monitoring study. This information is discussed below "Information on Use of Respiratory Protection."

Information on Use of Respiratory Protection and Distribution of Inhalation Monitoring Data Within Specific SEGs

Data were available in the test order summary report on respiratory protection used at the monitored facilities. EPA has considered how information on reported use of respiratory protection may inform interpretation of risk estimates for each SEG below. Additionally, where relevant, EPA considered the distribution of inhalation monitoring data within each SEG, and how that might impact the resulting risk estimates.

Operators: Based on the available information, use of task-based respiratory protection was documented during 13 out of 49 (26%) of the full-shift samples collected on operators during the inhalation monitoring study. Usage of a respirator was indicated for four of the 20 highest full-shift sample concentrations, including 2 out of 3 highest full-shift sample concentrations (but not the highest full-shift sample concentration). Additionally, use of a respirator was noted for 20 of 38 task-based samples. Use of respiratory protection was not indicated for the top-five highest task-based exposure concentrations (0.13–1.6 ppm, sample duration range: 15–100 minutes). The task-length samples where respiratory protection usage was indicated corresponded to the full-shift samples where respiratory protection usage was indicated, as these samples were collected concurrently. In many casesm multiple short-term samples were collected on a worker during the full-shift, indicating that when respiratory protection was documented as being worn it may have been worn for multiple tasks throughout the full-shift. Operators were reported to wear half-face air-purifying during open loop sample collection tasks and full-face respirators during other tasks such as process leak response activities. These respirators correspond to potential APF of 10 or 50, when utilized under a continuing, effective respirator program (as required by 29 CFR 1910.134).

Based on the available information, only a subset (≈25%) of workers in this SEG were documented as wearing respiratory protection, and usage of respirators does not correspond to the highest full-shift or task-length exposures reported in this SEG. EPA notes 1,1,2-trichloroethane is produced as a byproduct at these manufacturing facilities and usage of a respirator may be dictated by exposures to other chemicals, such as the primary chemical being manufactured. All monitored concentrations were below current regulatory limits.

Although workers in these SEGs were generally described as wearing respirators during certain tasks, based on the available data, the majority of the samples indicated respiratory protection was not being utilized by workers in this SEG. EPA did not have sufficient evidence to indicate that workers in this SEG wear respiratory protection on a consistent basis. In particular, use of a respirator was not associated with the highest exposure monitored full-shift or task-based exposures. As such, EPA has confidence that the inhalation exposure estimates for these SEGs are reflective of worker exposures without the consideration of potential effects of respirator usage, and that the inhalation exposure estimates are not likely to be overly conservative. Potential acute, intermediate, and cancer risks relative to applicable benchmarks were indicated at the high-end exposure only. Potential chronic, non-cancer risks relative to applicable benchmarks were indicated at central tendency and high-end exposures, as described below.

Laboratory Technicians: For laboratory technicians, EPA notes that the two highest full-shift exposure measurements in this SEG were approximately 7 to 8 times higher than the next full-shift exposure measurement (0.054, 0.048, and 0.0065 ppm). However, the two highest sample concentrations were not identified as outliers by the study authors and are considered representative of measured concentrations at the high-end exposure distribution for this SEG. For the logistics technician SEG, EPA also notes that the highest full-shift exposure concentration was over 5 times greater than the next highest full-shift exposure concentration (0.1 and 0.02 ppm). This sample (0.1 ppm) was identified as an outlier at 5% significance by the final study report—though it was noted that it was "determined to represent true measurements at the high end of the exposure distribution" and was not excluded from the study report analysis. EPA also did not exclude this sample from the evaluation in this draft risk evaluation because it is a measured concentration that represents a plausible exposure in the high-end range for this SEG.

Certain laboratory personnel were described as wearing full-face air purifying respirators during disposal of hazardous wastes (APF 50). Additionally, it was noted that laboratory workers may wear half-face respirators during preparation of dry standards on a benchtop, but that this specific task was not observed during the inhalation study. Use of task-specific respiratory protection was documented during one of 29 full-shift samples (0.002 ppm). Additionally, use of a dust mask was documented on a task-length sample collected on another worker in this SEG. As such, there is limited evidence that workers in this SEG wore respirators during the inhalation monitoring that was performed, at central-tendency or high-end exposures estimates. EPA has confidence that the inhalation exposure estimates for these SEGs are reflective of worker exposures without the consideration of potential effects of respirator usage, and that the inhalation exposure estimates are not likely to be overly conservative. For this SEG, potential risks relative to applicable benchmarks were not indicated at chronic, non-cancer or cancer central tendency exposures. Potential acute and intermediate risks relative to applicable benchmarks were indicated at the high-end exposure only.

Logistics Technicians: Use of task-based respiratory protection was documented for 9 out of 15 (60%) of the full-shift samples collected on logistics technicians during the inhalation monitoring study. This included seven of the eight highest full-shift concentrations, including the two highest concentrations. Respiratory protection was documented for all 7 of 13 task-length samples. Respiratory protection was

noted for the three of the four highest task length sample (range: 0.079–2.9 ppm; duration range: 15–55 minutes), including the highest task length sample. Logistics technicians were noted as wearing half-face or full-face respirators during specific tasks, which would correspond to an APF of 10 or 50 APF. Based on the available information, the majority of logistics technicians were documented as wearing respiratory protection during the highest exposure concentrations on a full-shift (7/8) and task-length basis (3/4), documented for all high-exposure potential tasks. For this SEG, potential risks relative to applicable benchmarks were not indicated at chronic, non-cancer or cancer central tendency exposures. Potential acute and intermediate risks relative to applicable benchmarks were indicated at the high-end exposure only.

EPA also notes that the highest full-shift exposure concentration was over 5 times great than the next highest full-shift exposure concentration (0.1 and 0.02 ppm). This sample (0.1 ppm) was identified as an outlier at 5% significance by the final study report, though it was noted that it was "determined to represent true measurements at the high end of the exposure distribution" and was not excluded from the study report analysis. EPA also did not exclude this sample from the evaluation in this draft risk evaluation, as this is a measured concentration that represents a plausible exposure in the high-end range for this SEG. Additionally, the highest task-based exposure concentration (2.9 ppm) was several orders of magnitude above the next highest concentration (0.16 ppm). EPA considers that the evidence that this exposure concentration is an outlier, in combination with the evidence that workers wear PPE at the highest exposure tasks, indicates that the high-end exposure estimates may be an overestimation of worker exposures, particularly for acute duration exposures (one 8-hour day). For this SEG, EPA considered reasonably available information on PPE as well as the high-end outlier exposure, which influenced EPA's reliance on high-end exposure estimates in the risk determination (see Section 6.1.3).

Maintenance Technicians: A high level of variation was observed within the full-shift sample results collected on maintenance technicians. A geometric standard deviation of 25 was reported for this SEG. EPA notes a bimodal distribution of measured concentrations with two ranges: an upper range of 0.008 to 0.037 ppm and a lower range of 0.0002 ppm to below the LOD (<0.0001 ppm). The upper-bound range captures exposure potential during maintenance work on equipment such as compressors and reboilers during line breaks. The Vinyl Institute noted that these tasks occur with a frequency of once per month to four times per year. EPA notes that the high-end inhalation estimate is driven by infrequent tasks, and as such, the Agency considers the high-end intermediate, chronic non-cancer, and cancer estimates overly conservative as they include multiple conservative assumptions.

It was generally reported that maintenance technicians wore full-face airline respirators of APF 1,000 during major maintenance tasks (*e.g.,* line breaks and other equipment openings). Use of task-based respiratory protection was documented for 3 of 23 full-shift samples collected on maintenance technicians. Of the 17 task-length samples collected on maintenance technician workers, respiratory protection usage was documented on 8 samples. Respiratory protection usage was not noted on any of the six highest task-length samples.

Due to the lack of reported use of respirators for this SEG, EPA has confidence that the inhalation exposure estimates for these SEGs are reflective of worker exposures without the consideration of potential effects of respirator usage. While workers in these SEGs were generally noted as wearing respirators during certain tasks, the highest full-shift exposures of 1,1,2-trichloroethane were not associated with these tasks, and only a few examples of respiratory protection use were documented in association with the airborne inhalation monitoring that was performed. In particular, use of a respirator was not associated with the highest exposure monitored full-shift or task-based exposures. For this SEG, potential risks relative to applicable benchmarks were not indicated at chronic, non-cancer or cancer

central tendency exposures. Potential acute and intermediate risks relative to applicable benchmarks were indicated at the high-end exposure only. As described above, EPA has lower confidence in the high-end intermediate risk estimates, as these are driven by tasks that occur infrequently (up to once per month), and thus, it is not expected that workers would have high-end inhalation exposures during the entire intermediate duration (22 working days during a 30-day exposure period).

ONUs: According to the final study report, ONUs utilized standard process area PPE when conducting walk-throughs or tasks in process areas. Based on the test order sampling results, task-based respiratory protection (documented by a yes/no response) was reported for 21% of the full-shift samples collected on ONUs (6 of 29 full-shift samples). Specifically, respiratory protection was documented for the 6 of the 13 highest full-shift sample concentrations, but not for the 4 highest full-shift sample concentrations. Task-based samples were not collected on ONUs. The specific types of respirator protection worn by ONUs were not reported in the final study report or in the raw sample results; however, EPA's understanding is that the respiratory protection utilized will vary by process area and task. For ONUs, potential risks relative to applicable benchmarks were not indicated at high-end acute or intermediate exposures, or at chronic, non-cancer, or cancer central tendency exposures. Although high-end chronic, non-cancer estimates were below the MOE of 300, EPA has lower confidence in use of high-end estimates for chronic exposures, as previously described.

4.3.2.1.2 OES for Manufacturing as a Byproduct in Pulp and Paper Industry

As previously described in Table 4-27, EPA did not perform a quantitative assessment. Although release data were available for this OES, occupational exposures were not quantitatively evaluated due to a lack of identified inhalation monitoring data and generic scenarios. EPA did assess occupational exposures from byproducts formed unintentionally in the OES of Manufacturing as a Byproduct from Chemical Manufacturing (as described above in Section 4.3.2.1.1). The Agency considers that exposure data from the Manufacturing as a Byproduct at Chemical Manufacturing Facilities OES may be appliable to this OES, with lower confidence. As noted in the executive summary public input section, EPA seeks additional information on occupational exposure potential for this OES, including process description, airborne exposure concentrations of 1,1,2-trichloroethane, and use of PPE and controls.

4.3.2.1.3 OES for Repackaging for Laboratory Chemical Use

Inhalation Exposure Estimates

EPA's evidence for import and repackaging for 1,1,2-trichloroethane is based on data on imports from a laboratory chemical distributor. Laboratory chemicals are distributed in small containers; EPA assumes that there is a repackaging step from the import containers into the smaller size containers of 1 gallon or less for laboratory use. Import of smaller size containers would not involve repackaging and these containers would go directly to laboratory settings for use (which is assessed under the Commercial Use of Laboratory Chemicals OES in Section 4.3.2.1.8).

EPA did identify data on logistics technicians at 1,1,2-trichloroethane manufacturing facilities from the test order. These workers perform tasks related to receiving and shipping chemicals, such as connecting and disconnecting hoses. This data is considered applicable for assessing a bulk repacking scenario but not analogous for the repackaging into small size laboratory containers where the number of containers filled on a daily basis and exposure duration would be greater than bulk repackaging of 1 or 2 containers.

As a result, the Agency estimated inhalation exposures using a modeling approach. The basis for the modeling approach is an EPA Generic Scenario on Repackaging, which includes a process description where sources and activities with a potential for release and exposure are identified. The generic

scenario provides an estimation approach for each source and recommends default parameters for each model parameter if specific data is not available.

For estimating inhalation exposure, the model estimates the vapor generation rate of the chemical being emitted from a source, such as container loading and unloading activity. The model then estimates the airborne concentration that results from the emission. EPA uses this value to approximate the exposure concentration to a worker who performs the tasks. Generally, the models recommended in the generic scenario to estimate air releases and exposure concentrations are the standard EPA/OPPT models used in ChemSTEER.

EPA used a probabilistic modeling approach with Monte Carlo in executing the model. The Agency defined a range of values and distribution types for the release and exposure parameters in the model. The model was executed with 100,000 iterations with each iteration representing a different combination of values. The number of iterations was set at 100,000 as a sufficient number for the model results to converge on the values for the exposure distribution. EPA uses the 50th percentile results to represent the central tendency exposure and the 95th percentile to represent the high-end exposure.

EPA assessed exposure for this scenario for the generic SEGs of workers and ONUs. Worker activities for these SEGs are described in Table 4-2. The model estimates the exposures to the workers but does not estimate exposure to ONUs. Therefore, EPA assumed ONU exposure is equal to the workers central tendency to estimate the ONU inhalation exposure.

For this modeling approach, the facility throughput in kg/site-year is a key determinant in the level of exposure. The throughput impacts the amount of chemical repackaged each day, the number of containers repackaged, and as a result the amount of time that it takes to repackage. Throughput also impacts the number of exposure days. In the absence of data on the repackaging of 1,1,2-trichloroethane into smaller containers such as for laboratory chemical use, EPA made conservative assumptions to estimate the facility throughput. Specifically, the Agency utilized the default values suggested in the Chemical Repackaging Generic Scenario. More detail is described in Section 4.2.3.2 of the *Draft Chemistry, Fate, Release and Exposure Assessment for 1,1,2-Trichloroethane Technical Support Document* (U.S. EPA, 2026g).

The model estimates the exposure and time duration for a single worker activity. EPA combined the results from several worker activities in estimating the workers 8-hour TWA exposure, assuming that the same worker can perform more than one task with a potential for exposure in a given day. The Agency assumes that the exposure for the remaining part of the worker's day is zero. For this scenario, EPA combined the exposures for the worker activities of drum emptying, container filling, and drum cleaning. In this particular case, the total exposure time estimated by the model time was up to 0.43 hour/day with the remaining time as zero exposure.

EPA rates the weight of scientific evidence as slight-to-moderate for the modeling scenario. The strengths are in the use of the generic scenario as the foundation of the model and the use of EPA/OPPT exposure models in conjunction with Monte Carlo modeling. As with any exposure modeling approach, a key exposure determinant is the facility throughput, and there is uncertainty in the value selected for this parameter and its applicability to 1,1,2-trichloroethane repackaging into smaller containers. Overall, EPA considers the central tendency results as suitable for risk determination. Use of the high-end estimate in consideration of the uncertain and conservative assumption of throughput (as previously discussed) may be overly conservative for this purpose.

Although the model considers a range of values for general building ventilation, it does not consider more specific engineering controls that may be used around an emission source such as local exhaust ventilation. Also, consistent with monitoring data, the model estimates the exposure concentrations near the worker's breathing zone and does not consider exposure reduction that results from the use of respiratory protection. The inhalation exposure results from the modeling are provided in Table 4-6. Estimation of chronic non-cancer and cancer risks include values for exposure frequency and working years. For this scenario, exposure frequency was estimated in the model using the site throughput and container volume resulting in an exposure frequency ranging from 24 days/year to 119 days/year. EPA used data from the U.S. Bureau of Labor Statistics (BLS) and U.S. Census as a basis for the working years. In modeling inhalation exposures using a Monte Carlo simulation, EPA applies a triangular distribution for working years based on the BLS data with a lower bound of 10.4 years, an upper bound of 44 years, with a mode of 36 years.

The occupational inhalation risk estimates are provided in Table 4-27. EPA found acute, intermediate, and chronic non-cancer inhalation estimates below the benchmarks of 100, 30, and 300, respectively, for workers for both the central tendency (50th percentile) and high-end (95th percentile) exposure levels when not accounting for PPE usage. EPA also found inhalation cancer risk estimates greater that 1×10^{-4} for workers for both central tendency (50th percentile) and high-end (95th percentile) exposure levels when not accounting for PPE usage. For ONUs, EPA only presents risk estimates for central tendency exposures. The Agency found acute, intermediate, and chronic non-cancer risk estimates for ONUs below the benchmarks of 100, 30, and 300, respectively, and cancer risk estimates above 1×10^{-4} when not accounting for PPE usage. In Table 4-27, where the estimated MOE is below the benchmark value for non-cancer and cancer risk is greater than 1×10^{-4}, an indication of the respiratory APF needed to mitigate risk is provided.

Information on Use of Respiratory Protection

EPA did not identify reasonably available information on PPE usage in repackaging for small containers scenarios.

4.3.2.1.4 OES for Processing as a Reactant

Inhalation Exposure Estimates

As described in Section 4.1.1.1.2, EPA did not identify inhalation exposure monitoring data related to 1,1,2-trichloroethane processing as a reactant. The Agency used worker exposure data at 1,1,2-trichloroethane manufacturing (unintended, non-isolated byproduct) facilities as an analogous scenario for use of 1,1,2-trichloroethane as a reactant. As discussed previously, EPA did not find evidence of 1,1,2-trichloroethane being produced as a primary product—only as a byproduct. Manufacturers will reclaim value of the byproduct streams and process as a reactant to make other chemicals.

As previously described in the byproduct Manufacturing OES, the test order provided 116 full-shift samples for workers and 29 full-shift samples for ONUs; 21 worker and 11 ONU samples were below the limit of detection ($<6\times10^{-5}$ to $<7\times10^{-5}$ ppm) (Section 4.1.1.1.2). Workers were categorized into exposure groups of operators, logistics technicians, maintenance technicians, laboratory technicians and ONUs. Within an exposure group, workers perform similar tasks. Additional details on the exposure groups are provided in Table 4-2. The number of full-shift samples (and number of non-detects) for each SEG was as follows: 49 operator (0 NDs), 29 laboratory technician (10 NDs), 15 logistics technician (4 NDs), and 23 maintenance technician (7 NDs). Non-detect values were assessed at the LOD/2. EPA used the monitoring data to estimate the 50th percentile as central tendency and the 95th percentile as the high-end exposures for each exposure group including ONUs. A summary of the full-shift occupational inhalation exposures is provided in Table 4-7.

EPA rated the weight of scientific evidence of the application of this data set to assess exposure for Processing as a Reactant as moderate. The primary strengths include the use of chemical-specific PBZ samples collected over a full-shift duration, a sufficient number of samples collected over a full-shift duration, and a sufficient number of samples for multiple worker SEGs and ONUs. Samples were collected across four facilities. Although these samples are specific to manufacturing of 1,1,2-trichloroethane, EPA expects that similar tasks and processes would be used during processing operations. A limitation is that it is specific to one industry (manufacturing as a byproduct) and it is uncertain if the measured concentrations and exposure and exposure frequencies accurately represent processing across all industries

EPA assumed up to 250 days/year of exposure for each SEG based on test order data from manufacturing and processing facilities which indicated that SEGs had tasks that could be performed "daily" combined with assumptions of 50 weeks per year and 5 days per week. The actual maximum number of exposures days for an individual worker within an SEG may be less than 250 days, and there is evidence from the inhalation monitoring study that not all tasks with high exposure potential are performed with a daily frequency during the working year. In calculating cancer risks, EPA utilized estimates of working years provided by BLS (CT value of 31 years and HE value of 40 years).

For this OES, EPA generally considers that high-end exposure and risk estimates are most appropriate for consideration of shorter duration exposures (acute, intermediate), while central tendency values are more representative for chronic exposures, without consideration of existing respiratory protections. EPA has lower confidence that high-end inhalation exposures are representative for chronic non-cancer and cancer inhalation exposure estimates because it is unlikely that a worker would experience the high-end concentration repeatedly across days and years. For one SEG (maintenance technicians), EPA has lower confidence that high-end inhalation exposures are representative of intermediate exposures, due to evidence that the high-end inhalation exposures are associated with infrequent tasks (as further described in Section 4.3.2.1.1).

The occupational inhalation risk estimates are provided in Table 4-27. EPA found acute, intermediate, and chronic non-cancer inhalation estimates below the benchmarks of 100, 30, and 300, respectively, and cancer risk estimates above 1×10^{-4} for operator/process technicians, laboratory technicians, logistics/distribution technicians, and maintenance technicians only for the high-end (95th percentile) exposure levels when not accounting for PPE usage. For ONUs, EPA found chronic non-cancer risk estimates below the benchmarks of 100, 30, and 300, respectively, and cancer risk estimates above 1×10^{-4}. In Table 4-27, where the estimated MOE is below the benchmark value for non-cancer or above 1×10^{-4} for cancer, an indication of the respiratory APF needed to mitigate risk is also provided. Additional discussion of the consideration of respiratory protection usage is provided below.

Information on Use of Respiratory Protection

EPA did not receive any specific information on PPE utilized by workers in processing facilities. In absence of industry or facility specific information, the Agency considers the information on PPE described for the Manufacturing as a Byproduct OES may be relevant to processing facilities, but with greater uncertainty as to how representative this might be across processing facilities.

4.3.2.1.5 OES for Formulation of Adhesives and Sealants

Inhalation Exposure Estimates

As described in Section 4.1.1.1.2, EPA did not identify inhalation exposure monitoring data related to formulation of 1,1,2-trichloroethane into adhesives and sealants. In absence of any 1,1,2-trichloroethane monitoring data and in accordance with the data assessment hierarchy in Table 4-1, EPA used worker

exposure data at 1,1,2-trichloroethane manufacturing (unintended, non-isolated byproduct) facilities as an analogous scenario for use of 1,1,2-trichloroethane as a reactant.

As previously described in the Byproduct Manufacturing OES (Section 4.3.2.1.1), the test order provided 116 full-shift samples for workers and 29 full-shift samples for ONUs; 21 worker and 11 ONU samples were below the limit of detection (<0.06 to <0.07 ppb). The number of full-shift samples (and number of NDs) for each SEG was as follows: 49 operators (0 NDs), 29 laboratory technicians (10 NDs), 15 logistics technicians (4 NDs), and 23 maintenance technicians (7 NDs). Non-detect values were assessed at the LOD/2. More details on the exposure groups are provided in Table 4-2. EPA used the monitoring data to estimate the 50th percentile as central tendency and the 95th percentile as the high-end exposures for each exposure group including ONUs. A summary of the full-shift occupational inhalation exposures is provided in Table 4-7.

EPA rated the weight of scientific evidence as moderate for this OES. The strengths included the use of chemical-specific breathing zone inhalation monitoring data that covered multiple worker SEGs and ONUs, including a number of tasks, and was collected across multiple facilities. EPA expects that similar tasks and processes would be used during formulation of adhesives and sealants. However, a limitation is that this data is specific to one industry (manufacturing as a byproduct), and there is uncertainty as to if the measured concentrations and exposure frequencies would represent all facilities across this OES.

EPA assumed up to 250 days/year of exposure for each SEG based on assumptions that each SEG could have tasks that needed to be performed on a daily basis as well as 50 weeks per year and 5 days per week. The actual maximum number of exposures days for an individual worker within an SEG for this OES may be less than 250. For working years, EPA used central tendency and high-end values based on BLS data of 31 and 40 years, respectively.

For this OES, EPA considers that high-end exposure and risk estimates are most appropriate for consideration of shorter duration exposures (acute, intermediate), while central tendency values are more representative for chronic exposures, without consideration of existing respiratory protections. EPA has lower-confidence that high-end inhalation exposures are representative for chronic non-cancer and cancer inhalation exposure estimates, because it is unlikely that a worker would experience the high-end concentration repeatedly across days and years. For one SEG (maintenance technicians), EPA has lower-confidence that high-end inhalation exposures are representative of intermediate exposures, due to evidence that the high-end inhalation exposures are associated with infrequent tasks (as further described in Section 4.3.2.1.1).

The occupational inhalation risk estimates are provided in Table 4-27. Chronic non-cancer risk estimates below the benchmark of 300 were found at the central tendency (50th percentile) exposure levels for operator/process technicians when not accounting for PPE usage. EPA found acute, intermediate, and chronic non-cancer inhalation estimates below the benchmarks of 100, 30 and 300, respectively, and cancer risk estimates above 1×10^{-4} for operator/process technicians, laboratory technicians, logistics/distribution technicians, and maintenance technicians for the high-end (95th percentile) exposure levels when not accounting for PPE usage. For ONUs, EPA found chronic non-cancer risk estimates below the benchmarks of 100, 30, and 300, respectively, and cancer risk estimates above 1×10^{-4}. In Table 4-27, where the estimated MOE is below the benchmark value for non-cancer or above 1×10^{-4} for cancer, an indication of the respiratory APF needed to mitigate risk is also provided. Additional discussion of the consideration of respiratory protection usage is provided below.

Information on Use of Respiratory Protection

EPA did not receive any specific information on PPE utilized by workers in formulation facilities. In absence of industry or facility specific information, EPA considers the information on PPE described for the Manufacturing as a Byproduct OES may be relevant this OES. but with greater uncertainty as to how representative this might be across formulation facilities.

4.3.2.1.6 OES for Use of Adhesives and Sealants

Inhalation Exposure Estimates

As described in Section 4.1.1.1.2, EPA estimated inhalation exposure based on surrogate monitoring data. The Agency did not identify any 1,1,2-trichloroethane inhalation monitoring data for this OES. Empirical data on inhalation exposure was available for trichloroethylene during use of paints, coatings, adhesives, and sealants. Trichloroethylene is also a volatile chemical with a vapor pressure of 69 mmHg. Trichloroethylene has a vapor pressure similar to 1,1,2-trichloroethane (23 mmHg) and the underlying data was included in the published risk evaluation for trichloroethylene. The trichloroethylene monitoring data were obtained from a NIOSH Health Hazard Evaluation report (HHEs) and three OSHA facility inspections (OSHA, 2017; Chrostek, 1981). EPA assessed exposures for the exposure groups of workers and ONUs. A general description of worker activities for this OES is provided in Table 4-2.

The inhalation exposure monitoring data encompass exposures from facilities using trichloroethylene in adhesive and coating applications. The data includes 22 samples for workers and 2 samples for ONUs. There were no samples below the LOD. EPA used the monitoring data to estimate the 50th percentile as central tendency and the 95th percentile as the high-end exposures for workers. For the ONUs, EPA used the average of the two data points for the central tendency and the highest data point for the high-end exposure. A summary of the full-shift occupational inhalation exposures is provided in Table 4-7.

In using surrogate data, EPA corrected for the differences in vapor pressure and mole fraction between the chemical that was monitored and the chemical being assessed. The Agency performed a vapor pressure correction to account for the differences in vapor pressure between both chemicals (TCE vapor pressure of 69 mmHg; 1,1,2-trichloroethane vapor pressure of 23 mmHg). Additionally, EPA assessed three potential scenarios to adjust the mole fraction: (1) 90% TCE and 10% 1,1,2-trichloroethane (9:1); (2) 50% TCE and 10% 1,1,2-trichloroethane (5:1); and (3) 10% TCE and 10% 1,1,2-trichloroethane (1:1). Due to the uncertainty in the percent weight of the adhesives used in the TCE monitoring studies, EPA considers scenario 1 and scenario 3 to be plausible upper- and lower-bound bounding estimates for this OES. EPA has the greatest confidence in scenario 2 as it represents a middle ground mole fraction adjustment that accounts for the potential uncertainties.

EPA rated the weight of scientific evidence as moderate for this OES. The strengths included the use of PBZ inhalation monitoring data, with data from studies from OSHA and NIOSH that had medium-to-high data quality ratings from the systematic review process. The limitations include the use of surrogate data as a less preferred approach for estimating inhalation exposure (as described in Table 4-1), though considering multiple scenarios of weight percent comparisons between assumed trichloroethane weight percents associated with the monitoring data compared to weight percents of 1,1,2-trichloroethylene increases EPA's confidence in this assessment.

EPA assumed 250 exposure days/year based on assumptions that each SEG could have tasks that needed to be performed on a daily basis as well as 50 weeks per year and 5 days per week. It is uncertain whether this captures actual worker schedules and exposures. For working years, EPA used central tendency and high-end values based on BLS data of 31 years and 40 years respectively.

The data and confidence support the use of the central tendency and high-end exposures for assessment of non-cancer acute and intermediate risk and the central tendency for the assessment of chronic and cancer risks. EPA considers that high-end exposure and risk estimates are most appropriate for consideration of shorter duration exposures (acute, intermediate). Chronic non-cancer and cancer effects involved repeated exposures over a high exposure frequency and high number exposure days. Use of the high-end estimate in combination with these other conservative default values may result in an overly conservative estimate of chronic risk for this OES.

The occupational inhalation risk estimates are provided in Table 4-27. EPA found acute, intermediate, and chronic non-cancer inhalation estimates below the benchmarks of 100, 30 and 300, respectively, and cancer risk estimates above 1×10^{-4} for operator/process technicians, laboratory technicians, logistics/distribution technicians, maintenance technicians, and ONUs for the both central tendency (50th percentile) and high-end (95th percentile) exposure levels when not accounting for PPE usage. This summary applies to both industrial and commercial use of adhesives and sealants. In Table 4-27, where the estimated MOE is below the benchmark value for non-cancer or above 1×10^{-4} for cancer—an indication of the respiratory APF needed to mitigate risk is also provided. Additional discussion of the consideration of respiratory protection usage is provided below.

Information on Use of Respiratory Protection

A NIOSH HHE for a coating facility (using TCE) indicates that PPE included single cartridge NIOSH-approved respirators during the mixing and spraying of coatings. The HHE noted that while the painters wore respirators, the foreman (an ONU) did not (NIOSH, 1981). There is uncertainty as to how representative this might be across facilities that manufacture adhesives and sealants, primarily given that this information is from historical studies from an analogous scenario.

4.3.2.1.7 OES for Use of Cleaning and Degreasing Solvents

Inhalation Exposure Estimates

EPA had limited evidence for 1,1,2-trichloroethane use as a cleaning and degreasing solvent, which pointed to the use being in open-top vapor degreasing and cold cleaning. EPA has uncertainty as to whether these are current uses of 1,1,2-trichloroethane. EPA assessed inhalation exposure if used in these OES.

Open-Top Vapor Degreasing

EPA did not have chemical-specific inhalation monitoring data. EPA's method for estimating inhalation exposure consisted of using PBZ monitoring data for trichloroethylene (TCE), perchloroethylene (PCE), and 1-bromopropane (1-BP) from published risk evaluations to use as a surrogate to estimate exposure to 1,1,2-trichloroethane. EPA used surrogate data from the TCE, PCE, and 1-BP during open-top vapor degreasing. TCE has a vapor pressure of 74 mmHg, PCE has a vapor pressure of 18.5 mmHg and 1-BP has a vapor pressure of 110.89 mmHg vs. 23 mmHg for 1,1,2-trichloroethane. The data includes 331 samples for workers and 97 samples for ONUs.

In EPA's analysis, vapor pressure corrections were made to all the data points. Mole fraction corrections were not done as the Agency's evidence for solvents indicate that the weight percent of solvents as used in vapor degreasing could be 100% and therefore the mole fractions would be 1. EPA estimated the 50th percentile and 95th percentile exposures from the data to represent the central tendency and high-end exposures.

Cold Cleaning

Similarly, EPA did not have chemical-specific inhalation monitoring data. The Agency's method for estimating inhalation exposures consisted of using PBZ monitoring data for perchloroethylene (PCE), from the published risk evaluation as a surrogate to estimate exposure to 1,1,2-trichloroethane. The vapor pressures are similar, 18.5 mmHg to 23 mmHg. Again, EPA did not correct for mole fraction assuming solvent weight percent of 100% in cold cleaning so the mole fraction would be 1. There were 29 samples for workers. For ONUs, the central tendency from the worker exposure concentrations was used to represent ONU exposures.

EPA rated the weight of scientific evidence as moderate for the two OES of Open-Top Vapor Degreasing and Cold Cleaning. The strengths included the use of PBZ inhalation monitoring data applicable to these two OESs. The vapor pressures of the surrogate chemicals are comparable and EPA has confidence that the mole fractions for the chemicals monitored would be the same as for 1,1,2-trichloroethane in these uses. The open-top vapor degreasing scenario had a large data set to estimate 50th and 95th percentile exposures and had medium-to-high data quality ratings from systematic review. The cold cleaning dataset, though smaller, still had 29 data points and had a high data quality rating from the systematic review process. The limitations include the use of surrogate data as a less preferred approach for estimating inhalation exposure (as described in Table 4-1), due to differences in chemical properties.

EPA assumed 250 exposure days/year based on assumptions that each SEG could have tasks that needed to be performed on a daily basis as well as 50 weeks per year and 5 days per week. It is uncertain whether this captures actual worker schedules and exposures. For working years, EPA used central tendency and high-end values based on BLS data of 31 years and 40 years respectively.

The data and confidence support the use of the central tendency and high-end exposures for assessment of non-cancer acute and intermediate risk and the central tendency for the assessment of chronic and cancer risks. EPA considers that high-end exposure and risk estimates are most appropriate for consideration of shorter duration exposures (acute, intermediate). Chronic non-cancer and cancer effects involved repeated exposures over a high exposure frequency, high number exposure days and high number of exposure years. Use of the high-end estimate in combination with these other conservative default values may result in an overly conservative estimate of chronic risk for this OES.

Estimates of occupational inhalation risks are presented in Table 4-27. Where the estimated MOE is below the benchmark value, an indication of the respirator APF needed to mitigate risk is also provided. Information on respiratory PPE that is applicable to this OES is discussed below.

The occupational inhalation risk estimates are provided in Table 4-27. EPA found acute, intermediate, and chronic non-cancer inhalation estimates below the benchmarks of 100, 30, and 300, respectively, and cancer risk estimates above 1×10^{-4} for workers for both central tendency (50th percentile) and high-end (95th percentile) exposure levels when not accounting for PPE usage for both open-top vapor degreasing and cold degreasing. For ONUs, EPA found acute, intermediate, and chronic non-cancer risk estimates below the benchmarks of 100, 30, and 300 for both central tendency (50th percentile) and high-end (95th percentile) exposure levels when not accounting for PPE usage for both open-top vapor degreasing and cold degreasing. Additionally, for ONUs, cancer risk estimates above 1×10^{-4} for central tendency exposure levels for open-top vapor degreasing and central tendency and high-end cold degreasing. In Table 4-27, where the estimated MOE is below the benchmark value for non-cancer or above 1×10^{-4} for cancer, an indication of the respiratory APF needed to mitigate risk is also provided. Additional discussion of the consideration of respiratory protection usage is provided below.

Information on Use of Respiratory Protection

The ESD on the Use of Vapor Degreasers summarized a monitoring study of worker exposure at 5 vapour degreasing facilities across several industries. Only 1 of 5 facilities studied indicated that respiratory protection was used. At this facility, 1 worker (of 31) effectively used the respirator for less than 15 to 20 minutes for the entire work shift. Two other workers at the facility briefly wore air-purifying respirators but did not wear them properly and failed quantitative fit testing. Respirators were not used by other employees or in other facilities.

NIOSH HHEs for various vapor degreasing facilities (using TCE) were varied, some mentioning respirator use. When respirators were not use, the NIOSH report typically included them in their recommendations (Seitz and Driscoll, 1989; Daniels et al., 1988; NIOSH, 1984; Lewis, 1980; NIOSH, 1973).

4.3.2.1.8 OES for Commercial Use of Laboratory Chemicals

Inhalation Exposure Estimates

EPA did not identify 1,1,2-trichloroethane monitoring data that was specific to the OES of Commercial Laboratory Use. EPA used worker exposure data for 1,1,2-trichloroethane during manufacturing as a byproduct. Process samples are collected for QA/QC (quality assurance/quality control) analysis at on-site laboratories. EPA used data for laboratory technicians at these facilities as an analogous scenario for use of 1,1,2-trichloroethane as a laboratory chemical. The Agency assumes the tasks described for laboratory technicians in a manufacturing setting would be similar to tasks performed by laboratory technicians in a commercial laboratory setting. The test order inhalation monitoring study provided 29 full-shift personal breathing zone samples for laboratory technician workers. EPA applied a mole fraction adjustment of the data to account for potential differences in concentrations experienced by workers in manufacturing facilities (exposed to up to 50% 1,1,2-trichloroethane by weight) and commercial laboratories (exposed to up to 100% 1,1,2-trichloroethane by weight). The Agency used the monitoring data to estimate the 50th percentile as central tendency and the 95th percentile as the high-end exposures for workers. EPA did not identify any ONU PBZ samples; while ONUs were sampled as part of the inhalation monitoring study submitted by Vinyl Institute, these ONUs were not specifically associated with laboratories. Therefore, the Agency used the central tendency from workers to represent ONU exposures.

EPA rated the weight of scientific evidence as moderate for this OES. Strengths include the use of PBZ data, the amount of data, and multiple data sources and settings represented. These data capture many of the tasks that are expected to occur in a laboratory setting. However, there is uncertainty with applying data from specific laboratory settings, such as QA/QC laboratories in manufacturing settings, to other laboratory settings. The use of analogous or surrogate data is a less preferred approach for estimating inhalation exposure compared to the use of inhalation monitoring data that is specific to the chemical and OES (as described in Table 4-1).

EPA assumed 250 exposure days/year based on assumptions that each SEG could have tasks that needed to be performed on a daily basis as well as 50 weeks per year and 5 days per week. It is uncertain whether this captures actual worker schedules and exposures. For working years, EPA used central tendency and high-end values based on BLS data of 31 years and 40 years respectively.

EPA notes that the two highest full-shift exposure measurements collected on laboratory technicians in manufacturing settings were approximately 7 to 8 times higher than the next full-shift exposure measurement (0.054 ppm and 0.048 vs. 0.0065 ppm). Additionally, upon review of these samples, EPA noted that the highest concentration sample included collection of “VC operator” samples, which was

noted as not being a normal job duty for laboratory technicians. EPA has uncertainty as to whether this upper-bound distribution of exposures in manufacturing laboratories is reflective of tasks or scenarios that may occur in laboratory settings covered by this OES (which does not include the manufacturing laboratories). For this OES, EPA considers that the high-end exposure and risk estimates may overestimate exposures for laboratory workers, due to the inclusion of tasks that are not representative of typical exposures in this OES. Overall, the data and confidence support the use of the central tendency exposures for assessment of non-cancer acute, intermediate, chronic (non-cancer), and cancer risks. In particular, chronic non-cancer and cancer effects involved repeated exposures over a high exposure frequency and high number exposure days. Use of the high-end estimate in combination with these other conservative default values may result in an overly conservative estimate of chronic risk for this OES.

The occupational inhalation risk estimates are provided in Table 4-27. EPA found acute, intermediate, and chronic non-cancer inhalation estimates below the benchmarks of 100, 30, and 300, respectively, and cancer risk estimates above 1×10^{-4} for workers for only high-end (95th percentile) exposure levels when not accounting for PPE usage. For ONUs, EPA did not find acute, intermediate, or chronic non-cancer risk estimates below the benchmarks of 100, 30, and 300 or cancer risk estimates above 1×10^{-4} for either central tendency (50th percentile) and high-end (95th percentile) exposure levels. In Table 4-27, where the estimated MOE is below the benchmark value for non-cancer or above 1×10^{-4} for cancer, an indication of the respiratory APF needed to mitigate risk is also provided. Additional discussion of the consideration of respiratory protection usage is provided below.

Information on Use of Respiratory Protection

While the test order submission from Vinyl Institute included information on respiratory protection worn by laboratory technicians in the manufacturing and processing facilities where inhalation monitoring was sampled, EPA has uncertainty as to if these data are representative of PPE use in other laboratory settings (including those not associated with manufacturing/processing settings). As previously described, use of a respirator was indicated for 1 of 29 full-shift samples collected on laboratory technicians in the manufacturing setting. More generally, the test order documentation described that certain laboratory personnel wore full-face, air purifying respirators during disposal of hazardous wastes from fume hoods (APF 50). However, this information was specific to manufacturing and processing facilities, and there is a lack of certainty as to whether this PPE usage applies to workers in commercial laboratory settings.

4.3.2.1.9 OES for Disposal to Incineration

Inhalation Exposure Estimates

EPA did not identify any 1,1,2-trichloroethane inhalation monitoring data for the Disposal by Incineration OES. The Agency used worker exposure data to 1,1,2-trichloroethane during manufacturing as a byproduct for logistics technicians and maintenance technicians, as an analogous scenario for handling 1,1,2-trichloroethane during disposal to incineration. The test order provided 15 samples for logistics technicians (4 < LOD) and 23 maintenance technicians samples (7 < LOD). EPA selected these worker SEGs as their job activities are expected to be similar to tasks performed at incineration facilities, such as loading/unloading tasks performed by logistics technicians in manufacturing settings. Additionally, maintenance technicians monitored in the study were reported to perform work with and around incinerators. Due to differences in site setting and potential concentration of 1,1,2-trichloroethane, EPA expects that concentrations in disposal to incineration sites would typically be lower than those observed at disposal sites, in particular for wastes that contain lower concentrations of 1,1,2-trichloreothane (<45%).

From these monitoring data, EPA calculated the 50th and 95th percentile 8-hour TWA concentrations to estimate a central tendency and high-end estimate of potential occupational inhalation exposures, respectively, for incineration sites. The central tendency from each worker SEG concentration was used to represent ONU exposure. Results are presented in Table 4-7.

EPA rated the weight of scientific evidence as moderate for this OES for assessment of inhalation exposure. The primary strength of these data is that they are PBZ and capture tasks that are expected to occur at an incineration facility. This is chemical-specific data that was collected as part of a test order process. The primary limitations include (1) the data are for workers in a manufacturing setting, rather than an incineration facility, and so the dataset may contain exposure from activities or environments that would not occur in an incineration facility; and (2) the lack of data for ONUs.

EPA assumed 250 exposure days/year based on assumptions that each SEG could have tasks that needed to be performed on a daily basis as well as 50 weeks per year and 5 days per week. It is uncertain whether this captures actual worker schedules and exposures. For working years, EPA used central tendency and high-end values based on BLS data of 31 and 40 years respectively. The actual maximum number of exposures days for an individual worker within an SEG for this OES may be less than 250.

The data and confidence support the use of the central tendency and high-end exposures for assessment of non-cancer acute and intermediate risk and the central tendency for the assessment of chronic and cancer risks. EPA considers that high-end exposure and risk estimates are most appropriate for consideration of shorter duration exposures (acute, intermediate). Chronic non-cancer and cancer effects involved repeated exposures over a high exposure frequency and high number exposure days. Use of the high-end estimate in combination with these other conservative default values may result in an overly conservative estimate of chronic risk for this OES.

The occupational inhalation risk estimates are provided in Table 4-27. EPA found acute, intermediate, and chronic non-cancer inhalation estimates below the benchmarks of 100, 30, and 300, respectively, and cancer risk estimates above 1×10^{-4} for workers for only high-end (95th percentile) exposure levels when not accounting for PPE usage for both maintenance and logistics technicians. For ONUs, EPA did not find acute, intermediate, or chronic non-cancer risk estimates below the benchmarks of 100, 30, and 300 or cancer risk estimates above 1×10^{-4} for either central tendency (50th percentile) and high-end (95th percentile) exposure levels. In Table 4-27, where the estimated MOE is below the benchmark value for non-cancer or above 1×10^{-4} for cancer, an indication of the respiratory APF needed to mitigate risk is also provided. Additional discussion of the consideration of respiratory protection usage is provided below.

Respiratory Protection

EPA did not identify reasonably available information on PPE usage for this OES. In absence of industry or facility specific information, EPA considers the information on PPE described for the Manufacturing as a Byproduct OES (specifically for logistics/maintenance technicians) may be relevant to the workers at incineration sites, but with greater uncertainty as to how representative this information might be for this OES.

4.3.2.1.10 OES for Disposal to Landfill

Inhalation Exposure Estimates

EPA did not identify any chemical-specific inhalation monitoring data to assess exposure for the OES of Disposal to Landfill. EPA did identify 115 area monitoring samples from 6 hazardous waste sites and a sanitary landfill in New Jersey. Sampling locations include leachate ponds, exposed drums, vents, areas

with soil discoloration, and areas in close proximity to homes. The study provided 115 area samples. Discrete data were not provided; therefore, EPA used the central tendency and high-end geometric means to represent 50th percentile and 95th percentile potential occupational inhalation exposures, respectively, for this scenario. The number of samples below the detection limit were not provided. Area monitoring can be used for estimating inhalation exposures by making assumptions on the duration that workers may be near where the area monitor is located (see Table 4-1). EPA assumed up to 8 hours in estimating 8-hour TWAs from the area monitoring data. EPA assessed exposure for the generic exposure groups of workers and ONU. Worker activity information is provided in Table 4-2.

EPA rated the weight of scientific evidence as slight-to-moderate. The strengths are having data on actual 1,1,2-trichloroethane air concentrations from multiple landfill sites. The limitations are in the use of area monitoring data to assess worker exposure and that only summary statistics were available in the study as opposed to discrete samples. EPA did not identify data for ONU exposures and used the default assumption of the central tendency from the workers inhalation exposures to represent ONU inhalation exposures.

EPA assumed 250 exposure days/year based on assumptions that each SEG could have tasks that needed to be performed on a daily basis as well as assumptions of 50 weeks per year and 5 days per week. It is uncertain whether this captures actual worker schedules and exposures. For working years, EPA used central tendency and high-end values based on BLS data of 31 years and 40 years respectively. The actual maximum number of exposures days for an individual worker within an SEG for this OES may be less than 250.

The data and confidence support the use of the central tendency and high-end exposures for assessment of non-cancer acute and intermediate risk and the chronic and cancer risks. Discrete data points were not available and EPA used the highest geometric mean from the data set to estimate the high-end, which may understand the high-end from the monitoring data if discrete samples were available.

The occupational inhalation risk estimates are provided in Table 4-27. EPA did not find acute, intermediate, and chronic non-cancer inhalation risk or cancer risk for workers or ONUs for either the central tendency (50th percentile) or high-end (95th percentile) exposure levels when not accounting for PPE usage.

Respiratory Protection

EPA did not identify reasonably available information on PPE usage for this OES.

4.3.2.1.11 OES for Disposal to POTW/WWT

Inhalation Exposure Estimates

EPA identified 1,1,2-trichloroethane monitoring data from the test order for the assessment of inhalation exposure for the OES of Disposal to POTW/WWT. There were two full-shift operator samples, both detected and one full-shift ONU sample, detected. EPA estimated central tendency using the midpoint of the two samples and the higher sample for the high-end exposure.

Due to the limited number of samples specific to 1,1,2-trichloroethane, EPA also considered surrogate monitoring data from wastewater treatment that was specific to 1,2-dichloroethane. This information was received via a test order submission and public comment from the Vinyl Institute. From these two sources, EPA identified 71 operator samples; 35 of which were below the LOD (LOD range: 0.024–0.28 ppm). This data was chosen due to the similarity in chemicals (both being volatile solvents), and high quality of the test order submission data (recent data with high number of samples). Vapor pressure

adjustment was performed to account for the differences in vapor pressure between the two chemicals (1,1,2-trichloroethane vapor pressure: 23 mmHg; 1,2-dichloroethane vapor pressure: 78.9 mmHg).

Specific to 1,1,2-trichloroethane, EPA identified one ONU sample that described work relevant to the wastewater process area. EPA utilized this value for the central tendency and high-end exposure estimates. Specific to the 1,2-dichloroethane surrogate monitoring data, EPA identified three full-shift, personal breathing samples for ONUs; two samples were below the limit of detection (0.024 and 0.21 ppm).

EPA rated the weight of scientific evidence as moderate for this OES. The Agency had a small number of chemical and OES specific data and supplemented with surrogate data from a test order and a larger data set that was specific to the OES. The surrogate data is personal breathing zone data obtained from workers at wastewater treatment plans, which represents exposure to several processes that commonly occur at wastewater treatment plants. The primary limitations of these data are that there is limited metadata or information about how the data was collected, a large number of samples were below the LOD, and there is a high LOD for many samples. The high number of non-detects leads to larger uncertainty due to the high LOD. The range of LOD was well above the calculated OEV for this chemical (Appendix G). To address this uncertainty in the surrogate monitoring data, EPA performed a sensitivity analysis to address the potential impacts of the non-detects on the risk estimates. Impacts of this analysis on the risk estimates are discussed below, and full results of this analysis are presented in Appendix H.

EPA assumed up to 250 days/year of exposure for each SEG based on assumptions that each SEG could have tasks that needed to be performed on a daily basis as well as assuming 50 weeks per year and 5 days per week. The actual maximum number of exposures days for an individual worker within an SEG for this OES may be less than 250. For working years, EPA used central tendency and high-end values based on BLS data of 31 and 40 years, respectively.

The data and confidence support the use of both the central tendency (50th percentile) and high-end (95th percentile) exposure estimates for assessment of acute and intermediate risks and the use of CT estimate in the assessment of chronic non-cancer and cancer risks. The uncertainties of the high-end assessment in combination of assumptions of repeated exposures at this level for assessment of chronic risks may be overly conservative.

Estimates of occupational inhalation risks are presented in Table 4-27. Where the estimated MOE is below the benchmark value, an indication of the respirator APF needed to mitigate risk is also provided. Risk estimates based on the 1,1,2-trichloroethane monitoring data indicated potential acute, intermediate, and chronic non-cancer risks relative to applicable benchmarks for workers at both high-end and central tendency exposure estimates. For cancer, risk estimates at the central tendency exposure were above the cancer benchmark for workers. There were no risks relevant to applicable benchmarks for ONUs.

Risk estimates based on the 1,2-dichlorethane surrogate monitoring data indicated potential acute, intermediate, and chronic non-cancer risks and cancer risks relevant to applicable benchmarks for workers at both high-end and central tendency exposure estimates. Based on the results of the sensitivity analysis (Appendix H), cancer risk estimates calculated from this data may be driven by a high LOD, and EPA has higher uncertainty in these risk estimates. Chronic, non-cancer risk estimates at the central tendency were not driven by the high LOD, and risks were still below benchmark MOE when non-

detected values were below zero. High-end exposure and risk estimates did not change per the sensitivity analysis. A full description of these results is provided in Appendix H.

For ONUs, inhalation estimates based on the surrogate monitoring data indicated potential acute and cancer risks relevant to applicable benchmarks at high-end exposures only, and potential intermediate and chronic, non-cancer risks relevant to applicable benchmarks at central tendency and high-end exposures. EPA notes that per the analysis discussed in Appendix H, potential acute inhalation risks from this dataset may be driven by the high LOD.

Respiratory Protection

Use of respiratory protection was not documented for any of the three 1,1,2-trichloroethane inhalation monitoring samples utilized in this analysis. EPA identified information on respiratory protection worn by workers in biological wastewater treatment areas and facilities associated with 1,2-dichloroethane manufacturing and processing facilities (which would include facilities that manufacturing 1,1,2-trichloroethane as an unwanted byproduct during the manufacture of 1,2-dichloroethane). Specifically, some operators that worked in wastewater process areas in the surrogate monitoring dataset were described as wearing half-face air purifying respirators. Other workers were not described as wearing respiratory protection. Additional information on respiratory use was not provided.

4.3.2.1.12 OES for Disposal by Remediation

As previously described in Table 4-27, this OES did not receive a quantitative assessment. Although release data were available for this OES (Section 3.1.3), occupational exposures were not quantitatively evaluated due to a lack of identified inhalation monitoring data and generic scenarios. However, remediation exposures are considered comparable to other Disposal OESs, depending on the type of remediation being performed. For example, removal of 1,1,2-trichloroethane from contaminated water that involves utilizing wastewater treatment units is comparable to the Disposal to POTW or Disposal to Non-POTW WWT. However, there will likely be differences in the amounts handled and the concentration of the chemical, depending on the type of remediation being performed.

4.3.2.1.13 OES for Distribution in Commerce

EPA did not quantitatively assess exposures for an OES of Distribution in Commerce. Activities associated with loading and unloading chemical products were assessed as part of each COU's OES. It is possible that 1,1,2-trichloroethane may go through a third party for temporary storage/warehousing before distribution to users. If repackaging takes place at these facilities involving transfer from larger to smaller containers, this would be captured under the OES of Repackaging. Transport containers are not expected to be opened during transport between producing and receiving sites. EPA expects all the 1,1,2-trichloroethane containing products to be transported in a closed system such that there is negligible potential for releases. Therefore, no occupational exposures are reasonably expected to occur and no separate assessment was performed for estimating releases and exposures from distribution in commerce. Speculative exposures that may result from irregular and unpredictable accidental spills during transport are not assessed by EPA in TSCA section 6 risk evaluations.

4.3.2.2 Occupational Dermal Exposure Risk Characterization

This section provides summary tables and dermal risks (Table 4-28), as well as a discussion of the risk characterization for dermal exposures. Table 4-28 also provides occupational dermal MOEs for the OES and worker categories assessed for 1,1,2-trichloroethane. Additionally, EPA incorporated reasonably available information on dermal PPE, including considerations for evaluating dermal protection, in this section (see "Discussion of Available Information on Dermal PPE Usage by OES" section).

3752 **Table 4-28. Occupational Dermal Risk Summary Table**

COU			OES	Category	Exposure Level	Acute Non-Cancer (Benchmark MOE = 30)	Intermediate Non-Cancer (Benchmark MOE = 30)	Chronic Non-Cancer (Benchmark MOE = 300)	Chronic Cancer [a]
Life Cycle Stage	Category	Subcategory				MOE – No Gloves [b]	MOE – No Gloves [b]	MOE – No Gloves [b]	No Gloves [b]
Manufacturing	Domestic Manufacture	Domestic Manufacture	Manufacturing as Byproduct in Chemical Manufacturing	Operator / Process Technicians	CT	1,356	76	**82**	9.4E−05
					HE	237	**13**	**14**	**5.4E−04**
				Laboratory technicians	CT	1,356	76	**82**	9.4E−05
					HE	237	**13**	**14**	**5.4E−04**
				Logistics / Distribution Technicians	CT	1,356	76	**82**	9.4E−05
					HE	237	**13**	**14**	**5.4E−04**
				Maintenance technicians	CT	1,356	76	**82**	9.4E−05
					HE	237	**13**	**14**	**5.4E−04**
Manufacturing	Import	Import	Repackaging for Laboratory Chemical Use	Worker	CT	621	44	**47**	**1.4E−04**
Processing	Repackaging	Repackaging			HE	69	**4.7**	**5.0**	**1.5E−03**
Processing	Processing – As a reactant Recycling	Intermediate in: Plastic manufacturing Intermediate in: Petro-chemical manufacturing Intermediate in: All other chemical product manufacturing Recycling	Processing as a Reactant	Operator / Process Technicians	CT	463	**26**	**28**	**2.4E−04**
					HE	103	**5.8**	**6.2**	**1.2E−03**
				Laboratory technicians	CT	463	**26**	**28**	**2.4E−04**
					HE	103	**5.8**	**6.2**	**1.2E−03**
				Logistics / Distribution Technicians	CT	463	**26**	**28**	**2.4E−04**
					HE	103	**5.8**	**6.2**	**1.2E−03**
				Maintenance technicians	CT	463	**26**	**28**	**2.4E−04**
					HE	103	**5.8**	**6.2**	**1.2E−03**
Processing	Incorporation into a formulation, mixture, or reaction product	Formulation of adhesives and sealants	Formulation of Adhesives and Sealants	Worker	CT	1,303	73	**79**	8.6E−05
					HE	237	**13**	**14**	**5.1E−04**

COU			OES	Category	Exposure Level	Acute Non-Cancer (Benchmark MOE = 30)	Intermediate Non-Cancer (Benchmark MOE = 30)	Chronic Non-Cancer (Benchmark MOE = 300)	Chronic Cancer [a]
Life Cycle Stage	Category	Subcategory				MOE – No Gloves [b]	MOE – No Gloves [b]	MOE – No Gloves [b]	No Gloves [b]
Industrial Use	Adhesives and sealants	Adhesives and sealants	Industrial Use of Adhesives and Sealants	Worker	CT	5,193	292	313	2.1E−05
					HE	1,384	78	**83**	8.7E−05
Commercial Use	Adhesives and sealants	Adhesives and sealants	Commercial Use of Adhesives and Sealants	Worker	CT	5,193	292	313	2.1E−05
					HE	1,384	78	**83**	8.7E−05
Industrial Use	Solvents (for cleaning and degreasing)	Solvents (for cleaning and degreasing)	Use of Cleaning and Degreasing Solvents (OTVD)	Worker	CT	154	**8.7**	**9.3**	**7.2E−04**
					HE	62	**3.5**	**3.7**	**2.0E−03**
			Use of Cleaning and Degreasing Solvents (Cold Cleaning)	Worker	CT	154	**8.7**	**9.3**	**7.2E−04**
					HE	62	**3.5**	**3.7**	**2.0E−03**
Commercial Use	Other use	Laboratory chemical	Use of Laboratory Chemicals	Worker	CT	621	44	**47**	**1.4E−04**
					HE	69	**4.7**	**5.0**	**1.5E−03**
Disposal	Disposal	Disposal	Disposal to Incineration	Logistics technician	CT	462	**26**	**28**	**2.4E−04**
					HE	103	**5.8**	**6.2**	**1.2E−03**
			Disposal to Incineration	Maintenance technician	CT	462	**26**	**28**	**2.4E−04**
					HE	103	**5.8**	**6.2**	**1.2E−03**
			Disposal to Landfill	Worker	CT	462	**26**	**28**	**2.4E−04**
					HE	103	**5.8**	**6.2**	**1.2E−03**
			Disposal to POTW and Non-POTW WWT	Worker	CT	462	**26**	**28**	**2.4E−04**
					HE	103	**5.8**	**6.2**	**1.2E−03**

CT = central tendency; HE = high end

[a] For the manufacturing as a byproduct OES, EPA calculated the cancer estimates using Vinyl Institute provided data on years of service for workers at manufacturing facilities (8.9 years central tendency; 33 years high-end) (EPA-HQ-OPPT-2018-0427-0181). For all other OES, EPA calculated cancer estimates using working years from the Bureau of Labor Statistics (BLS) data (31 years central tendency; 40 years high-end) (U.S. Census Bureau, 2019; U.S. BLS, 2014)

[b] Risk estimates that exceed the benchmark (*i.e.,* non-cancer risks less than the risk benchmark and cancer risks exceeding the cancer risk benchmark) are **bolded and shaded**.

3753

Dermal Exposure Estimates

The dermal exposure assessment used the DEVL Model to estimate dermal exposures. A key strength of the approach used was the use of data on fractional absorption that was developed from a TSCA Section 4 test order for 1,1,2-trichloroethane using the guideline OECD 428 *in vitro* dermal absorption study utilizing human skin relevant to the risk evaluation. Because 1,1,2-trichloroethane is a highly volatile chemical, any estimate of dermal exposure must take volatility into account which was quantified by the vapor trap in the study as well as the fraction absorbed through the skin. The tests were conducted using 100% (neat), 50%, 10%, and 1% concentrations of 1,1,2-trichloroethane in 1,2-dichloroethane as the COU vehicle as the remaining mass. Due to its volatility, the study results had high variability within individual test concentrations as well as across the test concentrations. To address this uncertainty and variability, the Agency statistically adjusted the mean absorption values for each test concentration of 1,1,2-trichloroethane (for detailed calculations, see U.S. EPA (2026aa)). Furthermore, EPA has assumed that the fraction absorbed for the various test fractions of 1,1,2-trichloroethane are absorbed through the skin by dermal exposures are equal to the systemic dose. This conclusion is based on the test order data where the amount in the receptor fluid (representing blood tissue) represents the actual systemic dose. For the neat chemical (100% 1,1,2-trichloroethane) the adjusted fraction absorbed is 1.0% and 0.5% absorption for 10% 1,1,2-trichloroethane in the 1,2-dichloroethane vehicle. The IHSkin Perm Model result for neat 1,1,2-trichloroethane is a similar value of 1.4% absorption.

Adjusting the data for variability and mass loss enabled EPA to generate a more accurate and statistically-based estimate of the absorbed dose (Labcorp Early Development, 2024). This approach to correct the raw absorption values for lost mass is appropriate and based on OECD GD156 dermal absorption guidance, and is supported by recommendations from the 1,1-dichloroethane SACC meeting (U.S. EPA, 2025c). A prior *in vitro* dermal absorption study (DuPont Haskell Lab, 2005) was submitted under a TSCA test rule, "In Vitro Dermal Absorption Rate Testing of Certain Chemicals of Interest to the Occupational Health and Safety Administration" (69 FR 22402 [April 26, 2004]), for derivation of a permeability coefficient (K_p) and short-term absorption rates at 10 and 60 minutes the values derived from this study were not applied in the DEVL Model. This 2004 study only tested the neat chemical for short durations and not the full COUs under TSCA with respect to vehicles, concentrations and exposure durations which influence dermal flux.

The rationale for the issuance of the TSCA section 4 test order for 1,1,2-trichloroethane was to allow for test preparations of various 1,1,2-trichloroethane concentrations that were more representative to COU/OES exposure scenarios for workers based on industry recommendations. Furthermore, the concentration of 1,1,2-trichloroethane in the test compartments was measured up to 24 hours following an 8-hour exposure period to monitor 1,1,2-trichloroethane absorption throughout the work shift and after to monitor 1,1,2-trichloroethane translocation even after cessation of exposure and skin washing. Additionally, the availability of multiple fraction absorption values for 1,1,2-trichloroethane based on the various concentrations (1, 10, 50%, and neat) tested in the test order allows for application and alignment of the corresponding COU/OES to the most representative absorption value to mimic occupational exposures. For the 1,1,2-trichloroethane testing, the mass balance recovery was 92% or greater than the applied dose for all testing conditions. Overall, the dermal absorption study was well conducted with a high systematic review rating and there is robust confidence in utilizing its data for dermal risk calculations.

The dermal loading values (mg/cm^2) used for the DEVL Model are based on experimental studies and EPA is applying these loading values for exposure scenarios that are encountered in the industrial and commercial settings for the COU/OES identified for 1,1,2-trichloroethane. The experimental study used oils as substances to measure the applied amount on skin as opposed to solvents, which are less viscous

(U.S. EPA, 1992). The modeling approach includes a weight fraction parameter that accounts for differences in the weight fraction of 1,1,2-trichloroethane between OESs. However, it does not account for other differences that may exist among the OESs that impact dermal exposure such as differences in dermal loading, skin surface area exposed, and frequency of contact. The weight of scientific evidence was rated as moderate for the dermal modeling method used to assess dermal exposure for the COU/OES of 1,1,2-trichloroethane.

In executing the DEVL Model, EPA used a probabilistic modeling approach with Monte Carlo methods to incorporate variability in the values for model parameters. This calculation included variation in fraction absorbed for different weight percents of 1,1,2-trichloroethane among the various OES. The skin surface area of contact was also varied with a uniform distribution of values ranging from 0 cm^2 to 1,070 cm^2 (value corresponding to the surface area of 2 hands) used in the Monte Carlo methodology. The model estimates the acute absorbed dose rate. There is limited data available on dermal exposure in industrial and commercial settings to for comparison of the model results.

For dermal exposure for all OESs, generally EPA considers that high-end exposure and risk estimates are most appropriate for consideration of shorter duration exposures (acute, intermediate), while central tendency values are appropriate for consideration for chronic exposures. The Agency has lower-confidence that high-end dermal exposures are representative for chronic non-cancer and cancer dermal exposure estimates, because it is unlikely that a worker would experience the high-end concentration for dermal contact repeatedly across operating days and working years. Additionally, the central tendency from DEVL Model is considered a more representative and appropriate exposure estimate for a frequent, repeated dermal exposure (*i.e.,* chronic) for closed system processes. EPA notes that potential risks relative to applicable benchmarks were not indicated for dermal acute exposures for any OES covered in this evaluation (MOE = 30).

The DEVL Model estimates the acute absorbed dose rate and does not take into account the protection provided by gloves when workers perform their tasks. Additional information on dermal PPE is provided in the below sections.

Consideration of Information on Dermal PPE Protection and Use

Hand protection provisions are provided in CFR 1910.138, but OSHA has not established quantitative protection factors for gloves. OSHA's hand protection standard (29 CFR 1910.138) requires that employers select and require employees to use appropriate hand protection when expected to be exposed to hazards such as those from skin absorption of harmful substances; severe cuts or lacerations; severe abrasions; punctures; chemical burns; thermal burns; and harmful temperature extremes. Dermal protection selection provisions are provided in CFR 1910.138(b) and require that appropriate hand protection is selected based on the performance characteristics of the hand protection relative to the task(s) to be performed, conditions present, duration of use, and the hazards to which employees will be exposed. OSHA provides various guidance documents[6] on the selection of protective gloves. These guidance documents note that glove permeability and breakthrough rates are affected by a number of factors, including temperature, glove thinning due to performance of tasks with increased pressure or friction, glove degradation, wear time, and reuse of gloves.

[6] See https://www.osha.gov/otm/section-2-health-hazards/chapter-2 and https://www.osha.gov/sites/default/files/publications/OSHA3151.pdf; both accessed July 23, 2026).

Discussion of Available Information on Dermal PPE Usage and Other Controls by OES

Manufacturing as a Byproduct OES: EPA has reviewed the information on glove use provided in the Vinyl Institute test order final study report and associated documentation (*e.g.,* seer Appendix O - Raw Sample Results) (Stantec ChemRisk, 2024). The information provided indicated that standard PPE (defined as PPE worn during normal operations on a full- to near full-shift basis) worn in the production process included leather gloves, as well as other clothing items with potential dermal protection such as coveralls, boots, and safety glasses. Task specific dermal PPE in the production process area included nitrile or viton/butyl gloves, as well as chemical resistant clothing items (*e.g.,* chemical-resistant apron, chemical boots). For the logistics work area, standard dermal PPE included clothing items (fire-resistant clothing, safety glasses, steel-toed boots); use of gloves was not reported. Task specific dermal PPE in the logistics work area included heavy duty nitrile gloves, chemical boots, and chemical splash googles. Standard PPE worn in the laboratory work areas included nitrile gloves, and other clothing items such as lab coats, fire-resistant clothing, closed toed shoes, and safety googles. Nitrile gloves and face shields were noted as task-specific PPE. EPA notes that other controls (such as engineering and administrative controls) were also documented in the test order, and are described in greater detail in the *Draft Chemistry, Fate, Release and Exposure Assessment for 1,1,2-Trichloroethane* (U.S. EPA, 2026g). For example, the test order included information on administrative controls utilized as part of generic standard operating procedures, such as restricting access to areas where work is occuring.

Use of gloves was documented during the collection of the full-shift inhalation exposure samples, and reported use varied by SEG (Stantec ChemRisk, 2024). Across all workers, use of chemical gloves was indicated during 53% of the full-shift samples and 78% of the task-based/short-term samples (note that this does not indicate the duration with which the gloves were specifically worn). Reported use of gloves ranged based on worker SEG. Specifically, glove use was documented during 52% (maintenance technicians) to 100% (laboratory technicians) of the full-shift inhalation samples that were collected. For task-length/short-term inhalation samples, documentation of chemical gloves ranged from 65% (maintenance/logistics technicians) to 100% (laboratory technicians).

Based on the available information, workers in manufacturing settings were documented as wearing gloves when the inhalation monitoring was performed, including during specific tasks where potential for dermal exposures were identified by the test order study report authors (*e.g.,* operators described as wearing nitrile gloves during open loop sample collection). Dermal PPE usage varies and could include various types of chemical resistant gloves (nitrile, viton/butyl, heavy duty nitrile) as well as other types of physical or chemical protection (*e.g.,* steel-toed boots, chemical aprons).

As there are no dermal exposure measurements available, EPA is unable to evaluate the reported usage of gloves in the context of specific dermal exposure measurements or concentrations. The Agency does not have any other information on how facilities in this OES rank or evaluate dermal exposures. EPA had information on generic standard operating procedures utilized by the facilities covered in the inhalation test order monitoring study, which noted minimum PPE requirements for specific tasks (such as use of chemical-specific gloves during closed-loop process sampling). EPA did not have specific information on how chemical gloves were selected for each task where required, or standard operating procedures for proper glove use by workers in the facilities monitored (*e.g.,* glove change-out schedules). Nonetheless, the occupational dermal risk estimates, which do not include or assume the use of gloves or other types of controls, may be an overestimate of dermal exposures as there is evidence that workers in these facilities utilize dermal PPE. EPA provided additional discussion of the available information on dermal PPE usage and existing controls for this OES in the risk determination (see Section 6.1.3). EPA welcomes additional information on how dermal protection is selected, applied, and utilized for this OES.

All Other OESs: EPA identified limited information on dermal PPE use for all other OESs. Available information is summarized below in Table 4-29.

Table 4-29. Other Information on Dermal PPE for OESs Not Covered in Test Order

OES	PPE Information
Repackaging	The Chemical Repackaging GS indicated that limited information was found regarding typical PPE workers used during repackaging processes. One chemical wholesaler website indicated that commonly used PPE includes safety glasses, face shields, aprons, and gloves, while engineering controls at another site include vacuum system and centrifugal degassing (U.S. EPA, 2022).
Processing as a Reactant	In absence of industry or facility specific information, EPA considered the information on PPE described for the Manufacturing as a Byproduct OES to be relevant to processing facilities. However, there is uncertainty as to how representative this might be across processing facilities.
Formulation of Adhesives and Sealants	Some information on PPE was available from the ESD on Adhesive Formulation, indicating potential use of gloves and safety glasses with side shields or goggles. Chemical submissions submitted to EPA by adhesive chemical manufacturers showed that, at a minimum, all manufacturers recommended the use of gloves and safety glasses with side shields or goggles. One submission for a hot-melt adhesive chemical also specifically recommended the use of thermal gloves (OECD, 2009). EPA also received worker protection information from the U.S. Department of Energy, which described that chemical-resistant gloves, safety glasses, Tyvek jackets, and engineering controls were required for activities associated with this COU (DOE, 2025)
Use of Adhesives and Sealants	The ESD on the Use of Adhesives indicated that the flexible packaging manufacturing industry utilizes the following PPE: chemical-resistant gloves and safety glasses (OECD, 2015a). A NIOSH HHE for a coating facility (using TCE) indicates that PPE included a paper helmet and goggles during paint mixing or applying coatings (NIOSH, 1981).
Cleaning and Degreasing Solvents (Open-Top Vapor Degreasing; Cold Cleaning)	The ESD on the Use of Vapor Degreasers summarized a monitoring study of worker exposure at 5 vapour degreasing facilities across several industries. The study reported that only few workers occasionally wore gloves, and those who wore gloves did not choose the proper glove material for the vapor degreasing chemical (OECD, 2021). NIOSH HHEs for various vapor degreasing facilities (using TCE) were varied, some mentioning glove use. When gloves were not use, the NIOSH report typically included them in their recommendations (Seitz and Driscoll, 1989; Daniels et al., 1988; NIOSH, 1984; Lewis, 1980; NIOSH, 1973).

OES	PPE Information
Use of Laboratory Chemicals	EPA notes that the information from the test order indicates that laboratory workers wear gloves as standard PPE. There is uncertainty regarding the applicability of this information for other laboratory settings (outside of the laboratories in manufacturing/processing settings that were monitored in the test order), but considers that gloves are typically worn in laboratory settings.
Disposal to Incineration, Landfill, POTW, and/or Non-POTW WWT	EPA did not identify reasonably available information on dermal PPE usage for any Disposal OES.

4.3.2.3 Overall Confidence and Remaining Uncertainties in Occupational Risk Estimates

This section provides a discussion of the confidence in the assessment of the occupational inhalation exposure scenarios, including remaining uncertainties across multiple OES. Detailed discussion of the inhalation exposure estimates for each OES is provided Section 4.3.2.1. As the same dermal modeling approach was utilized for dermal exposure assessment for all OES, the discussion of confidence in the dermal occupational exposure risk estimates is provided in Section 4.3.2.2.

Inhalation Exposure Risk Estimates

EPA has robust confidence in the inhalation data utilized for one of the OES that was evaluated as part of this risk evaluation (Manufacturing as a Byproduct at Chemical Manufacturing Facilities). EPA has moderate confidence in the majority of the other OESs that were evaluated. Confidence is increased by the utilization of full-shift, PBZ monitoring data from test order submission that were specific to 1,1,2-trichloroethane, where it was applied as directly applicable or analogous exposure monitoring data. For several OES, EPA utilized surrogate data from other chemicals, including 1,2-dichloroethane, trichloroethylene, and perchloroethylene. The Agency considered these OESs to have moderate confidence due to the high quality of the underlying datasets as well as the applicability of the exposure scenarios to the OES. EPA performed corrections to account for vapor pressure between surrogate chemicals and 1,1,2-trichloroethane as well as mole fraction corrections to account for differences in weight percent of 1,1,2-trichloroethane in different exposure scenarios. There was lower confidence in the OESs with limited inhalation monitoring data (area data, small sample size), or where modeling approaches were utilized to estimate exposure.

Overall, for most OES, EPA has higher confidence where high risk exposures estimates did not indicate risk relative to the benchmark, as many of these scenarios are likely to be overly conservative, especially for chronic noncancer and cancer exposures. The exception is the OES where area data was utilized (Disposal to Landfill). Additionally, EPA has lower confidence in risk estimates where ONU data were not available, as EPA assumed that the central tendency exposures for workers were appropriate for characterization of ONUs.

For most OES, EPA assumed an exposure duration of up to 250 days of exposure per year, with 8-hour shifts each working day. This is consistent with the OSHA PEL and other occupational exposure limits (OELs), but it is uncertain if this captures all potential worker schedules and exposures for any given OES. Additionally, inhalation exposure values were based on single-day full-shift measurements, and these values were extrapolated to represent average daily concentrations over the specific duration for intermediate and chronic estimates.

For most OESs, EPA relies on estimates of working years provided by BLS, which captures the expected lifetime career exposure of a worker. EPA utilized central tendency value of 31 years and high-end value of 40 years based on analysis of the BLS data. For this draft risk evaluation, EPA also used industry data on working years as well for one OES: Manufacturing as a Byproduct at Chemical Manufacturing Facilities. Estimates of working years provided by BLS capture the expected lifetime career exposure of a worker but are not industry specific. The industry data provided is specific to length of service (years) for workers at the facilities monitored as part of the test order. These values are industry specific, but do not capture the expected lifetime career exposure of a worker who may work at multiple facilities during their lifetime.

Personal inhalation monitoring results are obtained from the use of samplers attached to the workers to measure exposure concentrations near the workers' breathing zone. The placement of the samplers would be outside of any respiratory protection used so the inhalation exposures do not consider the exposure reduction from the use of respirators. The monitoring results do however reflect the use of exposure controls such as administrative and engineering controls because these control measures would impact the exposure concentrations measured near the worker's breathing zone.

Uncertainties with the PPE Use and Protection Factors

Respirator APFs have technical significance but are generic values based on assumed workplace conditions, and usage of a specific respirator type does not guarantee achieving the generic APF during all use scenarios. Nevertheless, respirator APFs are based on specific conditions and approved by NIOSH in conjunction with OSHA regulations.

The test order summary report describes dermal and respiratory PPE used in the facilities that were monitored, which is specific to facilities in one OES (Manufacturing as a Byproduct). EPA's practice is to consider if the PPE used at the facility as described in the test order summary report provides protection consistent with the Agency's assessment of the PPE protection factor needed for acceptable MOEs. As part of the test order submission process, the Vinyl Institute Consortium identified 15 sites that manufacture 1,1,2-trichloroethane as a non-isolated byproduct. Information on exposure (including the inhalation monitoring) and use of PPE was submitted for four sites that were determined to be representative facilities for this OES. EPA did not receive specific information on respiratory protection or other PPE usage for any other OES. There is also uncertainty as to application of this information to other OESs, such as Processing as a Reactant, as this information was collected from sites representative of Manufacturing as a Byproduct only.

Based on the available information in the test order report, workers in facilities that manufacture 1,1,2-trichloroethane as a byproduct do not wear respiratory protection as standard PPE for full- or near full-shift durations; however, respirators are used during specific tasks. As previously described, based on EPA's review of available information, use of respirators varied within each SEG, and reported use of respiratory protection was not typically associated with the highest measured exposure concentrations of 1,1,2-trichloroethane. The Agency performed a qualitative assessment of respirator use (where applicable) and noted where the documented use of respirators may result in an overestimate of exposure based on a monitored inhalation concentration but did not quantitatively incorporate use of a respirator into the risk evaluation. In the absence of specific information on how respiratory protection is applied and indicated, EPA assumed that usage of respirators in these facilities may be dictated by potential exposure to other chemicals, such as the primary chemical being manufactured.

4.3.3 Risk Estimates for Consumers

Table 4-30 and Table 4-31 summarize the inhalation MOEs; Table 4-32 summarizes dermal MOEs used to characterize non-cancer risk for acute and chronic inhalation exposure to 1,1,2-trichloroethane and presents these for all lifestages for the COU identified. EPA assessed three scenarios with varying values for input parameters the consumer inhalation assessment with duration of use, weight fraction and mass of product used as the input parameters driving the high-, medium-, and low-intensity scenarios. The MOEs that were below the benchmark were only identified for the high-intensity (highest weight fraction and highest mass of product used) scenario at each duration of use, whereas all other scenarios produced MOEs that were above the benchmark. The high-intensity scenario represents more conservative high-end estimates for each of the parameters based on available information discussed in Section 4.1.2.2. MOEs for all intensity levels are presented to showcase the range of risk when less conservative inputs are used.

The high-intensity exposure consisted of scenarios that included using the time it takes for the adhesive to set after application as the use duration with the highest weight fraction and mass of product. At each level of duration of use, the calculated MOEs (Equation 4-2) were below the benchmark with the combination of weight fraction and mass of product at the high-end values. Duration of use had no impact on risk. All risk was driven by the mass of product used or weight fraction. These high-end scenarios represent conservative estimates at each duration of use. The HEC (POD) was 6.1 mg/m^3. Using Haber's Rule and looking specifically at the 1- and 3-hour timeframe, the HECs were 48.8 mg/m^3 for the 3-hour timeframe and 146.4 mg/m^3 for the 1-hour timeframe and were used to calculate MOEs at these timeframes. EPA acknowledges the 1-hour TWA but for the purposes of characterizing risk, the 3-hour TWA was the more appropriate MOE to consider since the hazard acute benchmark was derived from a study with a 4-hour acute duration.

Risks were only present when the high-end inputs were used for mass of product and weight fraction with duration of use having a negligible impact for each exposure scenario. The sensitivity model was selected to display a wide range of exposures that can result from using the modeled products given the variability in human behavior. The high-end mass of product used represents a full bottle/tube of the product (≈50 g based on reported density of product). Each bottle/tube of the product represents a 1:1 mixture of resin to hardener. The resin contains 1,1,2-trichloroethane at weight fractions of 1×10^{-3} to 1×10^{-2}, while the hardener does not. This explains why the weight fraction used in the modeled scenario represents half of the weight fraction reported via the SDS of the resin component. All MOEs calculated for the chronic inhalation scenarios exceeded the benchmark.

EPA has robust confidence that the exposure concentrations represent a wide range of possible given the variability present in each parameter. EPA also has robust confidence that there is only acute inhalation MOEs below benchmark present when the high exposure levels are modeled because of conservative assumptions used in modeling of the high-end exposure scenario. These modeled consumer exposure scenarios represent a rarely occuring scenario and are expected to overestimate risk due to the compounding conservatism. The compounding factors of this scenario included the use of the E1 scenario in CEM which assumes emission of the chemical is at a much higher percentage than the E2 model that assumes only 25% of applied mass is released while the remaining fraction of the mass becomes trapped in the cured substrate. This scenario represents the use of a full bottle/tube of product while also assuming the highest weight fraction reported from the range of weight fraction reported on the SDS for the products. The additional estimation confirms that using the E2 model would result in MOEs above benchmark at the high-intensity scenario (Table 4-31).

All MOEs for both acute and chronic values were magnitudes above their respective benchmarks. EPA has robust confidence that there is no risk for these exposure scenarios. The dermal exposure model was modeled with the highest weight fraction, which is the parameter that influences the dermal fractional absorption equation used to calculate dermal doses in this assessment. This screening model also used the high-end value for the fraction absorbed value obtained from the study. EPA has robust confidence the high-intensity scenario used in this screening approach represents an upper bound and provides a health-protective estimate for consumer exposures. Lower intensity scenarios would result in an even larger MOEs; thus, there is no need for further refinement using the lower weight fractions reported.

4040 **Table 4-30. Consumer Inhalation Risk Summary**

Lifestage Cycle Stage/Category	Product	Exposure Route	Duration of Use (mins)	Weight Fraction	Mass of Product (g)	Acute Non-Cancer (Benchmark MOE = 100)						Chronic Non-Cancer (Benchmark MOE = 300)		
						1-Hour TWA			3-Hour TWA			CEM Calc. Chronic ADC		
						Adult (21+)	Youth 2 (16–20)	Youth 1 (11–15)	Adult (21+)	Youth 2 (16–20)	Youth 1 (11–15)	Adult (21+)	Youth 2 (16–20)	Youth 1 (11–15
Consumer Use – Adhesive and Sealants	Epoxy plastic bonder/ acrylic-based structural adhesive paste	Inhalation	5	5.0E−04	10	3,089			2,610			5.5E07		
					25	1,241			1,042			2.2E07		
					50	618			521			1.1E07		
				2.5E−03	10	618			521			1.1E07		
					25	246			209			4.3E06		
					50	123			104			2.1E06		
				5.0E−03	10	308			260			5.3E06		
					25	123			104			2.1E06		
					50	**62**			**52**			1.1E06		
			10	5.0E−04	10	3,108			,2610			2.7E07		
					25	1,241			1,045			1.1E07		
					50	623			522			5.3E06		
				2.5E−03	10	623			522			5.3E06		
					25	248			209			2.2E06		
					50	124			105			1.1E06		
				5.0E−03	10	310			261			9.5E06		
					25	124			105			1.1E06		
					50	**62**			**52**			5.4E05		
			20	5.0E−04	10	3,155			2,638			1.4E07		
					25	1,262			1,054			5.5E06		
					50	633			526			2.7E06		
				2.5E−03	10	631			526			2.7E06		
					25	252			210			1.1E06		
					50	126			105			5.5E05		
				5.0E−03	10	316			263			1.1E06		
					25	126			105			5.5E05		
					50	**63**			**53**			2.8E05		

CEM = MOE = margin of exposure; TWA = time-weighted average
MOEs below benchmark are **bolded and shaded gray**.

Table 4-31. E2 Model Risk Summary Table for High Intensity Scenarios

Lifestage Cycle Stage/Category	Product	Exposure Route	Weight Fraction	Mass of Product (g)	Duration of Use (mins)	Acute Non-Cancer (Benchmark MOE= 100)	
						1-Hour TWA [a]	3-Hour TWA [a]
Consumer use – Adhesive and sealants	Epoxy plastic bonder/ acrylic-based structural adhesive paste	Inhalation	5.0E−03	50	5	2,461	2,077
					10	2,477	2,085
					20	2,515	2,103
[a] Only used adult values for 1- and 3-hour TWA							

Table 4-32. Consumer Dermal Risk Summary Table

Lifestage Cycle Stage/Category	Product	Exposure Route	Weight Fraction	Lifestage	Acute Daily Dose (Benchmark = 30)	Chronic Average Daily Dose (Benchmark = 300)
Consumer use – Adhesive and sealants	Epoxy plastic bonder/ acrylic-based structural adhesive paste	Dermal	5.0E−03	Adult (21+)	3.9E03	7.9E03
				Youth 2 (16–20)	4.2E03	8.4E03
				Youth 1 (11–15)	3.9E03	7.8E03

4.3.4 Risk Estimates for General Population

EPA applied the best available science and a tiered approach to evaluate general population exposures to 1,1,2-trichloroethane for each of the media and pathways evaluated. As described in Section 4.1.3 and the *Draft Chemistry, Fate, Release and Exposure Assessment for 1,1,2-Trichloroethane* (U.S. EPA, 2026g), though multiple tiers of analysis are applied to several media for general population exposures, only the final results from the highest tier of analysis completed for that media for exposure are relied on in this draft risk evaluation to derive risk estimates and draft risk characterization. This is because the highest tier represents the most refined analysis found to be necessary or warranted for the respective hazard effect under the approach taken that provided EPA with moderate-to-robust confidence in the results. Where final results come from Tier 2 or Tier 3 analyses, those analyses replaced some conservative assumptions with more representative, spatially and temporally aligned data and information, when available, to provide EPA moderate-to-robust confidence in the results. Derived risk estimates, risk characterization, and weight of scientific evidence conclusions are presented in this section by pathway and route and attributed to OES and associated COUs.

4.3.4.1 Risk Estimates for Inhalation

EPA evaluated acute non-cancer, chronic non-cancer, and cancer risks associated with inhalation exposure of the general population to 1,1,2-trichloroethane via the ambient air pathway. EPA also evaluated multi-facility aggregate risks for cancer effects associated with inhalation exposure of the general population to 1,1,2-trichloroethane via the ambient air pathway using the HEM. Results for inhalation risks and risk characterization are presented by hazard endpoint in Sections 4.3.4.1.1 through 4.3.4.1.4. Results are based on the highest tier of analysis completed for each endpoint. The weight of scientific evidence conclusions for inhalation are presented in Section 4.3.4.1.5

4.3.4.1.1 Acute Non-Cancer Risk Estimates and Characterization for Inhalation

Inhalation exposures of the general population to 1,1,2-trichloroethane via the ambient air pathway for acute non-cancer effects were evaluated through the highly conservative, upper bounding Tier 1 analysis using IIOAC. Results from the Tier 1 analysis led EPA to conclude no additional, refined analyses were necessary or warranted for acute non-cancer effects to the general population. This is based on the findings that modeled concentrations did not result in calculated risk estimates less than the benchmark of 100 for acute non-cancer effects to the general population. Therefore, the Tier 1 analysis is the final tier of analysis for acute non-cancer effects to general population and results were used for deriving risk estimates and risk characterization as well as informing risk determination and regulatory decision-making for acute non-cancer effects.

The highest 95th percentile modeled daily average concentration across all exposure scenarios and release datasets evaluated (TRI, 2017 NEI, and 2020 NEI) was 34 µg/m^3. Using the margin of exposure (MOE) calculation from Section 4.3.1 (Equation 4-2) and the acute HEC (POD) of 6,100 µg/m^3 the calculated risk estimate (MOE) for acute non-cancer inhalation risk was 181. This MOE was nearly 2 times greater than the benchmark of 100 for acute non-cancer risk, indicating inhalation exposure to 1,1,2-trichloroethane via the ambient air pathway does not pose an identified acute non-cancer risk to the general population (including fenceline communities and PESS) under the OES/COUs evaluated.

4.3.4.1.2 Chronic Non-Cancer Risk Estimates and Characterization for Inhalation

Inhalation exposures of the general population to 1,1,2-trichloroethane via the ambient air pathway for chronic non-cancer effects were evaluated through the Tier 3-radial distance analysis and Tier 3 facility-specific census block analysis using the HEM. Results from the Tier 3-facility specific census block analysis led EPA to conclude no additional, refined analyses were necessary or warranted for chronic

non-cancer effects to the general population (including fenceline communities and PESS). This is based on the findings that modeled concentrations did not result in calculated risk estimates less than the benchmark of 300 for chronic non-cancer effects to the general population. Therefore, the Tier 3 analysis was the final tier of analysis and results were used for deriving risk estimates and risk characterization as well as informing risk determination and regulatory decision-making for chronic non-cancer effects.

Calculated risk estimates (MOEs) for all five OESs based on the maximum 95th percentile modeled concentrations at each radial distance are summarized in Table 4-33 and Table 4-34. Using the MOE calculation from Section 4.3.1 (Equation 4-2) and the chronic HEC (POD) of 620 $\mu g/m^3$, the calculated MOEs for chronic non-cancer effects ranged from 5 to 2.79×10^7 across the entire modeling domain evaluated (30–50,000 m) and across all five OESs evaluated. Findings show all five OESs evaluated have calculated MOEs less than the benchmark of 300 at one or more radial distances as far as 250 m from the modeled release point. This indicates inhalation exposure to 1,1,2-trichloroethane via the ambient air pathway may pose an identified chronic non-cancer risk to the general population for those individuals residing or frequenting locations within 250 m of a modeled release point. EPA therefore conducted an additional, refined analysis using the Tier 3 facility-specific census block analysis using the HEM to determine whether individuals reside within distances where risk estimates below the benchmark of 300 occurred from the Tier 3 radial distance analysis.

The Tier 3 facility-specific census block analysis for 1,1,2-trichloroethane provides modeled concentrations at the centroid of all populated census blocks across the entire modeling domain evaluated (30–50,000 m). Calculated MOEs for chronic non-cancer inhalation risk based on the Tier 3 facility-specific census block analysis ranged from 1,265 to 8.86×10^5 across all OES and all populated census blocks. These MOEs are at least four times greater than the benchmark of 300 for chronic non-cancer risk indicating inhalation exposure to 1,1,2-trichloroethane via the ambient air pathway does not pose an identified chronic non-cancer risk in populated census blocks where individuals within the general population (including fenceline communities and PESS) reside.

Taken together, while inhalation exposure of the general population to 1,1,2-trichloroethane may pose an identified chronic non-cancer risk as far as 250 m from the release points evaluated based on the radial distance analysis, the facility-specific census block analysis demonstrates individuals of the general population (including fenceline communities and PESS) do not reside at those distances or locations. Therefore, EPA concluded inhalation exposure to 1,1,2-trichloroethane via the ambient air pathway does not pose an identified chronic non-cancer risk in populated census blocks where individuals within the general population (again, including fenceline communities and PESS) reside under the OES/COUs evaluated.

Table 4-33. Calculated MOEs for Chronic Non-Cancer Effects by Radial Distance and OES (30–750 m)

OES(s)	# of Facilities in OES	30	60	100	250	500	750
Manufacturing as a Byproduct at Chemical Manufacturing Facilities (OES #1) Manufacturing as a Byproduct in the Pulp and Paper Industry (OES #2)	13	5	15	31	126	376	711
Processing as a Reactant	4	62	115	219	853	2,588	4,999
Open-Top Vapor Degreasing (OES #7) Cold Cleaning (OES #8)	1	121	221	432	1,506	3,300	5,103
Disposal to Incineration	5	153	332	599	2,427	7,068	1.3E04
Disposal to Landfill	6	190	397	914	4,302	1.4E04	2.9E04
MOE = margin of exposure; OES = occupational exposure scenario; Benchmark MOE = 300							

Table 4-34. Calculated MOEs for Chronic Non-Cancer Effects by Radial Distance and OES (1,000–50,000 m)

OES(s)	# of Facilities in OES	1,000	2,500	5,000	10,000	25,000	50,000
Manufacturing as a Byproduct at Chemical Manufacturing Facilities (OES #1) Manufacturing as a Byproduct in the Pulp and Paper Industry (OES #2)	13	1,112	4,475	1.3E04	3.6E04	1.4E05	4.2E05
Processing as a Reactant	4	7,980	3.5E04	1.1E05	3.3E05	15E05	4.5E06
Open-Top Vapor Degreasing (OES #7)/ Cold Cleaning (OES #8)	1	7,363	1.9E04	4.4E04	1.0E05	3.8E05	1.0E06
Disposal to Incineration	5	2.0E04	9.1E04	2.8E05	8.5E05	3.8E06	1.0E07
Disposal to Landfill	6	4.7E04	2.2E05	7.2E05	2.2E06	9.4E06	2.8E07
MOE = margin of exposure; OES = occupational exposure scenario; Benchmark MOE = 300							

4.3.4.1.3 Cancer Risk Estimates and Characterization for Inhalation

Inhalation exposures of the general population to 1,1,2-trichloroethane via the ambient air pathway for cancer effects were evaluated through the Tier 3-radial distance analysis (TRI release dataset) and Tier 3 facility specific census block analysis (TRI, 2017 NEI, and 2020 NEI release datasets) using the HEM. Results from the Tier 3 facility-specific census block analysis led EPA to conclude no additional, refined analyses were necessary or warranted for cancer effects to the general population (including fenceline communities and PESS). This is based on the findings that modeled concentrations did not result in calculated risk estimates greater than the benchmark of 1×10^{-6} for cancer effects to the general population. Therefore, the Tier 3 facility-specific census block analysis results were used for deriving risk estimates and risk characterization as well as informing risk determination and regulatory decision-making for cancer effects.

Results for the Tier 3 analyses for cancer in this section are summarized by analysis and release dataset evaluated. Although EPA starts its assessment with the cancer benchmark of 1×10^{-6} to determine whether additional, more refined analyses are necessary or warranted, EPA considers cancer benchmark values from 1×10^{-4} to 1×10^{-6} when evaluating general population risks.

Analyses based on the TRI release dataset evaluated all 29 facilities reporting releases of 1,1,2-trichloroethane to the ambient air for one or more years between 2019 and 2023. The modeled concentrations for the TRI release dataset analyses were based on the single highest maximum fugitive and stack releases reported by each facility across all 5 years of TRI release data considered.

Analyses based on the 2017 and 2020 NEI release datasets only evaluated the top ten facilities reporting the highest total facility releases of 1,1,2-trichloroethane to the ambient air for the respective NEI reporting year. As described in Section 4.1.3.1.3 and Section 5.2.4 of the *Draft Chemistry, Fate, Release and Exposure Assessment for 1,1,2-Trichloroethane* (U.S. EPA, 2026g), this approach with the NEI release datasets was taken to ensure high-end releases reported to the 2017 and 2020 NEI but not to the TRI were captured for this assessment and to further support findings and risk characterization based on the TRI release dataset results. Details of all Tier 3 analyses conducted for 1,1,2-trichloroethane were described in the *Draft Chemistry, Fate, Release and Exposure Assessment for 1,1,2-Trichloroethane* (U.S. EPA, 2026g).

Tier 3-Radial Distance Analysis Results (TRI Dataset)

Calculated cancer risk estimates for all five OESs based on the maximum 95th percentile modeled concentrations at each radial distance modeled are summarized in Table 4-35 and Table 4-36. Using the cancer risk calculation in Section 4.3.1.2 (Equation 4-3), the cancer IUR (POD) of 2.98×10^{-6} per $\mu g/m^3$, and the highest maximum annual average modeled concentrations at each radial distance evaluated and for each of the five OESs evaluated, the calculated risk estimates for cancer effects ranged from 6.6×10^{-11} to 3.4×10^{-4} across the entire modeling domain evaluated (30–50,000 m) and across all five OESs evaluated. Findings show all five OESs evaluated have calculated cancer risk estimates greater than the benchmark of 1×10^{-6} at one or more radial distances as far as 1,000 m from the modeled release point. Based on these findings, EPA determined additional, refined analysis using the Tier 3 facility-specific census block analysis was necessary or warranted for the general population (including fenceline communities and PESS). The purpose of this refinement was to determine whether individuals within the general population reside at radial distances (or in populated census blocks) where modeled concentrations resulted in calculated cancer risk estimates less than the benchmark of 1×10^{-6}.

Table 4-35. Calculated Cancer Risk Estimates by Radial Distance and OES (30–750 m)

OES(s)	# of Facilities in OES	30	60	100	250	500	750
Manufacturing as a Byproduct at Chemical Manufacturing Facilities (OES #1) Manufacturing as a Byproduct in the Pulp and Paper Industry (OES #2)	13	3.4E−04	1.2E−04	6.0E−05	1.5E−05	4.9E−06	2.6E−06
Processing as a Reactant	4	3.0E−05	1.6E−05	8.5E−06	2.2E−06	7.1E−07	3.7E−07
Open-Top Vapor Degreasing (OES #7) Cold Cleaning (OES #8)	1	1.5E−05	8.4E−06	4.3E−06	1.2E−06	5.6E−07	3.6E−07
Disposal to Incineration	5	1.2E−05	5.6E−06	3.1E−06	7.6E−07	2.6E−07	1.4E−07
Disposal to Landfill	6	9.7E−06	4.7E−06	2.0E−06	4.3E−07	1.3E−07	6.5E−08
OES = occupational exposure scenario; Cancer Risk Benchmark = 1E−04 to 1E−06							

Table 4-36. Calculated Cancer Risk Estimates by Radial Distance and OES (1,000–50,000 m)

OES(s)	# of Facilities in OES	1,000	2,500	5,000	10,000	25,000	50,000
Manufacturing as a Byproduct at Chemical Manufacturing Facilities (OES #1) Manufacturing as a Byproduct in the Pulp and Paper Industry (OES #2)	13	1.7E−06	4.1E−07	1.5E−07	5.1E−08	1.3E−08	4.4E−09
Processing as a Reactant	4	2.3E−07	5.3E−08	1.7E−08	5.6E−09	1.3E−09	4.1E−10
Open-Top Vapor Degreasing (OES #7) Cold Cleaning (OES #8)	1	2.5E−07	9.6E−08	4.2E−08	1.8E−08	4.9E−09	1.8E−09
Disposal to Incineration	5	8.9E−08	2.0E−08	6.6E−09	2.2E−09	4.9E−10	1.7E−10
Disposal to Landfill	6	3.9E−08	8.2E−09	2.6E−09	8.3E−10	2.0E−10	6.6E−11
OES = occupational exposure scenario; Cancer Risk Benchmark = 1E−04 to 1E−06							

Tier 3 Facility-Specific Census Block Analysis Results (TRI Dataset)

The Tier 3 facility-specific census block analysis for 1,1,2-trichloroethane using the TRI release dataset provided modeled concentrations at the centroid of all populated census blocks across the entire modeling domain evaluated (30–50,000 m). Calculated cancer risk estimates based on the Tier 3 facility-specific census block analysis and the TRI release dataset ranged from 3.3×10^{-9} to 1.5×10^{-6} and are summarized in Table 4-37. This range was based on the single maximum calculated risk estimate within a single populated census block across all populated census blocks within the modeling domain and all facilities within each OES.

Findings from this analysis identified four of the five OESs evaluated have calculated risk estimates for cancer effects in a populated census block less than the relative benchmark of 1×10^{-6}. The calculated risk estimates for these four OESs ranged from 3.3×10^{-9} to 9.5×10^{-7}. Based on these findings, EPA determined inhalation exposures to 1,1,2-trichloroethane via the ambient air pathway under these four OES (and associated COUs) did not pose an identified cancer risk in populated census blocks where individuals within the general population (including fenceline communities and PESS) reside. The OES: Manufacturing as a Byproduct at Chemical Manufacturing Facilities (COU: Domestic manufacturing) and OES Manufacturing as a Byproduct in Pulp and Paper Industry (COU: Domestic manufacturing) were included in these four OESs and associated COUs. Therefore 1,1,2-trichloroethane when "manufactured as a byproduct at chemical manufacturing facilities" during "domestic manufacturing" did not pose an identified cancer risk to the general population (including fenceline communit8ies and PESS).

The remaining OES: Open-Top Vapor Degreasing/Cold Cleaning; COU: Industrial use solvents (cleaning and degreasing) had a maximum calculated risk estimate of 1.5×10^{-6} as shown in Table 4-37 within a populated census block (cancer incidence of 4.1×10^{-5}) in the modeling domain of a modeled release point. This calculated risk estimate is greater than 1×10^{-6} but less than the benchmarks of 1×10^{-5} and 1×10^{-4} and indicates inhalation exposure to 1,1,2-trichloroethane via the ambient air pathway may pose an identified cancer risk to the general population (including fenceline communities and PESS) for individuals residing or frequenting locations within the census block identified in Table 4-37. EPA therefore further investigated the findings and associated facilities within this OES to ensure the findings are representative of actual general population exposures and current operating conditions. The investigation and additional analyses conducted are discussed and presented below.

EPA's further investigation into this OES revealed the OES included a single facility (K&G Manufacturing) with no other facilities in proximity (within the modeling domain of 30–50,000 m). Results for this facility-specific census block analysis were based on facility reported fugitive and stack releases from the 2019 TRI reporting year. For the remaining TRI reporting years considered for this evaluation, this facility reported zero releases of 1,1,2-trichloroethane (2020) and did not report 1,1,2-trichloroethane releases to TRI since 2021. EPA contacted the facility and revealed the facility used 1,1,2-trichloroethane from at least 2017 through 2019, but discontinued use of 1,1,2-trichloroethane after 2019 for business reasons. The discontinued use of 1,1,2-trichloroethane by this facility removed the exposure and therefore risk tied to this risk estimate.

Table 4-37. Maximum Risk Estimate for Cancer Effects Associated with a Populated Census Block by OES (TRI Dataset)

OES(s)	Census Block	# of Facilities in OES		Risk Estimate for Cancer
		Total	With Risk Estimates Exceeding Benchmark 1E−06	
Manufacturing as a Byproduct at Chemical Manufacturing Facilities Manufacturing as a Byproduct in the Pulp and Paper Industry	0032001012	13	0	9.5E−07
Processing as a Reactant	9527021022	4	0	5.7E−07
Open-Top Vapor Degreasing Cold Cleaning	0709011023	1	1	1.5E−06[a]
Disposal to Incineration	0302002040	5	0	1.1E−08
Disposal to Landfill	0113032028	6	0	3.3E−09

[a] This occupational exposure scenario (OES) was identified during EPA outreach to the 1 facility reporting the releases tied to this OES (K&G Manufacturing). The risk estimate of 1.5E−06 led EPA to conduct several additional analyses for and investigation into the single facility. EPA's outreach to this facility and additional analysis found the facility discontinued use of 1,1,2-trichloroethane in 2019, thus eliminating exposure of the general population (including fenceline communities and PESS) around the facility and removing risk due to releases of 1,1,2-trichloroethane as of 2020.

Results from both the radial distance analysis and the facility-specific census block analysis for the K&G Manufacturing facility are brought together in Figure 4-8 to illustrate findings from the Tier 3 analyses based on the TRI release dataset for the OES: Open-top vapor degreasing/cold cleaning; COU: Industrial use solvents (cleaning and degreasing). Findings from this show there are two populated census blocks within the modeling domain with calculated risk estimates for cancer greater than the benchmark of 1×10^{-6} (red polygons). Overlaying the radial distance results near the facility show the overall findings from both analyses align (*e.g.,* both show risk in the same locations) but also show the distinction between radial distance analysis results (at a finite distance) and facility-specific census block analysis results (single value at the centroid of each census block) which are considered together for purposes of characterizing both exposure and risks. For example, the radial distance analysis shows risk in multiple directions out to 250 m from the release point modeled. This distance aligns with both populated census blocks where risks at the centroid of the census block were found (east and west) and an unpopulated census block (NW). However, it also overlaps with a large census block north of the modeled release point where the modeled concentration at the centroid of the census block does not indicate risk, but if individuals live in the southern portion of that census block (within 250 m) there may be risk to those individuals based on the radial distance analysis.

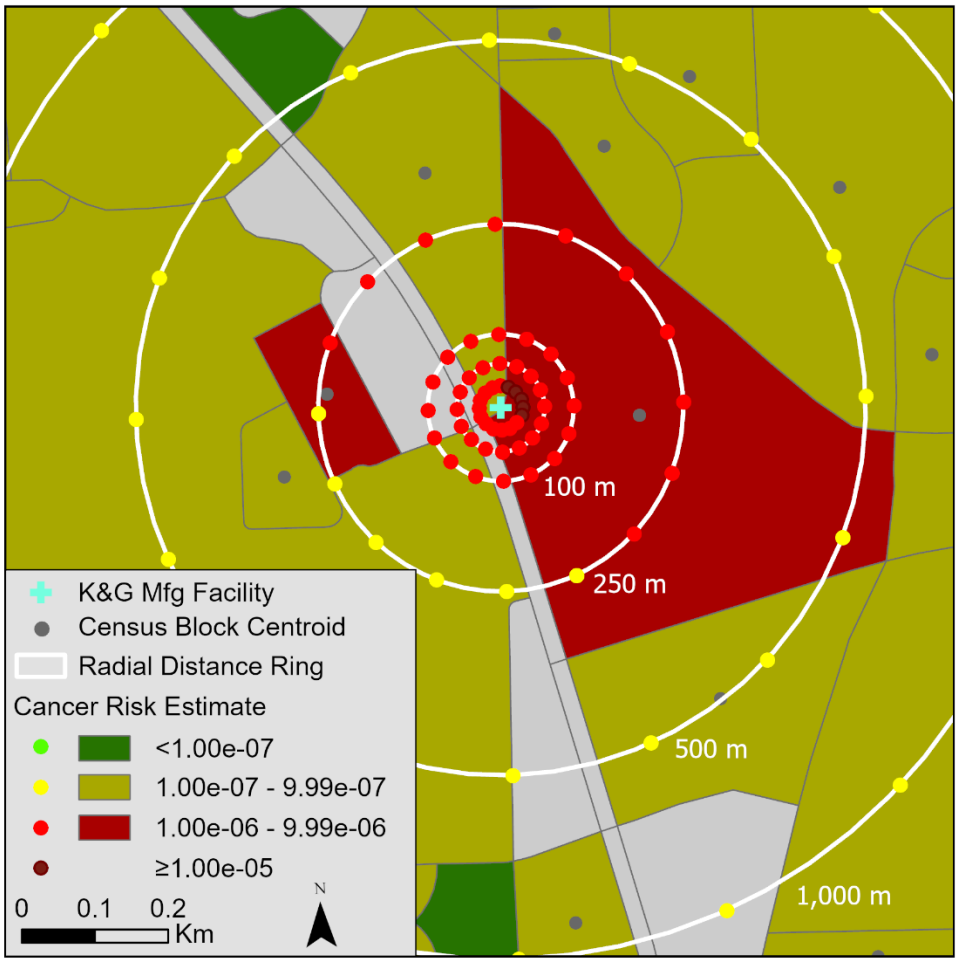

Figure 4-8. K&G Facility-Specific Radial and Census Block Analyses Results (TRI Dataset)

Colored points represent calculated cancer risk estimates at each radial point. Colored polygons represent estimated cancer risk for populated census blocks as calculated at its centroid. Gray polygons represent unpopulated census blocks.

Taken together, while inhalation exposure of the general population to 1,1,2-trichloroethane using the TRI release dataset may pose an identified cancer risk as far as 1,000 m from the release points evaluated for all five OESs evaluated based on the radial distance analysis, the facility-specific census block analysis found only the OES: Open-Top Vapor Degreasing/Cold Cleaning; COU: Industrial use solvents (cleaning and degreasing) showed calculated risk estimates in one or more populated census blocks where individuals of the general population (including fenceline communities and PESS) reside which are greater than the benchmark of 1×10^{-6}. Further investigation into this one OES revealed it was only associated with a single facility which stopped using 1,1,2-trichloroethane after 2019. Therefore, while results indicate inhalation exposure may pose an identified cancer risk to the general population between 2017 and 2019 residing around the facility based on the radial distance and facility-specific census block analyses, the discontinued use of 1,1,2-trichloroethane by the facility removed exposure of the general population to 1,1,2-trichloroethane under this COU and alleviated cancer risk to the general population (including fenceline communities and PESS) as of 2020 under this OES/COU. Based on these findings, EPA concluded inhalation exposure to 1,1,2-trichloroethane via the ambient air pathway currently does not pose an identified cancer risk in populated census blocks where individuals within the general population (including fenceline communities and PESS) reside under the OES/COUs evaluated.

Tier 3 Facility-Specific Census Block Analysis Results (2017 NEI Dataset)

The Tier 3 facility-specific census block analysis for 1,1,2-trichloroethane based on the top 10 facility reported releases of 1,1,2-trichloroethane to the 2017 NEI release dataset provided modeled concentrations at the centroid of all populated census blocks across the entire modeling domain evaluated (30–50,000 m) for each facility. Calculated risk estimates for cancer based on the Tier 3 facility-specific census block analysis and the 2017 NEI release dataset ranged from 5.4×10^{-9} to 3.1×10^{-5} and are summarized by facility (EIS ID) in Table 4-38. This range was based on the single maximum calculated risk estimate within a single populated census block across all populated census blocks within the modeling domain for each of the top ten facilities.

Findings from this analysis identified 8 of the top 10 facilities evaluated had maximum calculated risk estimates for cancer effects in a populated census block less than the relative benchmark of 1×10^{-6} for cancer effects. The calculated risk estimates for these eight facilities ranged from 5.4×10^{-9} to 2.0×10^{-7} and indicate inhalation exposures to 1,1,2-trichloroethane via the ambient air pathway for those eight facilities (and associated COUs) did not pose an identified cancer risk in populated census blocks where individuals within the general population (including fenceline communities and PESS) reside. The OES: Manufacturing as a Byproduct at Chemical Manufacturing Facilities (COU: Domestic manufacturing) and OES: Manufacturing as a Byproduct at Chemical Manufacturing Facilities (COU: Domestic manufacturing) were captured in these eight facilities. Therefore 1,1,2-trichloroethane when "manufactured as a byproduct" during "domestic manufacturing" did not pose an identified cancer risk to the general population.

The remaining 2 of the top 10 facilities evaluated (EIS ID 7107411 and 7442111) had maximum calculated risk estimates for cancer effects in a populated census block greater than the benchmark of 1×10^{-6} for cancer effects. The calculated risk estimates for these two facilities ranged from 5.4×10^{-6} to 3.1×10^{-5} and indicate inhalation exposures to 1,1,2-trichloroethane via the ambient air pathway for these two facilities may pose an identified cancer risk to the general population for individuals residing or frequenting locations within the census blocks identified in Table 4-38. EPA therefore further investigated the findings associated with these two facilities to ensure the findings are representative of actual general population exposures and current operating conditions.

Table 4-38. Maximum Risk Estimate for Cancer Effects for Top 10 Releases (2017 NEI)

EIS ID	Risk Estimate (Cancer)	Comparison to Benchmark of 1E−06?	Census Block ID	OES
7107411	5.4E−06	>Benchmark	0709021018	Open-Top Vapor Degreasing/Cold Cleaning
7354911	6.0E−08	<Benchmark	UHON000043	Manufacturing as a Byproduct at Chemical Manufacturing Facilities
13610611	5.4E−09	<Benchmark	9529011003	Processing as a Reactant
8216311	1.4E−08	<Benchmark	9501022046	Manufacturing as a Byproduct in the Pulp and Paper Industry
8232711	2.0E−07	<Benchmark	9601003037	Manufacturing as a Byproduct in the Pulp and Paper Industry
7442111	1.7E−06	>Benchmark	9567004037	Manufacturing as a Byproduct in the Pulp and Paper Industry
7442111 [a]	3.1E−05	*>Benchmark*	*9567004062*	*Manufacturing as a Byproduct in the Pulp and Paper Industry*
1003411	9.2E−08	<Benchmark	9503021013	Manufacturing as a Byproduct in the Pulp and Paper Industry
17735411	4.7E−09	<Benchmark	6644001110	Manufacturing as a Byproduct Chemical Manufacturing Facilities
7203811	1.6E−07	<Benchmark	9508004007	Manufacturing as a Byproduct in the Pulp and Paper Industry
8522011	1.4E−08	<Benchmark	0984003054	Manufacturing as a Byproduct in the Pulp and Paper Industry

OES = occupational exposure scenario
[a] For facility ID 7442111, this census block centroid is located on facility property and therefore not representative of general population exposure where individuals reside (or associated risk estimates). Therefore, EPA looked at the census block with the second highest risk estimate for purposes of characterizing exposures and risks to general population as that census block appeared to be off facility property where individuals may reside.

EIS ID 7107411: This EIS ID was associated with K&G Manufacturing. As described earlier, this facility discontinued use of 1,1,2-trichloroethane in 2019 and therefore removed exposure to 1,1,2-trichloroethane and associated risks. This was the same K&G Manufacturing from the Tier 3 facility-specific census block analysis using the TRI release dataset. Therefore, the findings described in the TRI release dataset analysis also apply to this analysis. One additional finding identified through EPA's investigation into this facility in relation to the 2017 NEI release dataset revealed the 2017 NEI reported facility latitude and longitude was different than the TRI reported latitude and longitude. Based on a visual investigation/land use analysis conducted for this facility, EPA revealed the latitude and longitude reported to the 2017 NEI dataset was spatially representative of the actual facility location and the TRI reported latitude and longitude was actually 2 km (2,000 m) north of the actual facility location. Although this had no impact on the radial distance analysis (if modeling the same releases), EPA recognized it could have significant impact on the facility-specific census block analysis results. To investigate the potential impact, EPA compared the reported releases across the 2017 NEI dataset and the 2019 TRI dataset. EPA also modeled the 2017 NEI releases for this facility using the HEM. Results are presented in Figure 4-9 based on the 2017 NEI-reported latitude and longitude.

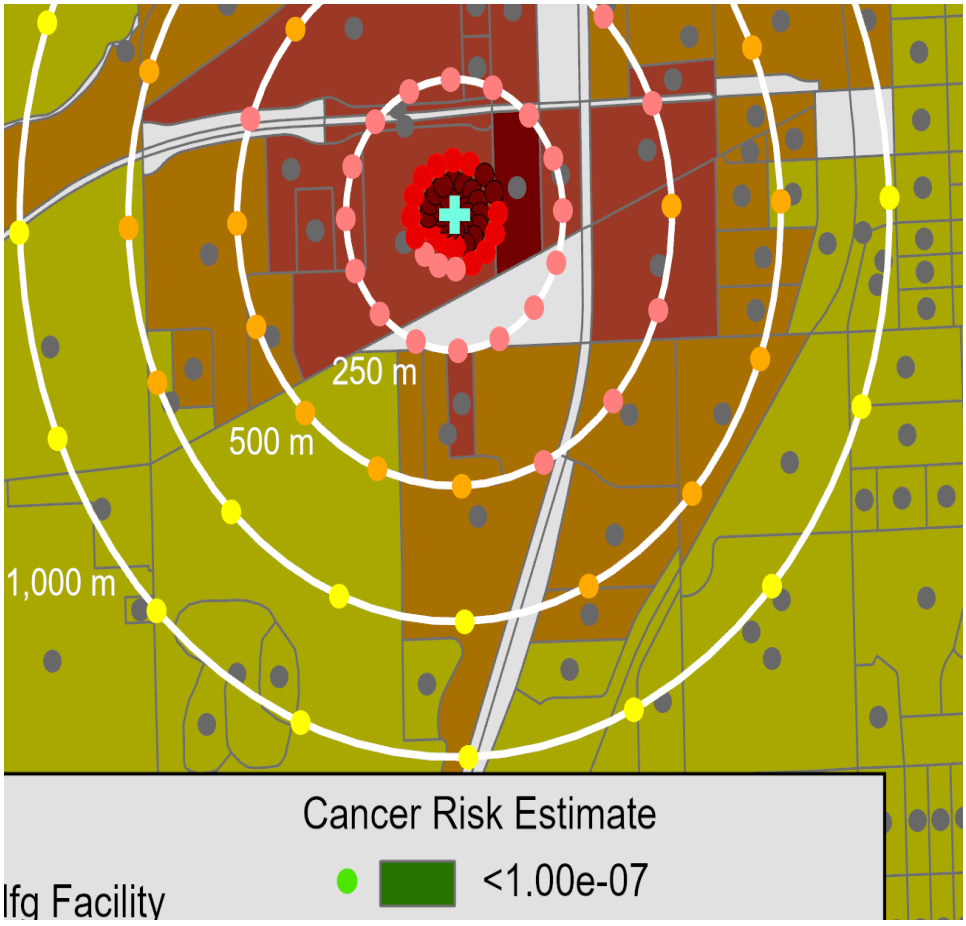

Figure 4-9. K&G Facility-Specific Radial and Census Block Analyses Results (2017 NEI Dataset)
Colored points represent calculated cancer risk estimates at each radial point. Colored polygons represent estimated cancer risk for populated census blocks as calculated at its centroid. Gray polygons represent unpopulated census blocks.

When reported releases from the K&G Manufacturing facility were compared between the 2017 NEI and 2019 TRI reported releases, EPA found the 2017 NEI stack and fugitive releases were approximately 2 times greater than the releases reported to 2019 TRI (2017 NEI: stack 7,230 kg/year and fugitive 816 kg/year compared to 2019 TRI: stack 3,638 kg/year and fugitive 304 kg/year). The impact of the higher 2017 NEI releases on the radial distance analyses can be seen in the results presented in Figure 4-9 where risk estimates greater than the benchmark of 1×10^{-6} occurred out to 500 m rather than out to 250 m based on the TRI release dataset (Figure 4-8). Across both datasets, risk estimates generally remained within the 1×10^{-6} benchmark and none in the 1×10^{-5} benchmark until very near the facility (30–100 m away from the release point modeled). Directionally (looking across both Figure 4-8 and Figure 4-9), risk estimates greater than the benchmark of 1×10^{-6} occurred in similar directions across the various distances (mostly Northwest, North, Northeast, and East) for both datasets. Directional considerations like this can inform risk characterization, identify the most impacted population, and is often based on predominant wind directions across the meteorological data for the year modeled. Therefore, the different modeled releases did impact the radial distance analyses although the overall findings across the two different modeled release datasets remain unchanged where both showed risk estimates greater than the benchmark of 1×10^{-6} out to 250 to 500 m with representative directional impacts. Specifically, the risk estimates based on the TRI dataset ranged from 1.5×10^{-5} (at 30 m) to 1.2×10^{-6} (at 250 m), while risk estimates based on the 2017 NEI dataset ranged from 4.4×10^{-5} (at 30 m) to 3.1×10^{-6} (at 250 m) and 1.3×10^{-6} (at 500 m).

The different latitude and longitudes modeled for the TRI and 2017 NEI release datasets had a greater impact on the facility-specific census block analyses. When EPA modeled the more spatially representative latitude and longitude from the 2017 NEI release dataset, the number of impacted populated census blocks increased substantially (8-fold increase) from two census blocks (based on the TRI-reported latitude and longitude) to 16 populated census blocks (based on the 2017 NEI dataset). However, for both datasets the nearest impacted populated census blocks still occurred around the 100 m radial distance under either dataset, so the exposed populations nearer the facility were not missed with either the TRI or 2017 NEI releases datasets. As discussed previously, however, even though there are multiple populated census blocks where both the radial distance analyses and the facility-specific census block analyses for both the TRI and 2017 NEI release datasets showed risk estimates exceeding the benchmark of 1×10^{-6}, the facility's discontinued use of 1,1,2-trichloroethane alleviated inhalation risks to the general population from this facility since 2020. Therefore, EPA's conclusion based on the TRI release dataset remains unchanged in that inhalation exposure to 1,1,2-trichloroethane via the ambient air pathway from this facility currently does not pose an identified cancer risk in populated census blocks where individuals within the general population (including fenceline communities and PESS) reside under the OESs/COUs evaluated.

EIS ID 7442111: This EIS ID was associated with a Georgia Pacific (GP) facility located in Louisiana and categorized under the OES: Manufacturing as a Byproduct in Pulp and Paper Industry (COU: Domestic manufacturing). This facility did not have reported releases to the TRI release dataset for any of the 5 years of data evaluated (2019–2023) and therefore a comparison of releases across the TRI and 2017 NEI release datasets could not be made. However, this facility had reported releases to both the 2017 and 2020 NEI release datasets. The facility was in the top 10 reported releases in the 2017 NEI dataset, driven by reported fugitive releases (1,923 kg/year). This facility was not in the top 10 reported releases in the 2020 NEI dataset based on a significant decrease in reported fugitive releases (41 kg/year or a forty-seven times lower reported fugitive release). Stack releases across the two NEI release datasets increased slightly from 2017 (4 kg/year) to 2020 (10 kg/year).

Results for the radial distance and facility-specific census block analyses for this facility are presented for the 2017 NEI dataset (see Figure 4-10). This facility had calculated cancer risk estimates greater than the relative benchmark of 1×10^{-6} based on the 2017 NEI release dataset but not the 2020 NEI release dataset.

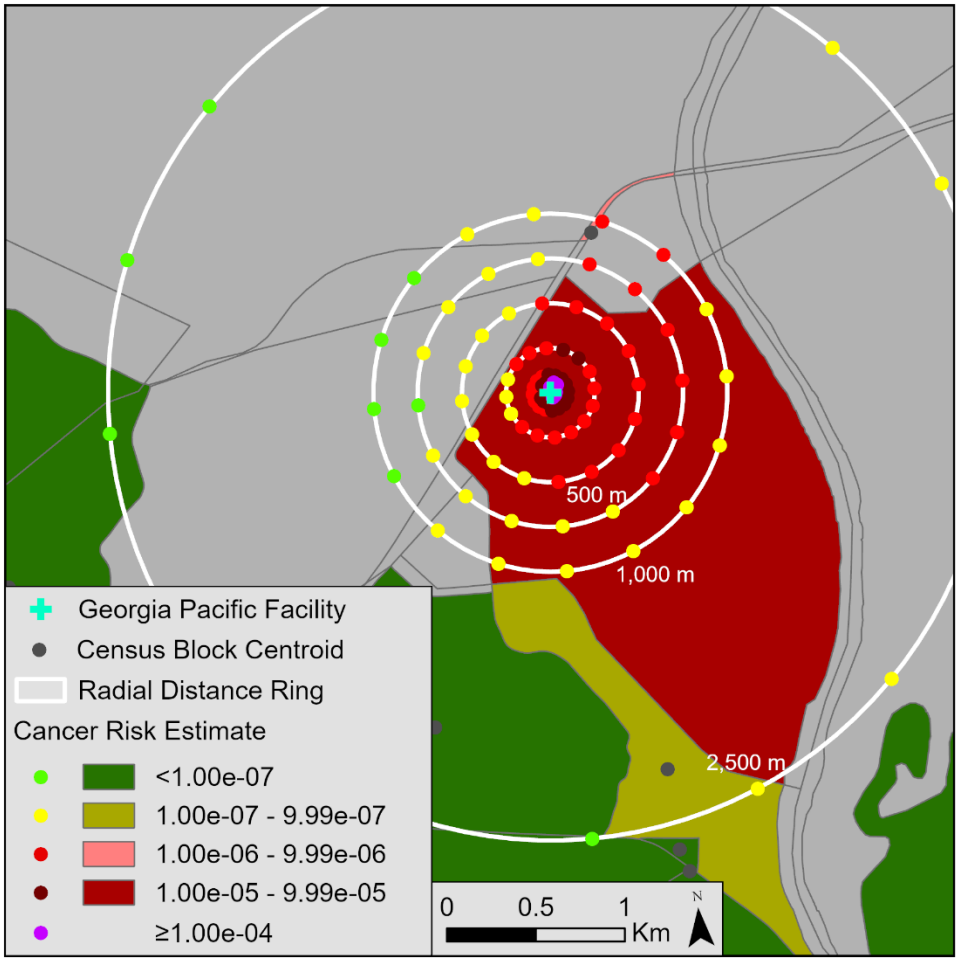

Figure 4-10. GP Facility-Specific Radial and Census Block Analyses Results (2017 NEI Dataset)
Colored points represent calculated cancer risk estimates at each radial point. Colored polygons represent estimated cancer risk for populated census blocks as calculated at its centroid. Gray polygons represent unpopulated census blocks.

As described in the *Draft Chemistry, Fate, Release and Exposure Assessment for 1,1,2-Trichloroethane* (U.S. EPA, 2026g), based on a visual investigation, the highest modeled concentration in a populated census block (large red polygon in Figure 4-10) had a risk estimate of 3.1×10^{-5}. However, the centroid of that census block was located on facility property based on the centroid latitude and longitude output by the HEM which fell under a radial receptor on the 100-meter ring SE of the facility and cannot be seen. Because that modeled concentration at the centroid was on facility property (which goes beyond 100 m), the modeled concentration and associated risk estimate at that centroid are not representative of general population exposure where individuals may reside. Taking this into account, EPA identified the second highest modeled concentration output from HEM in a populated census block to see if that was on or off facility property where general population may reside. The second highest modeled concentration occurred in a census block mostly north north-east of the highest census block location

and represented by a thin peach polygon. This census block appears to align with a roadway and had a risk estimate of 1.7×10^{-6}. While the population output from the HEM suggests six people reside in that census block, a visual investigation on Google Maps by EPA was unable to confirm or even identify any location within that thin/narrow census block where general population may reside on or along the roadway. Considering the multiple analyses and lines of evidence for this facility—including: (1) lack of residences in either of the two highest modeled census blocks with risk estimates greater than 1×10^{-6}; (2) multiple unpopulated census blocks (gray polygons) in most directions from the release point; (3) the significant decrease in releases from 2017 to 2020; (4) the absence of reported releases to TRI; and (5) the absence of visually identified locations where individuals within the general population may reside within the radial distances or census blocks where risk estimates were greater than 1×10^{-6}; and (6) the 2020 NEI reported releases for this facility were well below the top 10 releasing facilities reporting to the 2020 NEI (none of which showed risk, see below)—EPA determined inhalation exposure to 1,1,2-trichloroethane via the ambient air pathway from this facility does not pose an identified unreasonable cancer risk to the general population (including fenceline communities and PESS) under the OES/COUs evaluated.

Tier 3 Facility-Specific Census Block Analysis Results (2020 NEI Dataset)

The Tier 3 facility-specific census block analysis for 1,1,2-trichloroethane based on the top 10 facility reported releases of 1,1,2-trichloroethane to the 2020 NEI release dataset provided modeled concentrations at the centroid of all populated census blocks across the entire modeling domain evaluated (30–50,000 m) for each facility. Calculated cancer risk estimates based on the Tier 3 facility-specific census block analysis and the 2020 NEI release dataset ranged from 4.8×10^{-9} to 3.0×10^{-7} and are summarized by facility (EIS ID) in Table 4-39. This range was based on the single maximum calculated cancer risk estimate within a single populated census block across all populated census blocks within the modeling domain for each of the top 10 facilities.

Findings from this analysis identified all 10 of the top 10 facilities evaluated had maximum calculated cancer risk estimates in a populated census block less than the benchmark of 1×10^{-6} for cancer effects. Since these 10 facilities are the highest releasers across the entire 2020 NEI dataset, EPA expects all other lower releasing facilities reporting to 2020 NEI will also result in calculated cancer risk estimates less than the benchmark of 1×10^{-6} for cancer effects. Therefore, EPA's conclusion based on the TRI release dataset remains unchanged in that inhalation exposure to 1,1,2-trichloroethane via the ambient air pathway does not pose an identified cancer risk in populated census blocks where individuals within the general population (including fenceline communities and PESS) reside under the OES/COUs evaluated.

The OES: Manufacturing as a Byproduct at Chemical Manufacturing Facilities (COU: Domestic manufacturing) and OES: Manufacturing as a Byproduct the in Pulp and Paper Industry (COU: Domestic manufacturing) were captured in these top ten facilities evaluated. Therefore 1,1,2-trichloroethane when "manufactured as a byproduct" during "domestic manufacturing" did not pose an identified cancer risk to the general population (including fenceline communities and PESS).

Table 4-39. Maximum Risk Estimate for Cancer Effects for Top 10 Releases (2020 NEI)

EIS ID	Risk Estimate (Cancer)	Comparison to Benchmark of 1E−06?	Census Block ID	OES
7354911	7.4E−08	< Benchmark	UHON000043	Manufacturing as a Byproduct at Chemical Manufacturing Facilities
8216311	1.6E−08	< Benchmark	9501022046	Manufacturing as a Byproduct in the Pulp and Paper Industry
8232711	2.0E−07	< Benchmark	9601003037	Manufacturing as a Byproduct in the Pulp and Paper Industry
7225811	1.8E−09	< Benchmark	9503002079	Manufacturing as a Byproduct in the Pulp and Paper Industry
8522011	1.5E−08	< Benchmark	0984003054	Manufacturing as a Byproduct in the Pulp and Paper Industry
7203811	1.5E−07	< Benchmark	9508004007	Manufacturing as a Byproduct in the Pulp and Paper Industry
7212311	3.0E−07	< Benchmark	0208011001	Manufacturing as a Byproduct in the Pulp and Paper Industry
17735411	4.8E−09	< Benchmark	6644001110	Manufacturing as a Byproduct at Chemical Manufacturing Facilities
1000211	8.4E−08	< Benchmark	0312002027	Manufacturing as a Byproduct in the Pulp and Paper Industry
3967011	3.7E−09	< Benchmark	7262002003	Disposal to Non-POTW WWT

OES = occupational exposure scenario; POTW = publicly owned treatment works; WWT = wastewater treatment

4.3.4.1.4 Multi-Facility Aggregate Risk Estimates and Characterization for Cancer Effects for Inhalation

The multi-facility aggregate analysis was an additional Tier 3 analysis conducted for 1,1,2-trichloroethane using the TRI release dataset. The purpose of this analysis was to determine whether multiple facilities in proximity (within 50,000 m of another facility releasing 1,1,2-trichloroethane) did or did not pose a combined (aggregate) inhalation risk to the general population for cancer effects. The multi-facility aggregate analysis was conducted at the census block level through post-processing of facility-specific census block output files from the HEM. Post-processing combined individual facility-specific modeled concentrations at the centroid of each census block within the modeling domain to get a potential total aggregated concentration at the centroid of each census block from all facilities impacting each census block. Results from the multi-facility aggregate analysis cannot be attributed to a specific OES/COU since the aggregated concentration was the sum of all facilities impacting each census block and those facilities may not be categorized under the same OES/COU. As described previously, the benchmark of 1×10^{-6} is not a bright-line for purposes of risk determination as EPA considers the range of benchmarks between 1×10^{-4} and 1×10^{-6}. However, under the tiered approach applied, the Agency compares the calculated aggregate risk estimates to the cancer benchmark of 1×10^{-6} to inform whether additional, more refined analysis are necessary or warranted.

Results from the multi-facility aggregate analysis found 3 census blocks within the modeling domains of all 29 TRI facilities evaluated where calculated cancer risk estimates were greater than the benchmark of 1×10^{-6}. Calculated risk estimates for these three census blocks ranged from 1.0×10^{-6} to 1.5×10^{-6} and are summarized in Table 4-40. This range was based on the single maximum calculated risk estimate within a single populated census block across all populated census blocks within the modeling domain and all facilities within all OES.

Two of the three census blocks (block IDs 709011023 and 709013015) are associated with the K&G Manufacturing facility, based on the TRI reported latitude and longitude, which was discussed in the facility-specific census block analyses for both the TRI release dataset and the 2017 NEI release dataset as well as the *Draft Chemistry, Fate, Release, and Exposure Assessment for 1,1,2-Trichloroethane* (U.S. EPA, 2026g). Based on EPA's review of this facility and the associated census blocks, there were no other facilities within the TRI release dataset releasing 1,1,2-trichloroethane within 50 km of this single facility. Additionally, the facility discontinued use of 1,1,2-trichloroethane after 2019. Therefore, inhalation exposure to 1,1,2-trichloroethane via the ambient air pathway no longer poses an identified cancer risk to the general population under the OES: Open-Top Vapor Degreasing/Cold Cleaning for these two census blocks identified by the multi-facility aggregate analysis.

The third census block (block ID 32001012) was associated with (impacted by) two facilities in proximity (within 50 km of each other). The calculated aggregated cancer risk estimate for this census block was equal to 1×10^{-6} based on the releases modeled. As described in Section 4.1.3.1.4 and the *Draft Chemistry, Fate, Release and Exposure Assessment for 1,1,2-Trichloroethane* (U.S. EPA, 2026g) both facilities are categorized under the OES: Manufacturing as a Byproduct at Chemical Manufacturing Facilities. Additionally, while the modeled concentrations aligned spatially for each facility, they did not align temporally. Therefore, EPA refined the multi-facility aggregate analysis for both facilities by aligning modeled releases both spatially and temporally. Results from the refined analysis found there were no calculated aggregate cancer risk estimates greater than the benchmark of 1×10^{-6} for any of the five years of TRI releases evaluated. Therefore, inhalation exposure to 1,1,2-trichloroethane via the ambient air pathway did not pose an identified aggregate cancer risk to the general population under the Manufacturing as a Byproduct at Chemical Manufacturing Facilities OES for this census block.

Table 4-40. Multi-Facility Aggregate Risk Estimates for Cancer Within a Populated Census Block (TRI Dataset)

FIPS	Block ID	Longitude	Latitude	Population (Number of People in Census Block)	Risk Estimate for Cancer	# of Facilities Impacting Census Block	Distance of Census Block Centroid and Associated Risk Estimate from Nearest Facility (m)
22019	32001012	−93.2957	30.2334629	9	1.0E−06	2	1,392
27131	709011023	−93.2904	44.3140972	52	1.5E−06	1	190
27131	709013015	−93.2958	44.3144671	61	1.1E−06	1	238

4.3.4.1.5 Weight of Scientific Evidence Conclusions for Inhalation

Acute Non-Cancer

Because the modeled concentrations used in the Tier 1 analysis were based on highly conservative, high-end, upper bounding exposure scenarios and model inputs, and all other releases and exposure scenarios modeled would result in lower exposures and associated risks, EPA has robust confidence that high-end exposures were not missed, and the results relied on are protective of the general population (including fenceline communities and PESS). EPA also has robust confidence in its risk characterization that inhalation exposure of the general population to 1,1,2-trichloroethane via the ambient air pathway poses no identified acute non-cancer risk to the general population across the range of OESs/COUs evaluated.

Chronic Non-Cancer and Cancer

Because the modeled concentrations used in the refined Tier 3 analysis are based on conservative, high-end, facility-specific exposure scenarios and model inputs, and all other releases and exposure scenarios modeled result in lower exposures and associated risks, EPA has robust confidence that high-end exposures were not missed, and the results relied on are protective of the general population (including fenceline communities and PESS) for both chronic non-cancer and cancer effects. EPA also has robust confidence in its risk characterization that inhalation exposure of the general population to 1,1,2-trichloroethane via the ambient air pathway poses no identified chronic non-cancer or cancer risk to the general population across the range of OES/COUs evaluated.

4.3.4.2 Risk Estimates for Incidental Dermal

EPA assessed possible risk from incidental dermal exposures while swimming from both facility-specific releases identified in TRI/DMR and generic scenario releases from COU/OESs. Acute dermal exposures for facility-specific releases and generic scenario releases are fully described in Section 4.1.3.2 above and Section 6.4.1 of *Draft Chemistry, Fate, Release, and Exposure Assessment for 1,1,2-Trichloroethane* (U.S. EPA, 2026g) with presented acute doses for adult (21+ years); youth (11–15 years); and children (6–10 years). For facility-specific releases, each OES is represented by the facility within that OES with the highest estimated surface water concentration and generic scenarios are represented by the high-end release scenario and low flow scenario for each OES. These estimated surface water concentrations are combined with high-end default short-term exposure durations as well as age-group specific body weights and surface area exposed for each evaluated age group to arrive at potential doses. Correspondingly, these estimated exposures and risks are anticipated to be higher-end estimates of potential risk across OESs.

Facility-specific release modeling resulted in acute doses ranging from 5.5×10^{-7} to 3.2×10^{-4} mg/kg-day across age groups with the highest doses modeled for Manufacturing as a Byproduct OES from a 30Q5 surface water concentration of 78 µg/L (Section 4.1.3.2; see also Section 6.4.1 of U.S. EPA (2026g)). Associated margins of exposure (MOEs) related to these doses ranged from 3.9×10^{4} to 2.3×10^{7} that are all at least 1,300 times greater than the benchmark MOE of 30, indicating no identified risk below the benchmark (Table 4-41). Generic scenario release modeling resulted in acute doses ranging from 6.4×10^{-9} to 9.8×10^{-6} mg/kg-day with highest doses modeled for the Formulation of Adhesives and Sealants OES from a 30Q5 flow surface water concentration of 2.4 µg/L (Section 4.1.3.2; see also Section 6.4.1 of U.S. EPA (2026g)). Resulting MOEs related to these doses ranged from 1.3×10^{6} to 2.0×10^{9} that are at least 43,000 times higher than the benchmark MOE of 30 indicating no identified risk below the benchmark (Table 4-42). Given that these higher-end scenarios of possible dermal exposures from both facility-specific and generic scenario releases resulted in no identified risk and all other scenarios for other facilities or generic scenario releases would result in lower expected doses, EPA has

robust confidence that incidental dermal exposure from 1,1,2-trichloroethane poses no identified risk across its range of COUs/OESs.

Table 4-41. Facility-Specific Incidental Dermal (Swimming) Acute Risk for Adult, Youth and Child Lifestages by OES

OES[a]	Modeled Surface Water Concentrations		Acute MOE[b] (Benchmark = 30)		
	30Q5 Conc. (µg/L)	HM Conc. (µg/L)	Adult (21+ years)	Youth (11–15 years)	Child (6–10 years)
Manufacturing as a Byproduct at Chemical Facilities/Manufacturing in the Pulp and Paper Industry	78	43	3.9E04	5.1E04	8.4E04
Not Mapped to an OES	7.9	7.9	3.8E05	5.0E05	8.3E05
Processing as a Reactant	12	12	2.6E05	3.4E05	5.6E05
Repackaging for Laboratory Chemical Use	2.6	1.8	1.2E06	1.5E06	2.5E06
Use of Laboratory Chemicals	1.5	1.5	2.0E06	2.7E06	4.4E06
Disposal to Incineration	0.28	9.8E−02	1.1E07	1.4E07	2.3E07
Disposal to Landfill	0.46	0.28	6.6E06	8.6E06	1.4E07
Disposal to Non-POTW WWT	9.1	9.1	3.3E05	4.4E05	7.2E05
Disposal to POTW	4.9	4.1	6.2E05	8.1E05	1.3E06
Remediation	5	5	6.1E05	7.9E05	1.3E06

30Q5 = 30 consecutive days of lowest flow over a 5-year period; HM = harmonic mean; MOE = margin of exposure; OES = occupational exposure scenario; POTW = publicly owned treatment works; WWT = wastewater treatment
[a] Each OES is represented by the facility within that OES with the highest estimated 30Q5 surface water concentration for that OES as described in Section 6.2.1.1 in the *Draft Chemistry, Fate, Release, and Exposure Assessment for 1,1,2-Trichloroethane* (U.S. EPA, 2026g).
[b] MOEs calculated based off presented doses in Section 4.1.3.2 above and Section 6.4.1 of the *Draft Chemistry, Fate, Release, and Exposure Assessment for 1,1,2-Trichloroethane* (U.S. EPA, 2026g).

Table 4-42. Generic Scenario Incidental Dermal (Swimming) Acute Doses for Adult, Youth and Child Lifestages by OES

OES[a]	Flow Percentile	Modeled Surface Water Concentrations		Acute MOE[b] (Benchmark = 30)		
		30Q5 Conc. (µg/L)	HM Conc. (µg/L)	Adult (21+ years)	Youth (11–15 years)	Child (6–10 years)
Formulation of Adhesives and Sealants	P10	2.4	2	1.3E06	1.7E06	2.8E06
Use of Cleaning and Degreasing Solvents	P10	3.5E−03	3.5E−03	8.6E08	1.1E09	1.9E09
Use of Adhesives and Sealants	P10	3.3E−03	3.0E−03	9.1E08	1.2E09	2.0E09

OES[a]	Flow Percentile	Modeled Surface Water Concentrations		Acute MOE[b] (Benchmark = 30)		
		30Q5 Conc. (µg/L)	HM Conc. (µg/L)	Adult (21+ years)	Youth (11–15 years)	Child (6–10 years)

30Q5 = 30 consecutive days of lowest flow over a 5-year period; HM = harmonic mean; MOE = margin of exposure
[a] Each OES represented in table by the high-end release scenario for that OES as described in Section 6.2.1.2 in *Draft Chemistry, Fate, Release, and Exposure Assessment for 1,1,2-Trichloroethane* (U.S. EPA, 2026g)
[b] MOEs calculated based off presented doses in Section 4.1.3.2 above and Section 6.4.1 of *Draft Chemistry, Fate, Release, and Exposure Assessment for 1,1,2-Trichloroethane* (U.S. EPA, 2026g)

4.3.4.3 Risk Estimates for Incidental Oral

EPA assessed possible risk from incidental oral exposures while swimming from both facility-specific releases identified in TRI/DMR and generic scenario releases from COU/OESs. Acute oral ingestion exposures for facility-specific releases and generic scenario releases are fully described in Section 4.1.3.3 above and Section 6.4.2 of U.S. EPA (2026g) with presented acute doses for adult (21+ years); youth (11–15 years); and children (6–10 years). For facility-specific releases, each OES is represented by the facility within that OES with the highest estimated 30Q5 flow surface water concentration and generic scenarios are represented by the high-end release scenario and low flow scenario for each OES. These estimated surface water concentrations are combined with upper percentile ingestion rates for each evaluated age group to arrive at potential doses. Correspondingly, these estimated exposures and risks are anticipated to be higher-end estimates of potential risk across OESs.

Facility-specific release modeling resulted in acute doses ranging 8.6×10^{-7} to 4.2×10^{-4} mg/kg-day across age groups with the highest doses modeled for Manufacturing as a Byproduct OES from a 30Q5 surface water concentration of 78 µg/L (Section 4.1.3.3; see also Section 6.4.2 of U.S. EPA (2026g)). Associated margins of exposure (MOEs) related to these doses ranged from 3.0×10^{4} to 1.5×10^{7} that are all at least 1,000 times greater than the benchmark MOE of 30 indicating no identified risk below the benchmark (Table 4-43). Generic scenario release modeling resulted in acute doses ranging from 1.0×10^{-8} to 1.3×10^{-5} mg/kg-day with highest doses modeled for the Formulation of Adhesives and Sealants OES from a 30Q5 flow surface water concentration of 2.4 µg/L (Section 4.1.3.3; Section 6.4.2 of U.S. EPA (2026g)). Resulting MOEs related to these doses ranged from 1.0×10^{6} to 1.3×10^{9} which are at least 33,000 times higher than the benchmark MOE of 30 indicating no identified risk below the benchmark (Table 4-44). Given that these higher-end scenarios of potential incidental oral ingestion exposures from both facility-specific and generic scenario releases resulted in no identified risk and all other scenarios for other facility-specific or generic scenarios releases would result in lower expected doses, EPA has robust confidence that incidental oral ingestion from 1,1,2-trichloroethane poses no identified risk across its range of COUs/OESs.

Table 4-43. Facility-Specific Incidental Oral (Swimming) Acute Risk for Adult, Youth, and Child Lifestages by OES

OES[a]	Modeled Surface Water Concentrations		Acute MOE[b] (Benchmark = 30)		
	30Q5 Conc. (µg/L)	HM Conc. (µg/L)	Adult (21+ years)	Youth (11-15 years)	Child (6-10 years)
Manufacturing as a Byproduct	78	43	4.7E04	3.0E04	5.3E04
Not Mapped to an OES	7.9	7.9	4.6E05	3.0E05	5.3E05
Processing as a Reactant	12	12	3.1E05	2.0E05	3.5E05
Repackaging for Laboratory Chemical Use	2.6	1.8	1.4E06	9.0E05	1.6E06
Use of Laboratory Chemicals	1.5	1.5	2.5E06	1.6E06	2.8E06
Disposal to Incineration	0.28	9.8E–02	1.3E07	8.3E06	1.5E07
Disposal to Landfill	0.46	0.28	7.9E06	5.1E06	9.1E06
Disposal to Non-POTW WWT	9.1	9.1	4.0E05	2.6E05	4.6E05
Disposal to POTW	4.9	4.1	7.5E05	4.8E05	8.6E05
Remediation	5	5	7.3E05	4.7E05	8.3E05

30Q5 = 30 consecutive days of lowest flow over a 5-year period; HM = harmonic mean; MOE = margin of exposure; OES = occupational exposure scenario

[a] Each OES is represented by the facility within that OES with the highest estimated surface water concentration for that OES as described in Section 6.2.1.1 of *Draft Chemistry, Fate, Release, and Exposure Assessment for 1,1,2-Trichloroethane* (U.S. EPA, 2026g).

[b] MOEs calculated based off presented doses in Section 4.1.3.3 above and in Section 6.4.2 of the *Draft Chemistry, Fate, Release, and Exposure Assessment for 1,1,2-Trichloroethane* (U.S. EPA, 2026g).

Table 4-44. Generic Scenario Incidental Oral (Swimming) Acute Risk for Adult, Youth, and Child Lifestages by OES

OES[a]	Flow Percentile	Modeled Surface Water Concentrations		Acute MOE[b] (Benchmark = 30)		
		30Q5 Conc. (µg/L)	HM Conc. (µg/L)	Adult (21+ years)	Youth (11–15 years)	Child (6–10 years)
Formulation of Adhesives and Sealants	P10	2.4	2	1.5E06	1.0E06	1.8E06
Use of Cleaning and Degreasing Solvents	P10	3.5E−03	3.5E−03	1.0E09	6.7E08	1.2E09
Use of Adhesives and Sealants	P10	3.3E−03	3.0E−03	1.1E09	7.1E08	1.3E09

30Q5 = 30 consecutive days of lowest flow over a 5-year period; MOE = Margin of exposure

[a] Each OES is represented by the facility within that OES with the highest estimated surface water concentration for that OES as described in Section 6.2.1.2 of *Draft Chemistry, Fate, Release, and Exposure Assessment for 1,1,2-Trichloroethane* (U.S. EPA, 2026g).

[b] MOEs calculated based off presented doses in Section 4.1.3.3 above and in Section 6.4.2 of *Draft Chemistry, Fate, Release, and Exposure Assessment for 1,1,2-Trichloroethane* (U.S. EPA, 2026g)

4.3.4.4 Risk Estimates for Drinking Water

EPA assessed possible risk from drinking water consumption from both facility-specific releases identified in TRI/DMR and modeled generic scenario releases from COU/OESs. Drinking water exposures were evaluated for all age groups for acute and chronic non-cancer exposure and chronic cancer exposure, but presented for bottle-fed infants (<1 year), toddlers (1–5 years) and adults (21+ years) in Section 6.5.3 of U.S. EPA (2026g) with full results presented in *Draft General Population Surface Water Pathway Exposure Estimates for 1,1,2-Trichloroethane* supplemental file (U.S. EPA, 2026v). In including infant exposure estimates, the Agency is considering PESS and protecting this susceptible subpopulation. 30Q5 flow surface water concentrations are used for calculation of acute doses whereas harmonic mean flow concentrations are used for calculation of chronic non-cancer and chronic cancer doses. These estimated surface water concentrations are combined with upper percentile drinking water ingestion rates for each evaluated age group to arrive at potential doses.

4.3.4.4.1 Facility-Specific Releases

Evaluation of potential drinking water exposures from facility-specific releases followed a tiered approach where if preliminary indications of risk were identified for the evaluated COU/OESs at initial tiers of analysis, then higher tiers or refined analyses were evaluated when possible.

Table 6-5 in Section 6.2.1.1 of *Draft Chemistry, Fate, Release, and Exposure Assessment for 1,1,2-Trichloroethane* (U.S. EPA, 2026g) shows estimated 30Q5 and HM flow surface water concentrations from facility-specific releases following Tier 2 evaluation. These concentrations were used to estimate drinking water doses as shown in Table 6-21 in Section 6.4.3 of the *Draft Chemistry, Fate, Release, and Exposure Assessment for 1,1,2-Trichloroethane* (U.S. EPA, 2026g) and described in Section 4.1.3.4.1 above.

Acute doses associated with modeled facility-specific releases ranged from 1.1×10^{-5} to 1.1×10^{-2} mg/kg-day across presented age groups with the highest doses modeled for Manufacturing as a Byproduct OES from a 30Q5 flow surface water concentration of 78 µg/L following Tier 2 surface water concentration evaluation. Associated MOEs related to these doses ranged from 1,142 to 1.1×10^{6} that are all at least 38 times greater than the benchmark MOE of 30, indicating no identified risk below the benchmark for the acute drinking water pathway (Table 4-45). Because each OES is represented by the facility with the highest modeled surface water concentration from that OES, all other facilities within an OES would be expected to have lower doses and risks. Therefore, EPA has robust confidence that there is no identified acute drinking water risk due to 1,1,2-trichloroethane facility-specific releases across its range of COUs/OESs.

Average daily doses associated with the evaluation of chronic non-cancer risk ranged from 7.4×10^{-7} to 1.2×10^{-3} mg/kg-day across presented age groups with the highest doses similarly modeled for the Manufacturing as a Byproduct OES from a harmonic mean flow surface water concentration of 43 µg/L. Associated MOEs related to these doses ranged from 447 to 7.0×10^{5} that are all greater than the benchmark MOE of 300, indicating no identified risk below the benchmark for the chronic non-cancer drinking water pathway (Table 4-45). Since each OES is represented by the facility with the highest modeled surface water concentration from that OES, all other facilities within an OES would be expected to have lower doses and risks. Therefore, EPA has robust confidence that there is no identified chronic non-cancer drinking water risk due to 1,1,2-trichloroethane facility-specific releases across its range of COUs/OESs.

Lifetime average daily doses associated with the evaluation of chronic cancer risk ranged from 2.4×10^{-8} to 3.3×10^{-4} mg/kg-day across presented age groups with the highest doses modeled for Manufacturing

as a Byproduct OES from a harmonic mean flow surface water concentration of 43 µg/L following Tier 2 surface water concentration evaluation. Associated lifetime cancer risks ranged from 1.9×10^{-8} to 1.2×10^{-5} across all OES with the highest estimated cancer risk for the Manufacturing as a Byproduct OES (Table 4-45). In total, 10 facilities across 5 OES had estimated lifetime cancer risks higher than the benchmark of 1.0×10^{-6} for chronic cancer drinking water exposures following Tier 2 evaluation. These OESs are provided below:

- Manufacturing as a Byproduct at Chemical Manufacturing Facilities/Manufacturing as a Byproduct in the Pulp and Paper Industry;
- Facilities not mapped to an OES;
- Processing as a Reactant;
- Disposal to Non-POTW WWT; and
- Disposal to POTW.

Based on estimated exposures and identified preliminary risk, a Tier 3 evaluation of potential drinking water exposures was conducted that maps facility releases and identifies their proximity to drinking water intakes and potential dilution downstream (Section 4.1.3.4.1; Section 6.2.2 of *Draft Chemistry, Fate, Release, and Exposure Assessment for 1,1,2-Trichloroethane* (U.S. EPA, 2026g)). Of the 10 facilities evaluated for downstream drinking water intake analysis, 4 had identified downstream drinking water intakes while 6 had no downstream drinking water intakes within 250 km. For those facilities with drinking water intakes downstream, no intakes were less than 70 km downstream and all releases were diluted to less than 0.1% of their initial concentration. Therefore, releasing facilities either did not have drinking water intakes downstream or those that did were far downstream, resulting in significant reductions of initially estimated 1,1,2-trichloroethane concentrations. Quantitative estimates of downstream concentrations are not provided here to shield protected intake location information. Nevertheless, due to either the lack of downstream drinking water intakes or the high degree of dilution expected to occur by the time a release of 1,1,2-trichloroethane reaches a downstream drinking water intake (>99.9% in all cases) all potential facility-specific release with identified preliminary chronic cancer risks during Tier 2 analysis are expected to be alleviated and have cancer risk values less than the benchmark. Therefore, EPA has robust confidence that no facility-specific releases are expected to pose substantial risk from drinking water exposures. Additional support for this conclusion is given by available drinking water monitoring information collected over multiple years and its designation as a regulated water contaminant (Section 6.1.3 in *Draft Chemistry, Fate, Release, and Exposure Assessment for 1,1,2-Trichloroethane* (U.S. EPA, 2026g)). Although it is difficult to directly compare monitored values to estimated facility-specific release locations, available data showed that 1,1,2-trichloroethane was infrequently detected and when collected, measured values were below EPA's Maximum Contaminant Level (MCL) of 5 µg/L.

4.3.4.4.2 Generic Scenario Releases

Evaluation of potential drinking water exposures due to generic scenario releases similarly followed a tiered approach. If exposures resulted in preliminary indications of risk for the evaluated COU/OESs at initial tiers of analysis based on higher-end or conservative inputs and assumptions, then higher tiers or refined analyses followed when possible.

Table 6-11 in Section 6.2.1.2 of *Draft Chemistry, Fate, Release, and Exposure Assessment for 1,1,2-Trichloroethane* (U.S. EPA, 2026g) shows modeled 30Q5 and HM surface water concentrations from generic scenario releases from the Formulation of Adhesives and Sealants, Use of Adhesives and Sealants, and Use of Cleaning and Degreasing Solvents OESs. These concentrations were used to estimate drinking water doses as shown in Table 6-22 in Section 6.4.3 of *Draft Chemistry, Fate,*

Release, and Exposure Assessment for 1,1,2-Trichloroethane (U.S. EPA, 2026g) and described in Section 4.1.3.4.2 above.

Acute doses associated with high-end generic scenario releases modeled using the P10 flow percentile ranged from 1.3×10^{-7} to 3.3×10^{-4} mg/kg-day across presented age groups with the highest doses modeled for the Formulation of Adhesives and Sealants OES from a 30Q5 flow surface water concentration of 2.4 µg/L (Section 4.1.3.4.2; Table 6-22 in *Draft Chemistry, Fate, Release, and Exposure Assessment for 1,1,2-Trichloroethane* (U.S. EPA, 2026g)). Associated margins of exposure (MOEs) related to these doses ranged from 3.8×10^{4} to 2.2×10^{7} that are all at least 1,200 times greater than the benchmark MOE of 30 indicating no identified risk below the benchmark for the acute drinking water pathway (Table 4-46). Evaluated scenarios incorporated higher-end inputs for operating days and amount of 1,1,2-trichloroethane released along with lower flow conditions. Together these parameters result in higher modeled surface water concentrations. When these modeled concentrations are combined with other conservative inputs such as higher-end drinking water intake rates, all other scenarios using central tendency release conditions or higher flow conditions would result in lower estimated doses. Since presented scenarios resulted in no identified risk using these higher-end inputs, EPA has robust confidence that drinking water exposure from 1,1,2-trichloroethane poses no identified acute risk across its range of COUs/OESs.

Average daily doses associated with the evaluation of chronic non-cancer risk for generic scenario releases ranged from 2.4×10^{-8} to 5.7×10^{-5} mg/kg-day across presented age groups with the highest doses similarly modeled for the Formulation of Adhesives and Sealants OES from a harmonic surface water concentration of 2 µg/L (Section 4.1.3.4.2; Table 6-22 in *Draft Chemistry, Fate, Release, and Exposure Assessment for 1,1,2-Trichloroethane* (U.S. EPA, 2026g)). Associated MOEs related to these doses ranged from 9,106 to 2.2×10^{7} that are at least 30 times greater than the benchmark MOE of 300 indicating no identified risk below the benchmark for the chronic non-cancer drinking water pathway (Table 4-46). Similar to the acute results described above, evaluated scenarios incorporated higher-end inputs for operating days and amount of 1,1,2-trichloroethane releases along with lower flow conditions. These scenarios are expected to be higher-end estimates of potential risk and all other scenarios using central tendency release conditions or higher flow conditions would result in lower modeled doses and risk. Because the presented scenarios resulted in no identified risk, EPA has robust confidence that drinking water exposure from 1,1,2-trichloroethane poses no identified chronic non-cancer risk across its range of COUs/OESs.

Lifetime average daily doses associated with the evaluation of chronic cancer risk from generic scenario releases ranged from 7.8×10^{-10} to 1.6×10^{-5} mg/kg-day across presented age groups with the highest doses modeled for Formulation of Adhesives and Sealants OES from a HM flow surface water concentration of 2 µg/L (Section 4.1.3.4.2; Table 6-22 in *Draft Chemistry, Fate, Release, and Exposure Assessment for 1,1,2-Trichloroethane* (U.S. EPA, 2026g)). Associated lifetime cancer risks ranged from 6.1×10^{-10} to 5.7×10^{-7} across all OES with the highest estimated cancer risk for the Formulation of Adhesives and Sealants OES (Table 4-46). All of these estimated risks are below the benchmark of 1.0×10^{-6} and therefore indicate no identified risk. Importantly, unlike the facility-specific releases discussed above, generic scenarios are not location specific with releases to known, identifiable water bodies. Given that this initial evaluation was limited to high-end inputs of amount released and number of release days under the lowest flow conditions modeled (P10 flow), all other scenarios would be expected to result in lower estimated doses and risks. Because risk was not identified under these more conservative higher-end release and exposure conditions, EPA has robust confidence that drinking water exposure from 1,1,2-trichloroethane poses no identified chronic non-cancer risk across its range of TSCA generic scenario OESs.

Table 4-45. Facility-Specific Drinking Water Risks for Adult, Infant, and Toddler Lifestages by OES Based on Tier 2 Modeled Surface Water Concentrations

OES[a]	Surface Water Concentrations		Adult Lifetime Cancer Risk (BM = 1.0E−06)	Adult (21+ years)		Infant (birth to < 1 year)		Toddler (1-5 years)	
	30Q5 Conc. (µg/L)	HM Conc. (µg/L)		Acute Non-Cancer MOE (BM = 30)	Chronic Non-Cancer MOE (BM = 300)	Acute Non-Cancer MOE (BM = 30)	Chronic Non-Cancer MOE (BM = 300)	Acute Non-Cancer MOE (BM = 30)	Chronic Non-Cancer MOE (BM = 300)
Manufacturing as a Byproduct at Chemical Manufacturing Facilities/Manufacturing as a Byproduct in the Pulp and Paper Industry	78	43	**1.2E−05**	4,008	1,142	1,142	447	3,213	1,043
Not Mapped to an OES	7.9	7.9	**1.5E−06**	4.0E04	8,740	1.1E04	3,422	3.2E04	7,984
Processing as a Reactant	12	12	**3.2E−06**	2.7E04	4,194	7,589	1,642	2.1E04	3,831
Repackaging for Laboratory Chemical Use	2.6	1.8	3.5E−07	1.2E05	3.8E04	3.4E04	1.5E04	9.6E04	3.5E04
Use of Laboratory Chemicals	1.5	1.5	3.0E−07	2.1E05	4.5E04	6.0E04	1.7E04	1.7E05	4.1E04
Disposal to Incineration	0.28	9.8E−02	1.9E−08	1.1E06	7.0E05	3.1E05	2.7E05	8.8E05	6.4E05
Disposal to Landfill	0.46	0.28	5.4E−08	6.8E05	2.4E05	1.9E05	9.5E04	5.4E05	2.2E05
Disposal to Non-POTW WWT	9.1	9.1	**1.7E−06**	3.5E04	7,618	9,846	2,983	2.8E04	6,959
Disposal to POTW	4.9	4.1	**1.1E−06**	6.4E04	1.2E04	1.8E04	4,561	5.1E04	1.1E04
Remediation	5	5	9.6E−07	6.3E04	1.4E04	1.8E04	5,406	5.0E04	1.3E04

30Q5 = 30 consecutive days of lowest flow over a 5-year period; BM = benchmark; HM = harmonic mean; MOE = margin of exposure
[a] Each OES is represented by the facility within that OES with the highest estimated surface water concentration for that OES as described in Section 6.2.1.1 of *Draft Chemistry, Fate, Release, and Exposure Assessment for 1,1,2-Trichloroethane* (U.S. EPA, 2026g) and Section 4.1.3.4.1.
Values identifying preliminary risk are **bolded and shaded**.

Table 4-46. Generic Scenario Drinking Water Risk for Adult, Infant, and Toddler Lifestages by OES

OES[a]	Flow Percentile	Modeled Surface Water Concentrations		Adult Lifetime Cancer (BM = 1.0E−06)	Adult (21+ years)		Infant (birth to < 1 year)		Toddler (1-5 years)	
		HM Conc. (µg/L)	30Q5 Conc. (µg/L)		Acute Non-Cancer MOE (BM = 30)	Chronic Non-Cancer MOE (BM = 300)	Acute Non-Cancer MOE (BM = 30)	Chronic Non-Cancer MOE (BM = 300)	Acute Non-Cancer MOE (BM = 30)	Chronic Non-Cancer MOE (BM = 300)
Formulation of Adhesives and Sealants	P10	2	2.4	5.7E−07	1.3E05	2.3E04	3.8E04	9,106	1.1E05	2.1E04
Use of Cleaning and Degreasing Solvents	P10	3.5E−03	3.5E−03	7.9E−10	8.9E07	1.7E07	2.5E07	6.5E06	7.1E07	1.5E07
Use of Adhesives and Sealants	P10	3.0E−03	3.3E−03	6.1E−10	9.4E07	2.2E07	2.7E07	8.6E06	7.6E07	2.0E07

30Q5 = 30 consecutive days of lowest flow over a 5-year period; BM = benchmark; HM = harmonic mean; MOE = margin of exposure
[a] Each OES represented in table by the high-end release scenario for that OES as described in Section 6.2.1.2 of *Draft Chemistry, Fate, Release, and Exposure Assessment for 1,1,2-Trichloroethane* (U.S. EPA, 2026g) and Section 4.1.3.4.2.

4.3.5 Risk Characterization for Aggregate Exposures

Section 6(b)(4)(F)(ii) of TSCA requires EPA, as a part of the risk evaluation, to describe whether aggregate or sentinel exposures under the COUs were considered and the basis for their consideration. Furthermore, in the final RE framework rule, the Agency codified at 720.39(d)(8), a requirement that "EPA will consider aggregate exposures to the chemical substance, and, when supported by reasonably available information, consistent with the best available science and based on the weight of scientific evidence, include an aggregate exposure assessment in the risk evaluation, or will otherwise explain in the risk evaluation the basis for not including such an assessment." In this risk evaluation, EPA quantitatively evaluated combined inhalation exposure and risk across multiple facilities (Section 4.1.3.1.4).

5 ENVIRONMENTAL RISK ASSESSMENT

1,1,2-Trichloroethane – Environmental Risk Assessment (Section 5): Key Points

EPA evaluated the reasonably available information to support environmental risk characterization of 1,1,2-trichloroethane.

- The primary environmental exposure pathways of 1,1,2-trichloroethane are surface water and air.
- EPA assessed acute and chronic exposures to aquatic organisms (water column), sediment-dwelling invertebrates (sediment), terrestrial mammals (inhalation), terrestrial invertebrates (soil), and terrestrial plants (soil porewater).
- ***Aquatic Species***
  - Risk quotient (RQ) values for aquatic organisms in the water column were derived using concentrations of concern (COC) for acute exposures to vertebrates and invertebrates (25.3 mg/L), chronic exposures to vertebrates (2.67 mg/L), and 72-hour exposures to algae (26.3 mg/L) as well as the highest modeled surface water concentrations from facility-specific and generic scenario releases.
  - RQ values for sediment-dwelling animals were derived using the COC (2.89 mg/kg) and the highest modeled sediment concentrations.
  - RQ values did not exceed the benchmark of 1 for aquatic organisms in surface water or sediment.
  - EPA has robust confidence that this assessment of risk to aquatic organisms using facility-specific and generic scenario releases is protective.
- ***Terrestrial Species***
  - An RQ value of 1.6×10^{-6} µg/m^3 for inhalation by terrestrial mammals was derived using a hazard threshold to a human health rodent model species (2.1×10^{6} µg/m^3) and the highest modeled concentration in air (34 µg/m^3).
  - Based on monitoring data, physical and chemical properties, and release data, EPA has robust confidence that if present in soil, 1,1,2-trichloroethane will be at low concentrations that do not exceed the hazard thresholds to terrestrial invertebrates in soil (1.05 mg/kg) or terrestrial plants in soil porewater (306.9 mg/L).
  - EPA has robust confidence in the protective nature of this risk assessment to terrestrial animals and plants.

EPA assessed environmental risks of 1,1,2-trichloroethane exposure to aquatic and terrestrial species. Section 5.1 describes the environmental exposures through surface water, sediment, air, and soil. Environmental hazards for aquatic and terrestrial species are described in Section 5.2, whereas environmental risk characterization is described in Section 5.3.

5.1 Summary of Environmental Exposures

EPA assessed environmental concentrations of 1,1,2-trichloroethane in air, water, and land for use in environmental exposure. The environmental exposures are described in the *Draft Chemistry, Fate, Release, and Exposure Assessment for 1,1,2-Trichloroethane* (U.S. EPA, 2026g). 1,1,2-Trichloroethane is expected to be released to the environment via air, surface water, biosolids, and landfills. The measured log K_{OC} values, ranging from 1.35 to 2.95, suggest that 1,1,2-trichloroethane will have a low

to moderate affinity for organic matter and will undergo moderate to rapid migration to groundwater in terrestrial environments. Additionally, based on its vapor pressure (23 mmHg at 25 °C) and Henry's Law constant (8.24×10^{-4} atm·m^3/mol at 25 °C), 1,1,2-trichloroethane will also be subject to volatilization.

EPA conducted modeling with Exposure and Fate Assessment Screening Tool Version 2014 (E-FAST) methodologies (U.S. EPA, 2014) and Variable Volume Water Model (VVWM) in EPA's Point Source Calculator (PSC) v1.05 (U.S. EPA, 2019c) to estimate concentrations of 1,1,2-trichloroethane within surface water and sediment respectively. In surface water, 1,1,2-trichloroethane will be subject to volatilization to air, and have slow biodegradation, advection, dispersion, and dilution. There are limited measured data on concentrations of 1,1,2-trichloroethane in biosolids or soils receiving biosolids. EPA identified no studies that report evidence of 1,1,2-trichloroethane in tissues of any organisms. Based on the water solubility (4,580 mg/L) and hydrophobicity (log K_{OW} = 2.05; log K_{OC} = 2.06) of 1,1,2-trichloroethane, it is not expected to have potential for significant bioaccumulation, biomagnification, or bioconcentration in exposed organisms. Therefore, 1,1,2-trichloroethane has low potential for trophic transfer through food webs.

Table 5-1. 1,1,2-Trichloroethane Occupational Exposure Scenarios, Release Media, Route of Exposure, and High-End Modeled and Measured Environmental Exposure Concentrations Used in the Screening Risk Assessment

Description and OES	Release Medium	Route of Exposure	Estimated 1,1,2-Trichloroethane Concentration
Highest modeled facility specific release OES (Manufacturing as a Byproduct at Chemical Manufacturing Facilities)	Water	Surface water	145 µg/L
		Sediment	628 µg/kg
Highest modeled generic scenario release OES (Formulation of Adhesives and Sealants)		Surface water	2.8 µg/L
		Sediment	13.4 µg/kg
Highest measured concentration in United States[a]		Surface water	10.8 µg/L
		Sediment	NA[b]
N/A[c]	Air	Inhalation	33.7 µg/m^3
N/A	Land	Soil	NA[d]

[a] Data from Water Quality Portal (WQP; 2015–2025) (U.S. EPA, 2026g).
[b] No samples reported above the level of detection from WQP database (U.S. EPA, 2026g).
[c] Maximum modeled ambient air concentrations from combined fugitive and stack releases across all COUs based on highly conservative, Tier 1 analysis.
[d] EPA identified limited data on concentrations of 1,1,2-trichloroethane in landfills, soils, and biosolids (Section 2.2 and U.S. EPA (2026g)).

5.2 Summary of Environmental Hazards

Concentrations of concern (COCs) were derived for acute and chronic 1,1,2-trichloroethane exposures in water and sediment ((U.S. EPA, 2026w); Table 5-2). Hazard values (HV) were derived for chronic terrestrial exposures to mammals, invertebrates, and birds ((U.S. EPA, 2026w); Table 5-2). Confidence in hazard thresholds ranged from slight-to-moderate to robust based on the quality of the database,

consistency, strength and precision, dose-response, and relevance of the available data for each ecological receptor group (Table 5-2).

Table 5-2. Environmental Hazard Thresholds for 1,1,2-Trichloroethane

Receptor Group	Exposure Duration	Hazard Threshold (Confidence in COC or HV)	Assessment Medium	Citation (Study Quality)
Aquatic vertebrates and invertebrates	Acute exposure resulting in aquatic vertebrate and invertebrate species mortality	25.3 mg/L [a] (Robust)	Water column	From SSD [b]
Aquatic vertebrates	Chronic exposure to aquatic vertebrate species (reduced fish [*Pimphales promelas*] weight and survival over 32 days) [c]	2.67 mg/L (Moderate)	Water column	Ahmad et al. (1984) (High)
Aquatic invertebrates	Chronic exposure to aquatic invertebrate species (reduced *Daphnia magna* reproduction over 28 days) [c]	3.3 mg/L (Robust)	Water column	Richter et al. (1983) (High)
Sediment-dwelling invertebrate sediment exposure	Multiple acute exposures over 56 days to sediment-dwelling invertebrate (reduced midge [*Chironomus riparius*] emergence in the second generation after 56 days) [c d e]	2.89 mg/kg (Slight-to-Moderate)	Sediment	Smithers (2023) [e] (High)
Algae	72-hour exposure to algae (reduced *Chlamydomonas reinhardtii* population growth rate inhibition)	26.3 mg/L (Moderate)	Water column	Brack and Rottler (1994) (High)
Terrestrial mammals	Chronic inhalation exposure (7.5% reduced laboratory rat survival)	2,126 mg/m^3 (Slight-to-Moderate)	Air inhalation	WIL Research (2001) (High)
Terrestrial invertebrates	Acute exposure to soil invertebrates (50% lower earthworm [*Eisenia fetida*] survival 48 hours)	42 µg/cm^2 (1.05 mg/kg) (Moderate)	Soil	Neuhauser et al. (1985) (High)
Terrestrial plants	Chronic exposure in soil to plants (zero growth concentration in Canadian poplar [*Populus x canadensis*] biomass over 16 days)	307 mg/L [f] (Moderate)	Soil	Dietz and Schnoor (2001) (Medium)

COC = concentration of concern; dw = dry weight; HV = hazard value; SSD = species sensitivity distribution

[a] Represents the concentration expected to protect 95% of species. The sand goby (*Pomatoschistus minutus* [LC50 = 27 mg/L]) and bluegill (*Lepomis macrochirus* [LC50 = 40 mg/L]) were the most sensitive species to 1,1,2-trichloroethane.

[b] SSD derived from LC50 values of 16 species that represent 3 different phyla (Arthropoda, Chordata, and Mollusca) that inhabit both freshwater and marine environments.

[c] An assessment factor of 10 was applied to account for variation in species sensitivity and uncertainties in extrapolating from laboratory conditions to environmental concentrations and exposure durations (U.S. EPA, 2026w; Zeeman, 1995).

[d] Exposures consisted of acute applications of 1,1,2-trichloroethane on Day 1 and Day 29 of the experiment while measuring multiple endpoints across two generations. Measured exposure concentrations decreased rapidly after the 1,1,2-trichloroethane applications resulting in animals being exposed to <1% of applied concentrations on Day 28 and day 56 (U.S. EPA, 2026w; Smithers, 2023).

[e] Study submitted under a TSCA section 4 test order.

[f] Zero growth concentration reported by authors as the concentration at which net plant growth in a hydroponic nutrient solution was 0 over 16 days.

5.3 Environmental Risk Characterization

5.3.1 Risk Assessment Approach

The environmental risk characterization of 1,1,2-trichloroethane was conducted to evaluate whether the potential releases and resultant exposures of 1,1,2-trichloroethane in air, water, or soil will exceed the 1,1,2-trichloroethane concentrations that result in hazardous effects on populations of aquatic or terrestrial organisms. EPA established COUs under the lifecycle stages of manufacturing, processing, industrial use, commercial use, and disposal (Section 3; Table 3-1). In evaluating the 1,1,2-trichloroethane environmental risk in surface water and sediments, the Agency used a screening analysis using high-end measured and modeled exposure estimates. Environmental risk of 1,1,2-trichloroethane in air was also assessed using high-end exposure concentrations in a screening assessment. Environmental risk in soil via biosolids was considered but not assessed quantitatively due to 1,1,2-trichloroethane properties and fate. In evaluating the environmental hazard of 1,1,2-trichloroethane, a weight of scientific evidence approach was used to select hazard threshold concentrations for the derivation of risk quotients (RQs) for aquatic and terrestrial organisms.

Environmental risk was characterized by calculating RQs (U.S. EPA, 1998; Barnthouse et al., 1982). The RQ is defined in Equation 5-1:

Equation 5-1. Calculating the Risk Quotient

$$RQ = \frac{Predicted\ Environmental\ Concentration}{Hazard\ Threshold}$$

Environmental exposure concentrations (*i.e.,* surface water, pore water, sediment, and soil) were based on concentrations of 1,1,2-trichloroethane measured (*i.e.,* monitored data and/or available literature) and/or modeled (*i.e.,* EPA's Exposure and Fate Assessment Screening Tool [E-FAST], VVWM-PSC Tool, (U.S. EPA, 2026g)).

The COCs used to calculate RQs for aquatic organisms were derived from hazard values resulting from acute 1,1,2-trichloroethane exposures to animals, chronic exposures to aquatic vertebrates, 72-hour exposures to algae, and multiple acute sediment exposures to sediment-dwelling invertebrates (Section 5.2; (U.S. EPA, 2026w)).

The benchmark value for RQs in environmental risk characterization was 1. If the RQ was above 1, the exposure was greater than the COC or hazard threshold concentration, providing evidence of potential adverse effects on populations of animals or plants. If the RQ was below 1, the exposure was less than the hazard concentration. An RQ equal to 1 indicated that the exposures were the same as the concentration that caused effects. EPA further characterized risk estimates with the number of days of exceedance if RQ values are greater than 1 to describe and align the estimated durations of 1,1,2-trichloroethane exposure to the acute or chronic exposure durations that lead to adverse population effects. However, EPA considered all of the available weight of scientific evidence for determinations of risk.

RQ values were determined for surface water and sediment exposure to aquatic organisms from 10 COU releases using TRI- and DMR-reported data (Table 3-6) and 3 COUs using generic scenario modeling of 1,1,2-trichloroethane. A separate assessment of pore water exposure for sediment-dwelling organisms was not conducted because both pore water exposure concentrations and pore water hazard values were derived from sediment concentrations, such that evaluating pore water would not provide additional

information beyond the whole-sediment assessment. In all surface water and sediment scenarios, EPA assessed the risk of 1,1,2-trichloroethane to populations of aquatic organisms near immediate outflow of wastewater treatment facilities and assumed considerable wastewater treatment removal (*i.e.,* 73% (U.S. EPA, 2026g)). Because of dilution and the physical and chemical properties of 1,1,2-trichloroethane—especially its propensity to volatilize (U.S. EPA, 2026g)—EPA assumed that 1,1,2-trichloroethane concentrations would be lower further from wastewater treatment facilities, making risk estimates near facilities protective of other locations. This screening assessment used the estimated release days (Section 3.1.2; Table 3-4) of 1,1,2-trichloroethane and subsequent surface water concentration for each COU/OES. The overall confidence in the environmental risk characterization integrated confidence from both environmental exposures and environmental hazards.

Monitored environmental exposure data that were linked with 1,1,2-trichloroethane COU were not reasonably available. Thus, EPA relied on predicted exposure concentrations that were derived through modelling of COU-specific environmental concentrations. High-end model inputs and conservative assumptions were used for first-tier or screening assessments, resulting in higher confidence when RQ values were less than the benchmark of 1 for a COU. EPA also provided an additional line of evidence by considering comparisons of hazard thresholds to measured 1,1,2-trichloroethane concentrations in the U.S surface waters and sediments.

For aquatic organisms, EPA calculated RQ values for each ecological receptor group and duration for which a COC was derived (U.S. EPA, 2026w). However, only RQ values for acute exposures to aquatic animals, chronic exposures to fish, 72-hour exposures to algae, and sediment exposures to sediment-dwelling animals are presented in Section 5.3.3, these highlight the lower and more protective COCs from the water exposure pathway. Specifically, RQ values for chronic surface water exposure to fish were included because the COC (2.67 mg/L) is lower than the COC for chronic exposures to invertebrates (3.3 mg/L) and thus protective for all chronic water exposures. Also, for simplicity, only the RQ values for sediment-dwelling animals via sediment exposure were included because the RQ values from sediment pore water exposures are qualitatively identical.

To characterize potential risk from inhalation exposure, the hazard threshold for inhalation exposures to terrestrial mammals (2.1×10^{-6} µg/m^3) was compared to the highest modeled air concentration. EPA reviewed and screened environmental monitoring data to consider terrestrial exposure to 1,1,2-trichloroethane through direct soil exposure to terrestrial invertebrates and plants. The Agency also considered dietary exposure to terrestrial mammals through bioaccumulation and trophic transfer, but a screening-level fish ingestion assessment was not conducted because 1,1,2-trichloroethane has a low bioaccumulation potential (BAF = 6.59), a lack of empirical evidence for accumulation in fish, and a lack of dietary hazard information for wildlife, indicating that exposure and risk to fish consumers are not likely (U.S. EPA, 2026g).

5.3.2 Relevant Exposure Pathways into the Environment

EPA evaluated environmental releases of 1,1,2-trichloroethane to water, air, and land from COU releases. Environmentally relevant exposure pathways that potentially affect organisms from these releases were based on 1,1,2-trichloroethane's physical and chemical properties and fate, release volumes, and exposure estimates (Table 5-3) and focused on the COUs outlined in Section 3.1.1 (Table 5-4). EPA quantitatively characterized the environmental risk through the surface water pathway with high-end concentrations in a screening approach because releases may be at concentrations that affect aquatic organism survival or reproduction (U.S. EPA, 2026w).

Table 5-3. Relevant Exposure Pathway to Organisms and Corresponding Risk Assessment for the 1,1,2-Trichloroethane Environmental Risk Characterization

Exposure Pathway	Duration and Organism Hazard	Risk Assessment [a]
Surface water	Acute exposure resulting in aquatic vertebrate and invertebrate species mortality	RQ < 1 in screening scenarios with high-end measured and modeled water concentrations
	Chronic exposure to aquatic vertebrate species (reduced fish [*(Pimphales promelas)*] weight and survival over 32 days)	RQ < 1 after Tier 2 refinement of modeled surface water screening scenarios and concentrations [c]
	72-hour exposure to algae (reduced *Chlamydomonas reinhardtii* population growth by 10%)	RQ < 1 in screening scenarios with high-end measured and modeled water concentrations
Sediment	Multiple acute exposures over 56 days to sediment-dwelling invertebrate (reduced midge [*Chironomus riparius*] emergence in the second generation after 56 days) [b]	RQ < 1 in screening scenarios with high-end measured and modeled water concentrations
Air	Acute inhalation exposure to terrestrial mammals extrapolated to chronic exposure effects (reduced mammal survival)	RQ < 1 in screening scenario with high-end measured and modeled air concentrations
Biosolids to soil	Acute exposure to soil invertebrates (reduced earthworm [*Eisenia fetida*] survival over 48-hours) and chronic exposure to plants (reduced poplar [*Populus x canadensis*] growth over 16 days)	Not assessed as soil concentrations are expected to be minimal due to physical and fate parameters
Trophic transfer	No evidence of adverse effects on wild animal populations	Not assessed as bioaccumulation in organisms is expected to be minimal and no evidence of adverse effects on wild animal populations

RQ = risk quotient
[a] EPA has moderate-to-robust confidence in scenarios with conservative and screening assumptions resulting in RQs <1 (U.S. EPA, 2026w).
[b] Exposures consisted of acute applications of 1,1,2-trichloroethane on Day 1 and Day 29 of the experiment while measuring multiple endpoints across two generations. Measured exposure concentrations decreased rapidly after the 1,1,2-trichloroethane applications resulting in animals being exposed to <1% of applied concentrations on Day 28 and day 56 (U.S. EPA, 2026w; Smithers, 2023).
[c] RQ<1 after Tier 2 refinement of modeled surface water concentrations (U.S. EPA, 2026g).

Table 5-4. Environmental Risk Summary and Basis for 1,1,2-Trichloroethane Risk Characterization

Conditions of Use			Occupational Exposure Scenarios (OESs) for Assessment	Release Media	Risk Characterization
Life Cycle Stage [a]	Category [b]	Subcategory [c]			
Manufacturing	Domestic manufacture	Domestic manufacture	Manufacturing as a Byproduct at Chemical Manufacturing Facilities (OES #1); modeled using facility release data	Water and sediment	RQs<1
			Manufacturing as a Byproduct in the Pulp and Paper Industry (OES #2)	Air	RQs<1
	Import	Import	Repackaging for Laboratory Chemical Use (OES #3)	Air	RQs<1
Processing	Repackaging	Repackaging			
	Processing – As a reactant	Intermediate in: Plastic manufacturing	Processing as a Reactant (OES #4); modeled using facility release data	Water and sediment	RQs<1
		Intermediate in: Petrochemical manufacturing			
		Intermediate in: All other chemical product manufacturing			
	Recycling	Recycling			
	Incorporation into a formulation, mixture, or reaction product	Formulation of adhesives and sealants	Formulation of Adhesives and Sealants (OES #5); modeled using multimedia generic scenario	Water and sediment	RQs<1
Distribution in commerce	Distribution in commerce	Distribution in Commerce	Distribution in Commerce (OES #15) [d]	Water and sediment	RQs<1
Industrial use	Adhesives and sealants	Adhesives and sealants	Use of Adhesives and Sealants (OES #6); modeled using multimedia generic scenario	Air; water and sediment	RQs<1
	Solvents (for cleaning and degreasing)	Solvents (for cleaning and degreasing)	Open-Top Vapor Degreasing (OES #7); modeled using multimedia generic scenario	Air; water and sediment	RQs<1
			Cold Cleaning (OES #8)	N/A	Not assessed as environmental

Conditions of Use			Occupational Exposure Scenarios (OESs) for Assessment	Release Media	Risk Characterization
Life Cycle Stage [a]	**Category [b]**	**Subcategory [c]**			
					concentrations are expected to be minimal due to physical and fate parameters
Commercial use	Adhesives and sealants	Adhesives and sealants	Use of Adhesives and Sealants (OES #6); modeled using multimedia generic scenario	Air; water and sediment	RQs<1
	Other use	Laboratory chemical	Use of Laboratory Chemicals (OES #9); modeled using facility release data	Water and sediment	RQs<1
Consumer use	Adhesives and sealants	Adhesives and sealants	N/A [e]	N/A	Not assessed as environmental releases from consumer use and disposal are expected to be negligible. [f]
Disposal	Disposal	Disposal	Disposal to Incineration (OES #10); modeled facility release data	Water and sediment	RQs<1
			Disposal to Landfill (OES #11); modeled facility release data	Water and sediment	RQs<1
			Disposal to POTW (OES #12); modeled facility release data	Water and sediment	RQs<1
			Disposal to Non-POTW WWT (OES #13); modeled facility release data	Water and sediment	RQs<1
			Remediation (OES #14); modeled facility release data	Water and sediment	RQs<1

OES = occupational exposure scenario; POTW = publicly owned treatment works; RQ = risk quotient; WWT = wastewater treatment

[a] Life Cycle Stage Use Definitions (40 CFR 711.3)
– "Industrial use" means use at a site at which 1 or more chemicals or mixtures are manufactured (including imported) or processed.
– "Commercial use" means the use of a chemical or a mixture containing a chemical (including as part of an article) in a commercial enterprise providing saleable goods or services.
– "Consumer use" means the use of a chemical or a mixture containing a chemical (including as part of an article, such as furniture or clothing) when sold to or made available to consumers for their use. – Although EPA has identified both industrial and commercial uses here for purposes of distinguishing scenarios in this document, the Agency interprets the authority over "any manner or method of commercial use" under TSCA section 6(a)(5) to reach both.

[b] These categories of conditions of use (COUs) appear in the life cycle diagram, reflect Chemical Data Reporting (CDR) codes, and broadly represent COUs of 1,1,2-trichloroethane in industrial and/or commercial settings and for consumer uses.

Conditions of Use			Occupational Exposure Scenarios (OESs) for Assessment	Release Media	Risk Characterization
Life Cycle Stage [a]	**Category** [b]	**Subcategory** [c]			

[c] These subcategories reflect more specific COUs of 1,1,2-trichloroethane.
[d] Releases and exposures during distribution in commerce are not quantitatively assessed in this risk evaluation.
[e] Consumer uses are not assigned to OESs but are assessed elsewhere in this draft risk evaluation.
[f] The Agency expects that environmental releases of 1,1,2-trichloroethane from consumer use and disposal will be negligible and not expected to exceed hazard to ecological receptors. The disposal COU encompasses 1,1,2-trichloroethane contained in a waste stream collected from facilities and 1,1,2-trichloroethane contained in wastewater discharged by occupational users and disposed consumer products and articles.

4883

5.3.3 Risk Estimates for Aquatic Species

Risk to aquatic organisms was characterized by comparing COCs for aquatic organisms (U.S. EPA, 2026w) to the highest modeled surface water and sediment concentrations for OESs with facility-specific releases and for OESs without available DMR or TRI data using generic scenarios (U.S. EPA, 2026g). Risk estimates were derived for acute aquatic animals, chronic vertebrates, algae, and sediment-dwelling animals because the COCs of these ecological receptors represent the most protective concentrations and durations:

- The acute COC for aquatic animals of 25.3 mg/L was derived using a species sensitivity distribution (SSD) of LC50 values (concentrations of 1,1,2-trichloroethane that are lethal to 50% of test organisms) from studies of fish and invertebrate mortality over acute exposure durations (48- to 96-hour) (U.S. EPA, 2026w).
- The chronic COC for aquatic vertebrates of 2.67 mg/L was derived from a 32-day study of the fathead minnow (*Pimephales promelas*) resulting in 23% lower survival and 65% reduced weight (U.S. EPA, 2026w; Ahmad et al., 1984).
- The COC for algae of 26.3 mg/L was derived from a 72-hour study of *Chlamydomonas reinhardtii* resulting in 10% lower population growth (EC10) (U.S. EPA, 2026w; Brack and Rottler, 1994).
- The COC for sediment-dwelling invertebrates of 2.89 mg/kg was derived from a 56-day study of the midge (*Chironomus riparius*) resulting in 50% reduced emergence in the second generation (U.S. EPA, 2026w; Smithers, 2023).

5.3.3.1 Risk Estimates for Surface Water

The COCs for acute exposures to aquatic animals (25.3 mg/L), chronic exposures to aquatic vertebrates (2.67 mg/L), and 72-hour exposures to algae (26.3 mg/L) were compared to the highest modeled surface water concentrations. For context, EPA also compared COCs to high-end measured 1,1,2-trichloroethane concentrations reported from U.S. water bodies but were not known to be associated with EPA's COUs.

5.3.3.1.1 Facility Specific Reported Releases

The highest modeled concentrations of 1,1,2-trichloroethane in surface water (145 µg/L) resulted in RQ values for acute exposure to aquatic species (5.7×10^{-3}), chronic exposure to aquatic vertebrates (5.4×10^{-2}), and 72-hour exposure to algae (5.5×10^{-3}) that were less than the benchmark of 1 (Table 5-5). The Manufacturing as a Byproduct OES represents the highest water concentration from facility specific reported releases; therefore, all OES with facility specific reported releases had RQ values that were less than 1. Collectively, the facility-based analysis indicates no expected risk to aquatic organisms near direct outfalls under screened, high-end conditions. Given historical low-flow (7Q10; *i.e.,* lowest 7-day flow [on average] in a 10-year period) conditions, dilution, and the propensity of 1,1,2-trichloroethane to volatilize (Section 2.1), concentrations are expected to decline downstream. Therefore, near-outfall risk estimates from this high-end scenario are protective of other locations. EPA has robust confidence that this assessment of risk to aquatic organisms using facility specific releases is protective.

5.3.3.1.2 Generic Scenario Releases

High-end modeled concentrations of 1,1,2-trichloroethane in surface water (2.8 µg/L) for the Formulation of Adhesives and Sealants OES resulted in RQ values for acute exposure to aquatic species (7.51×10^{-5}), chronic exposure to aquatic vertebrates (7.12×10^{-4}), and 72-hour exposures to algae (7.2×10^{-5}) that did not exceed the benchmark of 1 (Table 5-5). Therefore, all generic scenario RQ values were less than 1.

Collectively, these RQs indicate that risk estimates are below the benchmark of 1, consistent with a low potential for acute or chronic risk. The highest modeled concentration reflects a high-end, rarely occurring scenario and is expected to overestimate risk for most locations and conditions due to compounding conservatisms. These scenarios represent historical low-flow (7Q10) conditions that resulted in the high-end concentrations assumed to occur at the immediate outflow into the water body. Given dilution and the propensity of 1,1,2-trichloroethane to volatilize (Section 2.1), concentrations are expected to decline downstream. Therefore, near-outfall risk estimates from this high-end scenario are protective of other locations. EPA has robust confidence that this assessment of risk to aquatic organisms using generic scenario releases is protective.

5.3.3.1.3 Monitored/Measured data

Data in the Water Quality Portal (WQP; (U.S. EPA, 2026g)) provide broad context and add confidence that these risk estimates are protective of other locations and scenarios. The highest measured value from the WQP database (10.8 µg/L; (U.S. EPA, 2026g)) does not exceed the COCs for acute animals, chronic vertebrates, or algae. Most other values from the WQP database were at least an order of magnitude lower than the acute COC. These data are derived from numerous organizations with multiple sampling objectives that are not linked to the COUs in this assessment. In other words, the concentrations represent all potential uses of 1,1,2-trichloroethane. including COUs and non-TSCA uses, making the WQP data less reliable and less relevant.

5.3.3.1.4 Overall Confidence and Weight of Scientific Evidence of Risk to Aquatic Organisms

High-end modeled concentrations of 1,1,2-trichloroethane in surface water indicate that RQ values did not exceed the benchmark of 1 for acute exposure to aquatic species, chronic exposure to aquatic vertebrates, and 72-hour exposure to algae. The use of high-end exposure inputs (U.S. EPA, 2026g) with all resultant RQs less than 1 provides a protective screening conclusion. Overall, EPA has robust confidence that this assessment of risk to aquatic organisms using facility-specific and generic scenario releases is protective.

Table 5-5. Risk Quotients from Facilities with Highest Modeled Instream Concentration per OES for TRI and DMR Releases 2019–2023 and from OES Generic Scenario Modeling

OES (NPDES)	Annual Release	Operating Days	Daily Release (kg/day)	7Q10 Flow (mld)	SWC (µg/L)	Sediment Conc. (µg/kg)	Risk Quotient [c]			
							Acute Animals	Chronic Vertebrates	Algae	Sediment-Dwelling Invertebrates
Facility-specific reported releases										
Manufacturing as a Byproduct at Chemical Manufacturing Facilities/Manufacturing as a Byproduct in the Pulp and Paper Industry (LAJ660151) [a]	38	350	0.11	0.75	145	628	5.7E−03	5.4E−02	5.5E−03	0.22
Not Mapped to an OES (NV0022888) [a]	0.76	250	3.0E−03	3.3	0.92	3.8	3.6E−05	3.5E−04	3.5E−05	1.3E−03
Processing as a Reactant (IL0002917) [a]	11	350	3.2E−02	2.7	12	53	4.7E−04	4.4E−03	4.6E−04	1.8E−02
Repackaging for Laboratory Chemical Use (IL0005126) [a]	428	250	1.7	438	3.9	17.5	1.5E−04	1.5E−03	1.5E−04	6.1E−03
Use of Laboratory Chemicals (CO0001511) [b]	5.9E−02	260	2.3E−04	0.15	1.5	6.5	5.9E−05	5.6E−04	5.7E−05	2.2E−03
Disposal to Incineration (CA0030210) [a]	2.3E−02	250	9.0E−05	0.16	0.56	2	2.2E−05	2.10E−04	2.1E−05	6.9E−04
Disposal to Landfill (KY0099660) [a]	0.64	250	2.6E−03	3.1	0.81	3.4	3.2E−05	3.1E−04	3.1E−05	1.2E−03
Disposal to Non-POTW WWT (CA0057827)	1.1	250	4.4E−03	0.33	13	51	5.3E−04	5.1E−03	4.9E−04	1.8E−02
Disposal to POTW (KY0107107) [a]	34	365	9.4E−02	19	5.1	24	2.0E−04	1.9E−03	1.9E−04	8.4E−03
Remediation (RI0022942) [a]	0.23	250	9.3E−04	0.52	1.8	6.9	7.1E−05	6.8E−04	6.84E−05	2.4E−03
Generic scenario releases										
Formulation of Adhesives and Sealants (central tendency)	180	145	1.3	5,934	0.22	N/A	8.7E−06	8.2E−05	8.4E−06	N/A
Formulation of Adhesives and Sealants (high-end)	224	365	5.0	1,793	2.8	13.4 [d]	1.1E−04	1.0E−03	1.1E−04	4.6E−03
Use of Adhesives and Sealants (central tendency)	0.73	260	2.7E−03	2,709	1.00E−03	N/A	3.95E−08	3.75E−07	3.8E−08	N/A

OES (NPDES)	Annual Release	Operating Days	Daily Release (kg/day)	7Q10 Flow (mld)	SWC (µg/L)	Sediment Conc. (µg/kg)	Risk Quotient [c]			
							Acute Animals	Chronic Vertebrates	Algae	Sediment-Dwelling Invertebrates
Use of Adhesives and Sealants (high-end)	1.6	260	6.2E−03	2,709	2.30E−03	N/A	9.09E−08	8.61E−07	8.8E−08	N/A
Use of Cleaning and Degreasing Solvents (central tendency)	17	269	5.2E−02	2.70E04	1.90E−03	N/A	7.51E−08	7.12E−07	7.2E−08	N/A
Use of Cleaning and Degreasing Solvents (high-end)	32	296	9.2E−02	2.70E04	3.40E−03	N/A	1.34E−07	1.27E−06	1.3E−07	N/A
Highest measured/monitored										
Water Quality Portal	N/A	N/A	N/A	N/A	10.8	N/A	4.27E−04	4.04E−03	4.1E−04	N/A

7Q10 = the modeled 7Q10 flow, in MLD (million liters per day); NPDES = National Pollutant Discharge Elimination System facility permit number; POTW = publicly owned treatment works; SWC = Surface Water Concentration. Surface water concentration modeled on 7Q10 P50 flow; WWT = wastewater treatment

[a] Concentrations based on flows from NHDPlus EROM dataset.

[b] Concentrations based on plant flow for representative facility extracted from Enforcement and Compliance History Online Dataset (ECHO)

[c] Risk quotients were based on acute animal (25,300 µg/L), chronic vertebrate (2,670 µg/L), algae (26,300 µg/L), and sediment-dwelling animal (2,890 µg/kg) concentrations of concern (U.S. EPA, 2026w). EPA has robust confidence in the quality, consistency, strength and precision, and relevance of the studies used in determining these COCs.

[d] Sediment concentration modeled on 7Q10 P10 flow.

4957

5.3.3.2 Risk Estimates for Sediment-Dwelling Organisms

The COC for multiple acute exposures over 56-days to sediment-dwelling invertebrates (2,890 µg/kg), was compared to modeled high-end sediment concentrations. No measured concentration of 1,1,2-trichloroethane greater than the levels of detection in sediment have been reported from U.S. water bodies.

5.3.3.2.1 Facility-Specific Reported Releases

The highest modeled concentration of 1,1,2-trichloroethane in sediment (628 µg/kg) resulted in an RQ value (0.22) that did not exceed the benchmark of 1 for exposures to sediment-dwelling animals (Table 5-5). The Manufacturing as a Byproduct OES represents the highest sediment concentration from facility-specific releases; therefore, all OES with facility-specific releases had RQ values that were less than 1. Collectively, the facility-based analysis indicates no expected risk to sediment-dwelling animals near direct outfalls under screened, high-end conditions. EPA has robust confidence that this assessment of risk to sediment-dwelling animals using facility-specific releases is protective.

5.3.3.2.2 Generic Scenario Releases

The highest modeled concentration of 1,1,2-trichloroethane in sediment (13.4 µg/kg) resulted in an RQ value (4.64×10^{-3}) that did not exceed the benchmark of 1 for exposures to sediment-dwelling animals (Table 5-5). The Formulation of Adhesives and Sealants OES represents the highest sediment concentration of all the generic release scenarios; therefore, all generic scenario RQ values were less than 1. EPA has robust confidence that this assessment of risk to sediment-dwelling animals using generic scenario releases is protective.

5.3.3.2.3 Monitored/Measured data

No measured concentration of 1,1,2-trichloroethane greater than the levels of detection in sediment have been reported (U.S. EPA, 2026g).

5.3.3.2.4 Overall Confidence and Weight of Scientific Evidence of Risk to Sediment-Dwelling Animals

The highest modeled concentrations of 1,1,2-trichloroethane in sediment indicate that RQ values did not exceed the benchmark of 1 for chronic exposure to sediment-dwelling organisms under any scenario. While the sediment COC is based on a single high-quality study, the use of high-end exposure inputs and indications that RQ < 1 for all evaluated scenarios provides a protective screening conclusion. Site-specific sediment organic carbon and hydrodynamics can vary, but the combination of limited sorption and volatilization suggests sustained, high sediment burdens are unlikely. Overall, EPA has robust confidence that this assessment of risk to sediment-dwelling animals using facility specific and generic scenario releases is protective.

5.3.4 Risk Estimates for Terrestrial Species

The hazard threshold for inhalation exposures to terrestrial mammals (2.1×10^{6} µg/m^3) was compared to the highest modeled air concentration. No evidence of dietary or oral toxicity to wild mammals or birds has been reported (U.S. EPA, 2026w); therefore, risk via ingestion was considered but not assessed quantitatively. Hazard thresholds for soil exposures to terrestrial invertebrates (1.05 mg/kg) and soil porewater exposures to terrestrials plants (306.9 mg/L) were not quantitatively compared to soil concentrations because the monitoring data suggest that for its current uses 1,1,2-trichloroethane is not likely to be present in soils from landfills, biosolids, or air deposition (U.S. EPA, 2026g).

The only identified sources of measured 1,1,2-trichloroethane were from locations associated with historic contamination from underground petroleum storage tanks but not apportioned to current COUs. Also, monitoring data agree with expectations based on the physical and chemical properties of the chemical that suggest moderate to high mobility in soils due to log K_{OW} (2.05) and log K_{OC} (2.06) resulting in migration to groundwater and volatilization from surface soil due to Henry's Law constant (8.24×10^{-4} atm·m^3/mol) (U.S. EPA, 2026g). Additionally, fugacity modeling suggests that air deposition is not likely to be a significant pathway for exposure. 1,1,2-Trichloroethane is not expected to sorb to biosolids based on its K_{OC} and K_{OW}, with volatilization expected to be the major removal mechanism in wastewater treatment (WWT) plants. Furthermore, based on its current uses and the TRI release data, 1,1,2-trichloroethane is not expected to be disposed of in non-hazardous landfills; however, it can be present in landfills due to biodegradation of other chlorinated ethanes, such as 1,1,1,2-tetrachloroethane. Overall, EPA has moderate confidence that 1,1,2-trichloroethane will be present at low concentrations in soils based on the monitoring data, physical and chemical properties, and release data, and therefore the Agency did not conduct a quantitative risk assessment for land pathways to soil.

5.3.4.1 Risk Estimates for Terrestrial Mammals via Air Inhalation

1,1,2-Trichloroethane releases were estimated and used as direct input to the IIOAC modeling (U.S. EPA, 2026g). To assess inhalation exposures to terrestrial species via the ambient air pathway, EPA identified a representative concentration from published studies to which an adverse effect was identified in terrestrial species. The Agency then compared the lowest 1,1,2-trichloroethane concentration showing an adverse health effect in terrestrial species (2.1×10^6 µg/m^3; (U.S. EPA, 2026w)) to the highest modeled concentration from a highly conservative Tier 1 analysis (34 µg/m^3; (U.S. EPA, 2026g)) resulting in RQ of 1.6×10^{-5}. Based on this comparison, the lowest concentration causing an adverse health effect in terrestrial species is five orders of magnitude (60,742 times) greater than the highest modeled concentration from the conservative Tier 1 analysis. For context, the maximum monitored concentration of 52 µg/m^3 described in U.S. EPA (2026g), resulted in RQ of 2.4×10^{-5}. Therefore, the Agency concludes with robust confidence inhalation exposure of terrestrial species to 1,1,2-trichloroethane via the ambient air pathway does not pose an identified acute or chronic non-cancer risk to terrestrial species.

5.3.4.2 Risk Estimates for Terrestrial Invertebrates and Plants via Soil

Based on monitoring data, physical and chemical properties, and release data (Section 2.2.1; (U.S. EPA, 2026g)), EPA has robust confidence that if present in soil, 1,1,2-trichloroethane will be at low concentrations that do not exceed the hazard threshold to terrestrial invertebrates (1.05 mg/kg). Additionally, based on monitoring data, physical and chemical properties, and release data (Section 2.2.1; (U.S. EPA, 2026g)), EPA has robust confidence that if present in soil porewater, 1,1,2-trichloroethane will be at low concentrations that do not exceed the hazard threshold to terrestrial plants (306.9 mg/L).

5.3.4.3 Risk Estimates for Terrestrial Vertebrates via Bioaccumulation and Trophic Transfer

1,1,2-Trichloroethane is a volatile organic compound for which bioaccumulation and trophic transfer in aquatic food webs are expected to be limited. Modeled bioaccumulation estimates indicate a low bioaccumulation factor (BAF) of 6.59 (Section 2; (U.S. EPA, 2026g)), that is consistent with its physical and chemical properties (log K_{OW} = 2.05; Section 2) and propensity for loss from surface waters via volatilization (Henry's Law constant of 8.24×10^{-4} atm·m^3/mol; Section 2.1). Consistent with this expectation, EPA identified no studies that report evidence of 1,1,2-trichloroethane in tissues of wild-caught fish or other organisms (U.S. EPA, 2026g). In addition, no evidence of dietary or oral toxicity to wild mammals or birds has been reported (U.S. EPA, 2026w). Collectively, the low-modeled

bioaccumulation potential, lack of empirical evidence for accumulation in fish, and absence of dietary hazard information for wildlife indicate that exposure and risk to ecological receptors via fish ingestion are not anticipated. Accordingly, a quantitative screening-level fish ingestion risk assessment was not conducted. EPA has robust confidence that if present in fish tissues, 1,1,2-trichloroethane will be at low concentrations that do not exceed the hazards to piscivores.

EPA has robust confidence that low bioaccumulation potential, lack of empirical evidence for accumulation in any trophic level (U.S. EPA, 2026g) indicate that exposure and risk ecological receptors via fish ingestion are not anticipated. EPA also has robust confidence that 1,1,2-trichloroethane does not undergo trophic transfer or biomagnification.

5.3.4.4 Overall Confidence and Weight of Scientific Evidence of Risk to Terrestrial Organisms

The highest modeled concentrations of 1,1,2-trichloroethane in air indicate that RQ values did not exceed the benchmark of 1 for inhalation exposure to terrestrial mammals. While the inhalation hazard threshold is based on a single high-quality study, the use of the highest exposure modeling inputs and resulting RQ less than 1 indicates that this scenario provides a protective screening conclusion. Based on monitoring data, physical and chemical properties, and release data, EPA has robust confidence in low-risk characterizations for 1,1,2-trichloroethane exposures to terrestrial invertebrates and plants. Overall, EPA has robust confidence in the protective nature of this draft risk assessment to terrestrial animals and plants.

5.3.5 Overall Confidence and Remaining Uncertainties in Environmental Risk Characterization

The weight of evidence indicates that 1,1,2-trichloroethane does not pose acute or chronic risk to aquatic and terrestrial organisms with robust confidence. EPA conducted a screening assessment that compared the highest modeled concentrations for water and air pathways to conservative protective hazard thresholds that were derived from multiple studies. EPA considered the soil and dietary pathway to terrestrial organisms and has robust confidence in expectations of low exposure concentrations and low risk characterizations.

A strength of this risk characterization is the context of multiple data sources from measured values, modeled values from facility-specific TRI and DMR release data, and modeled generic scenario values, which results in more confidence in the low exposure estimates being representative of most COU-related risk estimates. Additional confidence comes from protective COCs that describe adverse effects to populations of aquatic species.

The overall confidence in the environmental risk characterization synthesizes confidence from both environmental exposures and environmental hazards. Exposure confidence is detailed in the *Draft Chemistry, Fate, Release, and Exposure Assessment for 1,1,2-Trichloroethane* (U.S. EPA, 2026g). Environmental hazard confidence is detailed in the *Draft Human Health and Environmental Hazard Assessment for 1,1,2-Trichloroethane* (U.S. EPA, 2026w). Confidence determinations for each group of environmental exposures pathways are provided in Table 5-6.

5088 **Table 5-6. 1,1,2-Trichloroethane Evidence Table Summarizing Overall Confidence Derived for Environmental Risk Characterization**

Exposure Pathway	Exposure Confidence[a]	Hazard Confidence	Risk Characterization Confidence
Surface water	Moderate to robust: conservative modeling and monitoring information inform screening estimates	Robust: Acute exposure resulting in aquatic vertebrate and invertebrate species mortality	Robust (Section 5.3.3.1.4)
	Moderate to robust: conservative modeling and monitoring information inform screening estimates	Robust: Chronic exposure to aquatic vertebrate species (reduced fish [*Pimphales promelas*] weight and survival >32 days)	Robust (Section 5.3.3.1.4)
Sediment	Moderate to robust: conservative modeling and monitoring information inform screening estimates	Slight to moderate: Chronic exposure to sediment-dwelling invertebrate (reduced midge [*Chironomus riparius*] emergence in the second generation after 56 days) [b]	Robust (Section 5.3.3.2.4)
Air	Robust: modeling and monitoring information inform Tier 1 exposure characterization	Slight to moderate: Acute inhalation exposure to terrestrial mammals extrapolated to chronic exposure effects (reduced mammal survival) [c]	Robust (Section 5.3.4.4)
Soil	Moderate: expected low concentrations in soils based on monitoring data, physical and chemical properties, and release data	Robust: Acute exposure to soil invertebrates (reduced earthworm [*Eisenia fetida*] survival over 48 hours) and chronic exposure to plants (reduced poplar [*Populus x canadensis*] growth >16 days)	Robust (Section 5.3.4.4)
Trophic transfer	Robust: volatility, low bioaccumulation potential, and lack of accumulation at any trophic level indicate that 1,1,2-trichloroethane does not undergo trophic transfer or biomagnify	No evidence of adverse effects on wild animal populations	Robust (Section 5.3.4.4)

[a] EPA has moderate-to-robust confidence in scenarios with conservative and screening assumptions resulting in RQs <1 (U.S. EPA, 2026g).
[b] Exposures consisted of acute applications of 1,1,2-trichloroethane on Day 1 and Day 29 of the experiment while measuring multiple endpoints across 2 generations. Measured exposure concentrations decreased rapidly after the 1,1,2-trichloroethane applications resulting in animals being exposed to <1% of applied concentrations on Day 28 and Day 56 (U.S. EPA, 2026w; Smithers, 2023).
[c] Slight-to-moderate confidence based on uncertainties in extrapolating hazards from acute laboratory rodent data to chronic exposure hazards to wild mammal populations (U.S. EPA, 2026w).

5089

6 UNREASONABLE RISK DETERMINATION

TSCA section 6(b)(4) requires EPA to conduct a risk evaluation to determine whether a chemical substance presents an unreasonable risk of injury to health or the environment, without consideration of costs or other non-risk factors, including an unreasonable risk to a PESS identified by EPA as relevant to this risk evaluation, under the COUs.

EPA has preliminarily determined that 1,1,2-trichloroethane presents unreasonable risk of injury to human health driven by significant contributions to unreasonable risk to workers from inhalation and/or dermal exposures from 10 of the 12 total COUs assessed (see Table ES-1). Of these 10 COUs for 1,1,2-trichloroethane, 4 significantly contribute to inhalation risk to ONUs. EPA did not identify significant contributions to unreasonable risk to human health due to 1,1,2-trichloroethane exposures to the general population (which includes fenceline communities) or to consumers. Furthermore, the Agency has preliminarily determined that 1,1,2-trichloroethane does not present an unreasonable risk of injury to the environment.

This preliminary unreasonable risk determination is based on the information provided in previous sections of this draft risk evaluation, appendices, TSDs, and supplemental files (see Appendix C) in accordance with TSCA section 6(b). This preliminary unreasonable risk determination and the underlying evaluations are consistent with the best available science (TSCA section 26(h)) and based on the weight of scientific evidence (TSCA section 26(i)).

EPA notes uses that are not subject to TSCA (*e.g.,* cosmetics, medical devices) and result in human or environmental exposure to 1,1,2-trichloroethane were not evaluated as COUs by the Agency because these uses are explicitly excluded from TSCA's definition of a chemical substance. Thus, it is not appropriate to extrapolate from this preliminary risk determination to form conclusions about uses of 1,1,2-trichloroethane that are not subject to TSCA and that EPA did not evaluate as COUs.

The full list of 12 COUs evaluated for 1,1,2-trichloroethane is provided in Table 1-1. A summary of the specific pathways of exposure, populations (worker and ONU), and durations associated with each COU that informed the preliminary risk determination from 1,1,2-trichloroethane to human health is provided below in Table 6-7. EPA has preliminarily determined that the following 10 COUs significantly contribute to unreasonable risk to human health for workers and/or ONUs:

- Manufacturing – Domestic manufacture (worker inhalation and dermal)
- Manufacturing – Import (worker inhalation and dermal; ONU inhalation)
- Processing – As a reactant – Intermediate in: Plastic manufacturing; Petrochemical manufacturing; All other chemical product manufacturing (worker inhalation and dermal)
- Processing – Incorporation into a formulation, mixture, or reaction product – Formulation of adhesives and sealants (worker inhalation and dermal)
- Repackaging – Repackaging (worker inhalation and dermal; ONU inhalation)
- Recycling – Recycling (worker inhalation and dermal)
- Industrial use – Solvents (worker inhalation and dermal; ONU inhalation)
- Industrial and commercial use – Adhesives and sealants (worker inhalation and ONU inhalation)
- Commercial use – Other use – Laboratory chemical (worker dermal)
- Disposal (worker inhalation and dermal).

EPA has preliminarily determined that the following two COUs do *not* significantly contribute to unreasonable risk of 1,1,2-trichloroethane:

- Distribution in commerce; and
- Consumer use – Adhesives and sealants.

An unreasonable risk determination must be informed by science, and EPA considers risk-related factors beyond exceedance of benchmarks. Risk-related factors include the type and severity of health effects under consideration, the reversibility of the health effects being evaluated, exposure-related considerations (*e.g.,* duration, magnitude, frequency of exposure), population exposed—particularly PESS—and the confidence in the information used to inform the hazard and exposure values. For COUs evaluated quantitatively, as described in the risk characterizations (see Sections 4.3 and 5.3), EPA based the preliminary determination of unreasonable risk of injury to human health or the environment on the risk estimate that best represents the COU. The Agency described the strength of the scientific evidence supporting human health and environmental assessments as robust, moderate-to-robust, moderate, or slight-to-moderate.

This draft risk evaluation discusses important assumptions and key sources of uncertainty in the risk characterization. These are described in more detail in the respective weight of scientific evidence conclusions sections for fate and transport (Section 2.2.1), environmental release (Section 3.2), human exposures (Section 4.1.1.4, 4.1.2.5, 4.1.3.1.5), human health hazards (Section 4.2.3), human health risk characterization (Section 4.3), environmental exposures (Section 5.1), environmental hazards (Section 5.2), and environmental risk characterization (Section 5.3.5). Appendix G describes the derivation of EPA's draft acute, intermediate, and chronic non-cancer occupational exposure value as well as the lifetime cancer occupational exposure value. It also includes a summary of identified air sampling analytical methods.

6.1 Unreasonable Risk to Human Health

Calculated risk estimates (MOEs[7] and cancer risk estimates) can provide a risk profile of 1,1,2-trichloroethane by presenting a range of estimates for different health effects for different COUs. EPA conducted baseline assessments of risk and made its preliminary determination of unreasonable risk in a manner that takes into consideration reasonably available information (*e.g.,* information submitted by manufacturers and processors of 1,1,2-trichloroethane). In addition, risk estimates that are based on exposure scenarios with monitoring data reflect existing requirements, such as those established by OSHA or industry sector best practices. EPA received some information regarding PPE use relevant to manufacturing, repackaging, and for many of the processing COUs relevant to the test order data. In general, the Agency did not have enough confidence in the prevalence of respirator use (*i.e.,* by all workers who may be exposed to 1,1,2-trichloroethane within a given COU) or in the duration or frequency of use for those wearing respirators (*i.e.,* whether all SEGs wear a respirator for the full-shift or only during certain tasks or operations) to consider respiratory PPE use to be sufficient and comprehensive (for detailed review see Section 4.3.2.1.1 and discussed further in 6.1.3). EPA will consider any additional information to inform PPE use provided during the comment period in the development of the final risk evaluation.

To characterize risk from non-cancer endpoints, as a starting point, the estimated MOEs are compared to their respective benchmark MOE. The benchmark MOE accounts for the total uncertainty in a POD. The benchmark MOE is the total of several individual uncertainty factors (UFs) relevant to a given POD. Additional information regarding the non-cancer hazard identification and the benchmark MOE is provided in Section 1.1.1 of this draft risk evaluation. A calculated cancer risk estimate that is greater

[7] EPA derives non-cancer MOEs by dividing the non-cancer POD (HEC [mg/m^3] or HED [mg/kg-day]) by the exposure estimate (mg/m^3 or mg/kg-day). Section 4.2 provides additional information on the risk assessment approach for human health hazard.

than the cancer benchmark is a starting point for informing a determination of unreasonable risk of injury to health from cancer. Inhalation cancer risk estimates represent the incremental increase in probability of an individual in an exposed population developing cancer over a lifetime (excess lifetime cancer risk [ELCR]) following exposure to the chemical. Standard cancer benchmarks used by EPA are an increased cancer risk ranging from 1 in 1,000,000 to 1 in 10,000 (*i.e.*, 1×10^{-6} to 1×10^{-4}), depending on the subpopulation(s) exposed and other considerations. In this assessment the Agency considers 1×10^{-4} as the appropriate benchmark for increased cancer risk for workers and ONUs.

It is important to emphasize that these calculated risk estimates alone are not "bright-line" indicators of unreasonable risk. In the preliminary risk determination, EPA considered risk-related factors beyond exceedance of benchmarks—including the Agency's confidence in the data as well as an evaluation of the strengths, limitations, uncertainties, and confidences associated with the information used to inform the risk estimate and risk characterization. Descriptions of risk estimates that are based on highly refined hazard and exposure information would be considered differently than risk estimates based on conservative assumptions on both hazard and exposure. The process of determining unreasonable risk is made on a case-by-case basis given the inherently unique nature of chemical-specific risk evaluations.

6.1.1 Populations and Exposures EPA Assessed for Human Health

EPA evaluated risk to workers (aged 16+ years) and ONUs; consumers and bystanders (adults and children); as well as the general population (including fenceline communities and PESS)—using reasonably available monitoring and modeling data for inhalation, dermal, and ingestion exposures, as applicable. More specifically, the Agency has evaluated risk from inhalation and dermal exposure of 1,1,2-trichloroethane to workers, inhalation exposure to ONUs, and dermal exposures to consumers. Dermal exposure for ONUs is not expected and was not assessed because they do not directly handle 1,1,2-trichloroethane. Finally, the Agency evaluated risk from exposures from surface water, drinking water, soil from air to soil deposition, and land pathways (*i.e.,* landfills and application of biosolids) to the general population (Section 4.1). EPA's evaluation of the general population included evaluation of populations living near facilities releasing 1,1,2-trichloroethane to the ambient air, which includes fenceline communities, as part of the ambient air exposure assessment.

In developing the exposure and hazard assessments for 1,1,2-trichloroethane, EPA has analyzed reasonably available information to ascertain whether some human populations may have greater exposure and/or susceptibility than the general population to the hazard posed by 1,1,2-trichloroethane. For this draft risk evaluation, EPA accounted for the following PESS: pregnant women; infants; children; people who frequently use consumer products and/or articles containing high concentrations of 1,1,2-trichloroethane; people exposed to 1,1,2-trichloroethane in the workplace; and people in close proximity to releasing facilities, including fenceline communities. Appendix D summarizes the PESS that were incorporated into the draft risk evaluation through consideration of potentially increased exposures and/or potentially increased biological susceptibility; it also summarizes additional sources of uncertainty related to consideration of PESS.

6.1.2 Summary of Human Health Effects

EPA has preliminarily determined that the unreasonable risk presented by 1,1,2-trichloroethane is driven by significant contributions to both non-cancer and cancer effects (Section 6.1.3) in the following populations via the following listed exposures:

- workers and ONUs from acute, intermediate, and chronic non-cancer risk from inhalation exposures;
- workers from intermediate and chronic non-cancer risk from dermal exposures; and

- workers and ONUs from cancer risk from inhalation and dermal exposures.

Human health risks were evaluated for acute, intermediate, and chronic exposure scenarios as applicable based on reasonably available exposure and hazard data for 1,1,2-trichloroethane as well as the relevant populations for each. EPA identified non-cancer hazards to the olfactory tissue as the most protective endpoint following inhalation exposures and immunosuppression as the most protective endpoint following oral and dermal exposures.

The selected non-cancer hazard endpoints for the oral and dermal routes are neurotoxicity (decreased acute motor activity in rats) for acute durations and immunological effects (decreased hemagglutination titers mice) for intermediate and chronic durations. The acute dermal NOAEL HED is 12.6 mg/kg with an acute benchmark MOE of 30 (Table 4-22). The intermediate/chronic dermal NOAEL HED is 0.52 mg/kg/day with intermediate and chronic benchmark MOEs of 30 and 300, respectively (Table 4-22). For the inhalation route the hazard endpoint was respiratory (olfactory) effects with epithelium necrosis from acute duration exposures and lesions in the olfactory epithelium from intermediate and chronic duration exposures. The acute inhalation LOAEC HEC is 6.1 mg/m^3 with an acute benchmark MOE of 100 (Table 4-20). The intermediate and chronic inhalation BMCL10 HEC is 0.62 mg/m^3 with intermediate and chronic benchmark MOEs of 30 and 300, respectively (Table 4-20).

1,1,2-Trichloroethane is genotoxic and carcinogenic (Section 4.2), with oral and dermal cancer slope factors and cancer inhalation unit risk values for 1,1,2-trichloroethane presented in Table 4-23 and Table 4-24, respectively. The cancer slope factor was based on liver tumors; the inhalation unit risk (IUR) was derived via route-to-route extrapolation using a PBPK model (Sapphire Group, 2004b). EPA has moderate confidence in the inhalation unit risk value dervied using the PBPK for the inhalation route and low-to-moderate confidence in the cancer slope factor (CSF) for the dermal route due to the PBPK model not assessing the dermal compartment (Section 4.2.4). See the *Draft Human Health and Environmental Hazard Assessment for 1,1,2-Trichloroethane* (U.S. EPA, 2026w) for more information.

6.1.3 Basis for Unreasonable Risk to Workers

Based on the occupational risk estimates and related risk factors, EPA has preliminarily determined that 10 COUs significantly contribute to unreasonable risk to workers from 1,1,2-trichloroethane. Risk estimates are numerical expressions of many conservative assumptions, modeling choices, exposure data, and toxicity values derived by EPA specifically for the purposes of the 1,1,2-trichlorothane COUs included in this TSCA risk evaluation. For these reasons, the Agency uses benchmarks not as bright-lines for unreasonable risk determinations but rather part of the larger picture that considers other risk-based factors, including uncertainty.

EPA analyzed dermal and inhalation exposure in the occupational scenarios using a time-weighted average (TWA) for a typical 8-hour shift (see Section 4.3) for male and female workers. Estimates of central tendency and high-end inhalation and dermal exposures were made for workers directly working with 1,1,2-trichloroethane as well as estimates for inhalation exposures for ONUs not directly handling 1,1,2-trichloroethane. Non-cancer risk estimates were calculated from acute, intermediate, and chronic exposures. For most OESs, acute refers to an exposure timeframe of one 8-hour workday, intermediate refers to an exposure timeframe of 22 workdays (8 hours per day), while chronic refers to an exposure timeframe of 250 days per year for 31 to 40 years (8 hours per day).

The final study report published by the Vinyl Institute Consortium (Stantec ChemRisk, 2024) described worker activities by SEG at sites where 1,1,2-trichloroethane was manufactured as a byproduct. The test-order monitoring study included 95 task-duration samples collected across all worker SEGs, with sample durations ranging from 8 to 352 minutes. These samples were not used quantitatively in the risk

evaluation because full-shift samples were available for all SEGs and therefore were used for the risk assessment and are appropriate based on the identified health effects (Section 4.2). Instead, the task-based samples were considered qualitatively to provide additional context for the full-shift monitoring data. The task-based inhalation monitoring data from the test order may also be used to inform risk management.

EPA calculated risk estimates for both central tendency and high-end exposure levels for workers and ONUs. Risk estimates based on high-end exposure levels are generally intended to cover individuals exposed at exposure levels representative of 95th percentile values, whereas risk estimates at the central tendency exposure are intended to cover average or typical worker exposure. To determine whether a specific COU significantly contributes to the unreasonable risk, EPA may consider chemical-specific information and risk-related factors, including how the central tendency and high-end risk estimates best represent each COU. The Agency considered a threshold for determining unreasonable risk due to cancer effects based on risk estimates above a benchmark of 1×10^{-4} for workers. For all COUs with sufficient confidence to support a risk determination, and based on the reasonably available information as well as the Agency's confidence and uncertainties described earlier in this draft risk evaluation, EPA based its preliminary unreasonable risk determination on the risk estimates that best represent the COU. For COUs where the Agency was not able to estimate ONU inhalation exposure from monitoring data or models, the ONU exposure was assumed to be equivalent to the central tendency exposure for workers for the corresponding COU, as described in Table 4-7.

COUs Associated with 1,1,2-Trichloroethane Test Order Data

EPA has confidence that the Agency's risk estimates reflect working conditions at facilities handling 1,1,2-trichloroethane because the occupational risk assessment incorporates 1,1,2-trichloroethane inhalation monitoring data collected under a TSCA section 4 test order (*e.g.,* PBZ monitoring) by SEG at sites engaged in the manufacture of 1,1,2-trichloroethane as a byproduct (Stantec ChemRisk, 2024). However, uncertainty in estimates derived from a statistical distribution of multiple single-day measurements increases because those results are extrapolated to longer durations. In addition, available evidence indicates that high-exposure tasks are not performed on a daily basis over the course of a working year or working life. As explained in Section 4.3.2, high-end exposure and risk estimates are most appropriate for consideration of shorter duration exposures (acute, intermediate), while central tendency values are more representative for chronic exposures for COUs associated with 1,1,2-trichloroethane data. EPA has reduced confidence in high-end risk estimates from the maintenance technician (SEG) as review of the test order data indicated that these are driven by tasks that occur infrequently (*i.e.*, once per month) and it is not expected that workers would have high-end inhalation exposures during the entire intermediate duration (22 working days during a 30-day exposure period). Review of workers wearing respiratory protection within the SEGs based in monitoring data from test order data within Section 4.3.2.1.1 indicates inconsistent or lack of reported use. EPA's risk determination generally relies on high-end estimates to support its determination for workers for shorter-term inhalation exposures. This is because consistent high-end exposures are more likely to occur over a duration of time representative of an 8-hour work shift vs. central tendency estimates that were used for longer-term exposures (*i.e.*, several decades for chronic non-cancer effects).

To estimate worker dermal risk, EPA evaluated occupational results representing central tendency and high-end exposure conditions. Dermal exposure for ONUs is not expected and was not assessed because they do not directly handle 1,1,2-trichloroethane (Section 4.1.1). EPA based its preliminary unreasonable risk determination for workers using acute and intermediate dermal exposure on the high-end due to the potential for high short-term exposures during maintenance activities. The central tendency risk estimates were identified as more appropriate than the high-end for chronic dermal

exposures and dermal cancer risks. Additional information on occupational risk estimates is provided in Section 4.3.2. This is because consistent high-end exposures are more likely to occur over shorter time periods (*e.g.*, intermediate non-cancer risk covering average exposures >1 month), while central tendency estimates are used for longer term exposures (*i.e.,* several decades for chronic non-cancer and cancer).

EPA has determined all six COUs associated with 1,1,2-trichloroethane test order monitoring data (Stantec ChemRisk, 2024) significantly contribute to unreasonable risk to worker from acute, intermediate, and chronic inhalation exposures and/or dermal exposures when PPE is not used. The manufacturing COU is directly associated with test order data while the remaining five COUs used analogous exposure monitoring from the test order data:

- Manufacturing – Domestic manufacture – Domestic manufacture;
- Processing – Processing as a reactant – Intermediate in: Plastic manufacturing; Petrochemical manufacturing; All other chemical manufacturing;
- Processing – Incorporation into a formulation, mixture, or reaction product – Formulation of adhesives and sealants;
- Processing – Recycling;
- Commercial use – Other use – Laboratory chemical; and
- Disposal.

The preliminary determination that the Domestic manufacture COU significantly contributes to the unreasonable risk to workers is driven by acute, intermediate, and chronic non-cancer inhalation risks, in addition to intermediate (HE MOE = 13) and chronic (CT MOE = 82) non-cancer dermal risks. EPA has preliminarily determined that the Domestic manufacture COU does not significantly contribute to unreasonable risk to ONUs. Table 6-1 shows the significant contributions to unreasonable risk for this COU based on risk estimates from the operator, maintenance technician, and laboratory technician SEG.

Table 6-1. Significant Contributions to Preliminary Unreasonable Risk Determination for Workers from the Domestic Manufacture COU for Inhalation Exposure

COU	Population – SEG	Exposure Level	Human Health Effects (with APF to Address Risk)		
			Acute Non-Cancer (Benchmark MOE = 100)	Intermediate Non-Cancer (Benchmark MOE = 30)	Chronic Non-Cancer (Benchmark MOE = 300)
Manufacturing – Domestic manufacture	Worker – operator	CT	353	48	**51** (APF 10)
		HE	**18** (APF 10)	**2.4** (APF 25)	2.6
	Worker – maintenance technician	CT	1.1E04	1,480	1,585
		HE	**6.1** (APF 25)	0.83	0.89
	Worker – laboratory technician	CT	9,757	1,330	1,424
		HE	**50** (APF 10)	**6.8** (APF 10)	7.3

APF = assigned protection factor; COU = condition of use; CT = central tendency; HE = high-end; MOE = margin of exposure; SEG = similar exposure group
Bolded and shaded text indicates that a risk estimate significantly contributes to unreasonable risk.

Section 4.3.2.1.1 and subsection titled, "Reported Use of Respiratory protection by SEG" indicate inconsistent and/or lack of reported use of respiratory protection within the PBZ monitoring data for all four SEGs. For example, within the operator SEG only a subset (≈25%) of workers were documented as wearing respiratory protection, and usage of respirators did not correspond to the highest full-shift or

task-length exposures reported in this SEG. Monitoring data for the maintenance technician SEG, of the 17 task-length samples collected, respiratory protection usage was documented on 8 samples with respiratory protection usage not noted on any of the 6 highest task-length samples.

Details for the logistics technicians within the test order monitoring data (Stantec ChemRisk, 2024) indicated that this group was documented as wearing respiratory protection during the highest-exposure activities, both on a full-shift basis (7 of 8 samples) and on a task-duration basis (3 of 4 samples) for all tasks with high exposure potential. In addition, the highest task-based exposure concentration (2.9 ppm) was an order of magnitude greater than the next highest concentration of 0.16 ppm and EPA considers that this could result in an overestimation of high-end exposure estimates for this SEG. The combination of documented PPE use and high-end outlier exposure within the monitoring data limits the applicability of high-end exposure estimates for the logistic technician SEG within the current risk determination. Based on evidence presented within the occupational risk characterization, EPA has confidence that the inhalation exposure estimates for three worker SEGs (operators, maintenance technicians, and laboratory technicians) are reflective of worker exposures, without the consideration of respiratory protection.

The inhalation exposure estimates are not likely to be overly conservative (for review see Section 4.3.2.1.1) largely based on the role of PBZ monitoring data from 1,1,2-trichloroethane manufacturing test order data (Stantec ChemRisk, 2024). Respirator use by both operators and maintenance technicians was not associated with the highest monitored full-shift or task-based exposures. Specifically, respiratory protection was documented for 20 of 38 task-based samples for operators; however, respirator use was not indicated for the 5 highest task-based exposure concentrations (0.13–1.6 ppm; sample duration range: 15–100 minutes). Task-specific respiratory protection use was documented for 3 of 23 full-shift samples collected for maintenance technicians. Among the 17 task-length samples collected for maintenance technician workers, respiratory protection use was documented for 8 samples. Similar to operators, use of respiratory protection by maintenance technicians was not reported for any of the six highest task-length samples.

EPA did not perform a quantitative assessment for the “Manufacturing as a Byproduct in the Pulp and Paper Industry” OES; however, EPA did utilize information from the Manufacturing as a Byproduct OES (Table 3-1), which is aligned with the Domestic manufacturing COU and applicable to this OES. The Agency is seeking public comments on how 1,1,2-trichloroethane is produced as a byproduct at pulp and paper manufacturing facilities and is further used/disposed/distributed by the producing facility and will integrate these details into the final risk evaluation prior to public release.

The preliminary determination that two COUs—(1) Processing – Processing as a reactant – Intermediate in: Plastic manufacturing; Petrochemical manufacturing; All other chemical manufacturing; and (2) Processing – Recyling—associated with the Processing as a Reactant OES significantly contribute to the unreasonable risk to workers is driven by acute, intermediate, and chronic non-cancer inhalation risks as well as intermediate (HE MOE = 13) and chronic (CT MOE = 82) non-cancer dermal risks. EPA has also preliminarily determined that neither Processing COU significantly contributes to unreasonable risk to ONUs. Table 6-2 shows the significant contributions to unreasonable risk for both COUs based on risk estimates from the operator, maintenance technician, laboratory technician SEGs.

Table 6-2. Significant Contributions to Preliminary Unreasonable Risk Determination for Workers from Two Processing COUs for Inhalation Exposure

COU	Population – SEG	Exposure Level	Human Health Effects (with APF to Address Risk)		
			Acute Non-Cancer (Benchmark MOE = 100)	Intermediate Non-Cancer (Benchmark MOE = 30)	Chronic Non-Cancer (Benchmark MOE = 300)
Processing – Processing as a reactant – Intermediate in: Plastic manufacturing; Petrochemical manufacturing; All other chemical manufacturing	Worker – operator	CT	353	48	**51** (APF 10)
		HE	**18** (APF 10)	**2.4** (APF 25)	2.6
	Worker – maintenance technician	CT	1.1E04	1,480	1,585
		HE	**6.1** (APF 25)	0.83	0.89
	Worker – laboratory technician	CT	9,757	1,330	1,424
		HE	**50** (APF 10)	**6.8** (APF 10)	7.3
Processing – Recyling	Worker – operator	CT	353	48	**51** (APF 10)
		HE	**18** (APF 10)	**2.4** (APF 25)	2.6
	Worker – maintenance technician	CT	1.1E04	1,480	1,585
		HE	**6.1** (APF 25)	0.83	0.89
	Worker – laboratory technician	CT	9,757	1,330	1,424
		HE	**50** (APF 10)	**6.8** (APF 10)	7.3

APF = assigned protection factor; COU = condition of use; CT = central tendency; HE = high-end; MOE = margin of exposure; SEG = similar exposure group
Bolded and shaded text indicates that a risk estimate significantly contributes to unreasonable risk for 1,1,2-trichloroethane.

EPA did not identify reasonably available inhalation exposure monitoring data related to 1,1,2-trichloroethane processing as a reactant; however, applied worker exposure data from 1,1,2-trichloroethane manufacturing (unintended, non-isolated byproduct) facilities as an analogous scenario. The weight of scientific evidence for the application of this data set to assess exposure for Processing as a Reactant was determined to be moderate for both workers and ONUs. The moderate confidence was based on use of chemical-specific data collected as part of a test order process and the number of samples representing multiple worker SEGs and ONUs where PBZ samples were collected over a full-shift duration (Table 4-11). A central limitation is that these data were specific to one industry (manufacturing as a byproduct) and it is uncertain if the measured concentrations and exposure frequencies fully represent processing across all facility within the OES. For one SEG (maintenance technicians), EPA has lower-confidence that high-end inhalation exposures are representative of intermediate exposures, due to evidence that the high-end inhalation exposures are associated with infrequent tasks (as further described in Section 4.3.2.1.1). The unreasonable risks associated with the other SEGs (*i.e.,* operators, maintenance technician, and laboratory technician) are driven either by acute and intermediate high-end estimates that do not account for PPE or by chronic non-cancer based on central tendency estimates.

EPA did not identify reasonably available 1,1,2-trichloroethane inhalation monitoring data related to the Processing – Incorporation into a formulation, mixture, or reaction product – Formulation of adhesives and sealants COU and therefore used test order data from worker exposure data at 1,1,2-trichloroethane manufacturing (unwanted, non-isolated byproduct) facilities as an analogous scenario. The preliminary determination that the Processing – Incorporation into a formulation, mixture, or reaction product – Formulation of adhesives and sealants COU significantly contributes to the unreasonable risk to workers is driven by acute, intermediate, and chronic non-cancer for inhalation and intermediate (CT MOE = 13) and chronic (HE MOE = 73) non-cancer risks for dermal. EPA has preliminarily determined that this

Processing COU does not significantly contribute to unreasonable risk to ONUs. Table 6-3 shows the significant contributions to unreasonable risk for this COU based on risk estimates from operator, maintenance technician, and laboratory technician SEGs.

Table 6-3. Significant Contributions to Preliminary Unreasonable Risk Determination for Workers from One Processing COU for Inhalation Exposure

COU	Population – SEG	Exposure Level	Human Health Effects (with APF to Address Risk)		
			Acute Non-Cancer (Benchmark MOE = 100)	Intermediate Non-Cancer (Benchmark MOE = 30)	Chronic Non-Cancer (Benchmark MOE = 300)
Processing – Incorporation into a formulation, mixture, or reaction product – Formulation of adhesives and sealants	Worker – operator	CT	353	48	**51** (APF 10)
		HE	**18** (APF 10)	**2.4** (APF 25)	2.6
	Worker – maintenance technician	CT	1.1E04	1,480	1,585
		HE	**6.1** (APF 25)	0.83	0.89
	Worker – laboratory technician	CT	9,757	1,330	1,424
		HE	**50** (APF 10)	**6.8** (APF 10)	7.3

APF = assigned protection factor; COU = condition of use; CT = central tendency; HE = high-end; MOE = margin of exposure; SEG = similar exposure group
Bolded and shaded text indicates that a risk estimate significantly contributes to unreasonable risk for 1,1,2-trichloroethane.

Although it is uncertain if all SEGs represented in the test order are also represented at formulation sites, EPA assumed that similar tasks and processes would be used during formulation of adhesives. The weight of scientific evidence for the application of this data set to assess exposure for formulation of adhesives and sealants was determined to be moderate for both workers and ONUs. The moderate confidence was based on use of chemical-specific data collected as part of a test order process and the number of samples representing multiple worker SEGs and ONUs where PBZ samples were collected over a full-shift duration (Table 4-11). A central limitation is that these data were specific to one industry (manufacturing as a byproduct) and it is uncertain if the measured concentrations and exposure frequencies fully represent processing across all facility within the OES.

The preliminary determination that one COU (*i.e.,* Commercial use – Other use – Laboratory chemical) associated with the Laboratory Use OES significantly contributes to the unreasonable risk to workers is driven by intermediate (HE MOE = 4.7) and chronic (CT MOE = 47) non-cancer and cancer (CT cancer risk estimate = 1.4×10^{-4}) dermal risks. EPA has preliminarily determined that the COU Commercial use – Other use – Laboratory chemical does not significantly contribute to unreasonable risk to workers based on the inhalation route of exposure. EPA has also preliminarily determined that the Commercial use – Other use – Laboratory chemical COU does not significantly contribute to unreasonable risk to ONUs. For inhalation, the Agency assessed the 1,1,2-trichloroethane laboratory use in the manufacturing setting using analogous 1,1,2-trichloroethane test order data for the laboratory technicians SEG (Stantec ChemRisk, 2024). EPA has noted that inhalation samples from the laboratory technician SEG included the collection of "VC operator" samples at the manufacturing site which are not believed to be representative of a normal job duty for laboratory workers in this COU (which does not include the laboratory technicians at manufacturing sites). Therefore, risk was not driven by the activities covered under the inhalation monitoring data for the laboratory technician SEG. EPA considers that high-end exposure and risk estimates for the acute (HE MOE = 21) and intermediate (HE MOE = 2.9) exposure durations may overestimate exposure for laboratory workers, due to the inclusion

of tasks that are not representative of typical exposures in this COU. As a result, for inhalation, the data and confidence within the occupation risk characterization for this COU supports the representation of central tendency exposure levels for the assessment of non-cancer acute (CT MOE = 4,146), intermediate (CT MOE = 565), chronic (CT MOE = 605), and cancer (CT cancer risk estimate = 1.2×10^{-6}) risk estimates (Section 4.3.2.1.8).

For the Disposal COU, EPA preliminarily determined that it significantly contributes to unreasonable risk to workers driven by acute (HE MOE = 38), intermediate (HE MOE = 5.2), and chronic (CT MOE = 11) non-cancer inhalation risks, and intermediate (HE MOE = 5.8) and chronic non-cancer (CT MOE = 28) and cancer dermal risks (CT cancer risk estimate = 2.4×10^{-3}). Preliminarily identified risks are associated with disposal to incineration or to a POTW and non-POTW WWT; inhalation risk is not driven by disposal to a landfill. Additionally, based on EPA's characterization of the Remediation OES, only removal and disposal of 1,1,2-trichloroethane waste that align with Incineration, POTW, and the Non-POTW WWT OESs (*e.g.,* the removal and treatment of 1,1,2-trichloroethane-containing wastes utilizing water treatment units or incineration) are included in EPA's preliminary determination of unreasonable of unreasonable risk (see Table 3-2 for OES descriptions). The unreasonable risk was preliminarily determined via the use of analogous 1,1,2-trichloroethane test order data for the logistic and maintenance technician SEGs and test order data for disposal to a POTW/WWT with supplemented evidence from public comments on 1,2-dichloroethane. Risk estimates were derived from monitoring data specific to 1,1,2-trichloroethane from workers (2 samples) and one ONU sample. Surrogate 1,2-dichloroethane data from PBZ monitoring data for workers (70 samples) and ONUs (3 samples) was also included. The overall confidence in the occupational exposure estimates using analogous 1,1,2-trichloroethane manufacturing test order data (Stantec ChemRisk, 2024) for worker related to wastewater treatment and surrogate data from 1,2-dichloroethane was determined to be moderate (Table 4-11)

ONU risk estimates for the Disposal COU were below the benchmark MOEs acute (MOE = 43), intermediate (HE MOE = 5.8), and chronic (CT MOE = 18) non-cancer inhalation for the POTW/WWT scenario when using surrogate data from 1,2-dichloroethane, however, risk estimates were well above the benchmark MOE when using the 1,1,2-trichloroethane test order PBZ data. The use of surrogate data from 1,2-dichloroethane is a less preferred approach when 1,1,2-trichloroethane data is available and representative of the uses. Additionally, although the sample sizes for 1,1,2-trichloroethane specific PBZ monitoring from ONUs are low, the use of PBZ data from workers at wastewater treatment plants potentially represents several processes at these facilities. Therefore, risk estimates derived from 1,1,2-trichloroethane disposal to POTW/WWT PBZ data were used for the basis of the ONU determination and EPA is preliminarily determining that ONUs do not contribute to the unreasonable risk under this COU. The primary strength of these data is the use of PBZ data obtained from workers at wastewater treatment plans representing exposure due to several processes that commonly occur at wastewater treatment plants.

Information from the surrogate monitoring dataset with samples used to represent the Disposal to POTW/Non-POTW WWT OES indicated at a high LOD and elevated number of non-detects (NDs) within the dataset for 1,2-dichloroethane that is used as additional surrogate data as described within Section 4.3.2.1.11. EPA has presented the results of a sensitivity analysis to examine the impact to MOE values from varying approaches associated with replacing values below the LOD. Table_Apx H-1 demonstrates that risk estimates for workers at the high-end exposure estimates did not change based on this sensitivity analysis and chronic non-cancer risk estimates at the central tendency exposures were still below the benchmark MOE when NDs were replaced with 0 or 0.001 ppm. The consistency in risk estimates below the benchmark MOE among the different approaches to represent values below the

LOD increases certainty that risks calculated form these data are not due to the high limit of detection (Table_Apx H-1). The same sensitivity analysis was conducted with the surrogate 1,2-dichloroethane data for ONUs, however, risk estimates for this group are better represented with the analogous 1,1,2-trichloroethane monitoring data.

COU Assessed Using Trichloroethylene Monitoring Data

EPA did not identify reasonably available 1,1,2-trichloroethane inhalation monitoring data related to the following COU and therefore used surrogate data from trichloroethylene (TCE) during the use of adhesives, and sealants:

- Industrial and commercial use – Adhesives and sealants.

The preliminary determination that the Industrial and commercial use – Adhesives and sealants COU significantly contributes to the unreasonable risk to workers is driven by acute (HE MOE = 0.61), intermediate (HE MOE = 8.4×10^{-2}), chronic (CT MOE = 0.77) non-cancer, and cancer (CT cancer risk estimate = 9.2×10^{-4}) inhalation risks. For ONUs, the preliminary unreasonable risk determination for this COU is driven by acute (MOE = 27), intermediate (MOE = 3.7), chronic (MOE = 3.9) non-cancer, and cancer (cancer risk estimate = 9.2×10^{-4}) inhalation risks. This determination for workers is based on the high-end risk estimates for acute and intermediate durations and the central tendency risk exposures for chronic non-cancer and cancer risks. Although the use of surrogate data is a less preferred approach for estimating inhalation exposure, EPA's confidence increases for this COU based on the inclusion of PBZ inhalation monitoring data, mapping to similar OESs, and the application of a vapor pressure adjustment between TCE and 1,1,2-trichloroethane.

Further refinement with use of TCE data included representing three different possible weight fraction ratios between TCE and 1,1,2-trichloroethane as reasonable bounds for differences in concentrations between these two compounds and included: (1) 90% TCE and 10% 1,1,2-trichloroethane (9:1); (2) 50% TCE and 10% 1,1,2-trichloroethane (5:1); and (3) 10% TCE and 10% 1,1,2-trichloroethane (1:1). Acute, intermediate, and chronic non-cancer acute MOEs were consistently below benchmark for each weight fraction ration used (Table 4-27). The middle scenario (5:1) represented within the occupational risk characterization (Section 4.3.2) serves as the basis for the preliminary determination for risk for this COU with the other ratios serve as bounds that additional confirm the risk potential for this COU.

COU Assessed Using Trichloroethylene, Perchloroethylene, and 1-Bromopropane Data

EPA did not identify reasonably available 1,1,2-trichloroethane inhalation monitoring data related to the following COU and therefore used surrogate data from trichloroethylene, perchloroethylene, and 1-bromopropane during the use of during batch open-top vapor degreasing and cold cleaning:

- Industrial use – Solvents – Solvents.

The determination that the Industrial use – Solvents COU significantly contributes to the unreasonable risk to workers is driven by acute, intermediate, chronic non-cancer, and cancer inhalation and dermal risks. EPA used data on trichloroethylene, perchloroethylene, and 1-bromopropane monitoring data from open-top vapor degreasing based on the availability of surrogate monitoring data and because this process presents a conservative estimate of exposure due to its higher exposure potential. Similarly, EPA used monitoring data from trichloroethylene from cold cleaning as a surrogate to represent this activity within the Industrial use – Solvents COU. However, this resulted in exposure estimates that may represent an overly conservative estimate of risk. For example, there is uncertainty in whether the vapor degreasing and cold cleaning scenarios assessed are representative of 1,1,2-trichloroethane for this COU (Section 4.3.2.1.7). Based on the limitations and potential overestimation in EPA's assessment of this COU, EPA's preliminary unreasonable risk determination for workers and ONUs is based on central

tendency inhalation exposures for workers based risk estimates within Table 6-4 from the Open-Top Vapor Degreasing OES and Cold Cleaning OES.

Table 6-4. Significant Contributions to the Preliminary Unreasonable Risk Determination for Workers and ONUs from the Industrial Use – Solvents COU by OES from Inhalation Exposure

COU	OES	Population	Exposure Level	Human Health Effects (with APF to Address Risk)			
				Acute Non-Cancer (Benchmark MOE = 100)	Intermediate Non-Cancer (Benchmark MOE = 30)	Chronic Non-Cancer (Benchmark MOE = 300)	Lifetime Cancer (Benchmark = 1E−04)
Industrial use – Solvents	Open-Top Vapor Degreasing	Worker	CT	**0.77** (APF 1,000)	**0.11** (APF 1,000)	**0.11** (APF 10,000)	**6.3E−03** (APF 10,000)
			HE	5.8E−02	7.9E−03	8.4E−03	0.11
		ONU	CT	**77**	**11**	**11**	6.3E−05
			HE	0.90	0.12	0.13	7.0E−03
	Cold Cleaning	Worker	CT	**0.53** (APF 1,000)	**7.3E−02** (APF 1,000)	**7.8E−02** (APF 10,000)	**9.1E−03** (APF 1,000)
			HE	0.32	4.3E−02	7.8E−02	2.0E−02
		ONU	CT	**0.53**	**7.3E−02**	**7.8E−02**	**9.1E−03**

APF = assigned protection factor; COU = condition of use; CT = central tendency; HE = high-end; MOE = margin of exposure; OES = occupational exposure scenario
Bolded and shaded text indicates that a risk estimate significantly contributes to unreasonable risk for 1,1,2-trichloroethane.

For dermal risks, the preliminary determination of unreasonable risk to workers is driven by intermediate (HE MOE = 3.5) and chronic (CT MOE = 9.3) non-cancer and cancer (CT cancer risk estimate = 7.2×10^{-4}) risk estimates.

EPA's confidence in the estimates for exposures to workers and ONUs for the Industrial use – Solvents COU is moderate. The vapor pressures of the surrogate chemicals employed within this analysis are comparable to 1,1,2-trichloroethane and mole fractions for these surrogate chemicals would be similar to 1,1,2-trichloroethane for the uses within this COU (Section 4.3.2.1.7).

COUs Assessed with Modeling

EPA did not identify reasonably available relevant inhalation monitoring data and used modeling to estimate occupational exposures for the Manufacturing – Import and Processing – Repackaging COUs. EPA has preliminarily determined these COUs significantly contributes to the unreasonable risk to workers driven by acute (CT MOE = 33), intermediate (CT MOE = 5.5), chronic (CT MOE = 5.9) non-cancer, and cancer (cancer risk estimate = 1.1×10^{-4}) inhalation risks. Risk to workers is also driven by intermediate (HE MOE = 4.7), chronic (CT MOE = 47) non-cancer dermal and cancer (cancer risk estimate = 1.4×10^{-4}) dermal risks. For ONUs, the preliminary unreasonable risk determination for this COU is driven by acute (MOE = 33), intermediate (MOE = 5.5), chronic (MOE = 5.9) non-cancer, and cancer (cancer risk estimate = 1.1×10^{-4}) inhalation risks. Monte Carlo modeling was based on approaches and parameters in the Repackaging generic scenario. EPA rates the weight of scientific evidence as slight-to-moderate for the modeling scenario and notes facility throughput as a source of uncertainty. As a result, based on the limitations and potential overestimation in EPA's assessment of these COUs, the Agency's preliminary determination for inhalation is based on central tendency exposures for all populations and durations.

ONU Unreasonable Risk

Of the 10 COUs that significantly contribute to the unreasonable risk to workers, EPA has preliminarily determined that 4 COUs significantly contribute to unreasonable risk to ONUs from acute, intermediate, and/or chronic inhalation exposures (Table 6-5).

Table 6-5. Significant Contributions to the Preliminary Unreasonable Risk Determination for ONUs by COU and OES from Inhalation Exposure

COU	OES	Human Health Effects			
		Acute Non-Cancer (Benchmark MOE = 100)	Intermediate Non-Cancer (Benchmark MOE = 30)	Chronic Non-Cancer (Benchmark MOE = 300)	Lifetime Cancer (Benchmark = 1E−04)
Manufacturing – Import	Import-Repackaging for Laboratory Chemical Use	**33**	**5.5**	**5.9**	**1.1E−04**
Processing – Repackaging	Import-Repackaging for Laboratory Chemical Use	**33**	**5.5**	**5.9**	**1.1E−04**
Industrial use – Solvents	Open-Top Vapor Degreasing	**77**	**11**	**11**	6.3E−05
	Cold Cleaning	**0.53**	**7.3E−02**	**7.8E−02**	**9.1E−03**
Industrial and commercial use – Adhesives and sealants	Industrial and Commercial Use of Adhesives and Sealants	**27**	**3.7**	**3.9**	**1.8E−04**

COU = condition of use; CT = central tendency; HE = high-end; MOE = margin of exposure; OES = occupational exposure scenario
Bolded and shaded text indicates that a risk estimate significantly contributes to unreasonable risk for 1,1,2-trichloroethane.

Similar to EPA's determination for workers, because the occupational risk assessment for incorporated 1,1,2-trichloroethane inhalation monitoring data for ONUs, EPA has confidence that the Agency's risk estimates (except for in cases where there are a high number of ND samples within the Disposal to WWT OES whereby the overall confidence is moderate, Table 4-11), including estimates at the high-end (95th percentile), reflect working conditions. The four COUs determined to preliminary contribute to unreasonable risk for ONUs from inhalation exposure did not have reasonably available ONU-specific sampling data for 1,1,2-trichloroethane and EPA used a default assumption of the central tendency from modeled workers inhalation exposures and/or surrogate chemical data to represent ONU inhalation exposures. Considering the uncertainties associated with these risk estimates, the Agency's risk determination is driven only by the modeled central tendency exposures for these ONUs for all durations.

Distribution in Commerce COU Does Not Contribute to Unreasonable Risk

For the Distribution in commerce COU, activities associated with loading and unloading chemical products were assessed as part of each COU's OES (Section 4.3.2.1.13). Table 3-3 further details how relevant OESs are expected to receive the chemical for processing and use. EPA expects all the 1,1,2-trichloroethane or 1,1,2-trichloroethane-containing products and/or articles to be transported in a closed system or otherwise to be transported in a form (*e.g.*, articles containing 1,1,2-trichloroethane) such that there is negligible potential for releases. Transport containers are not expected to be opened during transport between producing and receiving sites. Therefore, no occupational exposures are reasonably expected to occur, no separate assessment was performed for estimating releases and exposures from distribution in commerce (Section 4.3.2.1.13). Speculative exposures that may result from irregular and unpredictable accidental spills during transport are not assessed by EPA in TSCA risk evaluations. EPA

has preliminarily determined that the Distribution in commerce COU does not contribute to unreasonable risk.

Dermal Considerations

EPA derived dermal risk estimates utilizing a probabilistic model with a full distribution for most of the modeled parameters (except for fraction absorbed and event frequency) to derive risk estimates for dermal exposure to 1,1,2-trichloroethane. Dermal exposure for ONUs is not expected and was not assessed because they do not directly handle 1,1,2-trichloroethane. EPA has preliminarily determined that nine COUs significantly contribute to unreasonable risk to human health for workers (Table 6-6).

Table 6-6. Significant Contributions to the Preliminary Unreasonable Risk Determination for Workers by COU from Dermal

COU	OES	Exposure Level	Human Health Effects			
			Acute Non-Cancer (Benchmark MOE = 30)	Intermediate Non-Cancer (Benchmark MOE = 30)	Chronic Non-Cancer (Benchmark MOE = 300)	Lifetime Cancer (Benchmark = 1E−04)
Manufacturing – Domestic manufacture	Manufacturing as a Non-Isolated Byproduct	CT	1,356	76	**82**	9.4E−05
		HE	237	**13**	14	5.4E−04
Manufacturing – Import	Import-Repackaging for Laboratory Chemical Use	CT	621	44	**47**	**1.4E−04**
		HE	69	**4.7**	5.0	1.5E−03
Processing – As a reactant – Intermediate in: Plastic manufacturing; Petrochemical manufacturing; All other chemical product manufacturing	Processing as a Reactant	CT	463	26	**28**	**2.4E−04**
		HE	103	**5.8**	6.2	1.2E−03
Processing – Incorporation into a formulation, mixture, or reaction product – Formulation of adhesives and sealants	Formulation of Adhesives and Sealants	CT	1,303	73	**79**	8.6E−05
		HE	237	**13**	14	5.1E−04
Processing – Repackaging	Import-Repackaging for Laboratory Chemical Use	CT	621	44	**47**	**5.4E−04**
		HE	69	**4.7**	5.0	1.5E−04
Processing – Recycling	Import-Repackaging for Laboratory Chemical Use	CT	621	44	**47**	**5.4E−04**
		HE	69	**4.7**	5.0	1.5E−04
Industrial use – Solvents	Open-top Vapor Degreasing; Cold Cleaning	CT	154	**8.7**	**9.3**	**7.2E−04**
		HE	62	**3.5**	3.7	2.0E−03

COU	OES	Exposure Level	Human Health Effects			
			Acute Non-Cancer (Benchmark MOE = 30)	Intermediate Non-Cancer (Benchmark MOE = 30)	Chronic Non-Cancer (Benchmark MOE = 300)	Lifetime Cancer (Benchmark = 1E−04)
Disposal	Disposal to Incineration; Waste Handling, Treatment, and Disposal (POTW and Non-POTW/WWT; Landfill)	CT	462	26	**28**	**2.4E−04**
		HE	103	**5.8**	6.2	1.2E−03

COU = condition of use; CT = central tendency; HE = high-end; MOE = margin of exposure
Bolded and shaded text indicates that a risk estimate significantly contributes to unreasonable risk for 1,1,2-trichloroethane.

Use of empirical evidence such as fractional absorption developed from a TSCA Section 4 test order for 1,1,2-trichloroethane provided increased confidence in the dermal estimates (Section 4.3.2.2). EPA has moderate confidence in the non-cancer risk estimates, and slight-to-moderate confidence in the cancer risk estimates generated by the model are sufficient for determining whether a COU significantly contributes to the unreasonable risk. The Agency used the high-end exposure estimates for intermediate non-cancer exposures and the central tendency chronic non-cancer and cancer dermal risk determinations The use of central tendency exposure for dermal from chronic non-cancer and cancer dermal risk estimates is due to reduced confidence that the high-end dermal exposures are representative with these longer duration exposures (Section 4.3.2.2). The central tendency estimated by the DEVL Model is considered a more representative and appropriate exposure estimate for frequent, repeated dermal exposure (*i.e.,* chronic) associated with closed-system processes.

Occupational dermal risk estimates did not include or assume the use of gloves or other types of controls (Section 4.3.2.2) and may overestimate dermal exposures. These risk estimates indicate dermal exposure for the COUs listed above that are well above intermediate and chronic absorbed doses based on the MOEs. Two COUs (Manufacturing – Domestic manufacture; and Processing – Incorporation into a formulation, mixture, or reaction product – Formulation of adhesives and sealants) have intermediate non-cancer dermal MOEs of 13 compared to the benchmark MOE of 30. Both COUs have similar intermediate exposure absorbed dose values at approximately 0.039 mg/kg/day with an intermediate HED of 0.52 mg/kg/day. Based on Equation 4-2 the intermediate dose that would result in an MOE at the benchmark of 30 is approximately 2.25 times less than the dose that resulted in the MOE of 13 for these COUs. High-end intermediate non-cancer risk estimates for dermal for the remaining COUs that significantly contribute to unreasonable risk to human health for workers resulted in MOEs one order of magnitude below the benchmark MOE of 30. All central tendency non-cancer risk estimates that significantly contribute to unreasonable risk to human health for workers were one-to-two orders of magnitude below the benchmark MOE of 300. EPA notes that potential risks relative to applicable benchmarks were not identified for acute dermal exposures for any OES evaluated in this assessment (Benchmark MOE = 30).

EPA did not have sufficient information to assume the use of 1,1,2-trichloroethane chemically resistant gloves in the risk determination for any COU. However, there is documentation supporting consistent glove use for one of the SEGs associated with manufacturing as a byproduct (*i.e.,* laboratory

technicians) and EPA notes dermal unreasonable risk may be mitigated for that SEG under that COU. Glove use was documented during collection of the full-shift inhalation exposure samples and varied by SEG (Stantec ChemRisk, 2024). Across all SEGs, chemical glove use was indicated in 53% of full-shift samples and 78% of task-based/short-term samples, though the duration of glove use was not reported. By SEG, full-shift glove use was documented in 52% of samples from maintenance technicians to 100% for laboratory technicians. Task-based/short-term samples documented glove use ranged from 65% for maintenance/logistics technicians to 100% for laboratory technicians. Application of gloves is well documented within the results of the test order report for laboratory technicians (Stantec ChemRisk, 2024) and is encouraging, however, the role of that reported use within an industrial setting does not broadly apply to all potential laboratory use scenarios within the Commercial Use – Other use – Laboratory chemical COU. Therefore, EPA does not consider the dermal protection information from laboratory technicians in manufacturing facilities representative of all commercial laboratories for the purpose of this national-level risk assessment for 1,1,2-trichloroethane.

6.1.4 Basis for No Unreasonable Risk to Consumers

Based on the consumer risk estimates and related risk factors, EPA has preliminarily determined that 1,1,2-trichloroethane does not present unreasonable risk to consumers via the acute and chronic non-cancer inhalation or dermal routes of exposure. Consumers are potentially exposed to 1,1,2-trichloroethane through inhalation and dermal exposures during application of the adhesives/glues containing 1,1,2-trichloroethane. These products consist of a two-part formula containing resin with concentration of 0.1 to 1.0% 1,1,2-trichloroethane and a hardener that does not contain 1,1,2-trichloroethane (U.S. EPA, 2026ax). The Agency did not assess cancer risk to consumers because the product/article use does not align with a lifetime exposure (Section 1.2.1).

Under the Commercial use – Adhesives and Sealants COU, EPA assessed consumer risk from inhalation and dermal exposures via a sensitivity analysis that varied exposure durations and product concentrations. Consumer populations assessed were youth 1 (11–15 years), youth 2 (16–20 years), and adults (21+ years). The assessment for consumers was conducted considering high-intensity exposure scenario risk estimates relying on reasonably available information and assumptions to assess exposures that would be expected to be on the high end of the exposure distribution. EPA assessed inhalation exposures via modeling using CEM (U.S. EPA, 2023b), a peer-reviewed modeling tool allowing for specific inputs such as weight fractions, product density, and frequency of use. Specifically, input parameters for the inhalation assessment consisted of CEM defaults with other information (*i.e.,* mass of product, duration of use, weight fractions and frequency of use) identified from the product technical support documents or safety data sheets in addition to the Westat Survey Household Solvent Products: A National Survey (Westat Inc., 1987).

Risk estimates for acute inhalation were represented with MOEs derived from 1- and 3-hour TWA exposures with the 3-hour TWA MOEs considered to be best aligned with the POD originating from a 4-hour exposure duration from an inhalation-based laboratory toxicity study. A fractional absorption method (U.S. EPA, 2007) was conducted for the dermal exposure assessment of the Commercial Use – Adhesives and Sealants COU. The input parameters for the fraction absorbed was from an OECD guideline study with results indicating a dermal absorption range of 0.5 to 1.0% for a 10% 1,1,2-trichloroethane solution (Labcorp Early Development, 2023). Dermal results for the consumer populations previously described above were considered protective for other life stages not within the analysis results. Ingestion is not anticipated based on the identified uses of these products and EPA does not reasonably expect exposures via ingestion.

Parameters of duration of use, mass of product, and weight fraction of 1,1,2-trichloroethane within the final volume of product used were all modulated to determine acute and chronic non-cancer MOE values for consumer inhalation exposure analysis. Duration of use, spanning 5, 10, and 20 minutes, did not impact overall MOE values compared to factors such as weight fraction and the mass of product used. Acute non-cancer MOE values for inhalation were above the benchmark MOE for weight fractions of 0.5 and 0.05%, all three mass of products used, and use durations (Table 4-30). The highest possible weight fraction (0.5%) with the maximum product volume used resulted in MOE values for acute inhalation exposure below the benchmark MOE using the E1 CEM emission model intended for liquid products such as cleaners. An additional emission model within CEM, known as E2 Emission from Product Applied to a Surface Indoors Double Exponential Model, was used for this high-end use scenario as it is specifically intended to represent liquid products that cure over time (Table 4-31). All acute non-cancer risk estimates for the high-intensity scenario for inhalation were above benchmark (Table 4-30). All MOE values calculated for the chronic inhalation scenarios were above benchmark. All three lifestages examined (youth 1, youth 2, and adults) resulted in acute and chronic MOE values below benchmark for the highest weight fraction using the highest reported fractional absorption value. (Table 4-32)

As discussed in Section 4.1.2.4 the overall confidence in the consumer exposure assessment is robust for both inhalation and dermal assessments; however, Section 4.3.3 details uncertainties and possible overlying conservative approaches that are important to consider when viewing the results of the CEM analysis. The use of the entire product is possible with the sensitivity analysis of 10, 25, and 50 grams of product resulting in a 0.8-centimeter (≈0.3 inches) wide bead at approximate lengths of 20 cm (7.8 inches), 50 cm (19.6 inches), and 100 cm (39 inches), respectively. The products examined are intended to be used for fast applications with working times as low as 5 minutes and can develop full-strength bonds within 25 minutes (U.S. EPA, 2026ax). The consumer inhalation assessment used an emision model within the CEM (E1: Emission from product applied to a surface indoors incremental source model) to represent a greater evaporation percentage of the applied mass of the product and is described for uses, "…generally applicable to liquid products applied to surfaces that evaporate from the surface, such as cleaners." These consumer products are characterized by fast set and cure times that would be expected to limit releases due to covered surface areas for material bonding and potential trapping within the cured product. Application of the E2 emission model within CEM accounts for liquid solutions curing by applying an initial fast release by evaporation followed by a slow release by diffusion as the mass of the chemical is trapped within cured substrate (U.S. EPA, 2023b).

There are uncertainties associated with the specific weight fraction concentrations of 1,1,2-trichloroethane within these products, thus a range of weight fraction values of 1,1,2-trichloroethane was sourced from the SDS materials (Section 4.1.2). Overall robust confidence for both the inhalation and dermal consumer exposure analysis was supported with use survey data (Westat Inc., 1987), validated CEM inputs, and confidence in human health hazard values (Section 4.2.3). EPA has preliminarily determined that the Commercial use – Adhesives and Sealants COU does not significantly contribute to unreasonable risk to consumers from acute and chronic inhalation or dermal exposures.

6.1.5 Basis for No Unreasonable Risk to the General Population

Based on the risk estimates and other risk-related factors, EPA did not identify significant contributions to unreasonable risk to the general population for any COU from the following exposure routes and pathways for 1,1,2-trichloroethane:

- inhalation exposure to ambient air;
- soil ingestion and dermal exposure from air deposition to soil and air, respectively; and
- dermal and oral exposure to surface water (incidental ingestion and dermal contact from swimming, and ingestion of drinking water).

EPA employed a tiered approach for assessing high-end exposure scenarios with data that reflects exposure expected to occur in proximity to releasing facilities. Proximity is largely represented within water releases as the point of release to mixing zone within a flowing water body, while area or distance from a release (*i.e.,* 100–1,000 m) is used for a release to air. The Agency evaluated surface water, drinking water, and ambient air, using an MOE and IUR approach using high-end exposure estimates to determine whether an exposure pathway had potential cancer or non-cancer risks. High-end exposure estimates were defined as those associated with the industrial and commercial releases from a COU and OES that resulted in the highest environmental media concentrations. If unreasonable risk was not indicated for an individual identified as having the potential for the highest exposure for a COU and given pathway of exposure, then EPA determined that the pathway was not a pathway of concern, and the pathway was not evaluated further. If any pathways were identified as a pathway of concern for the general population, further exposure assessments for that pathway would be conducted to include higher tiers of modeling if available, additional subpopulations and COUs.

Initial screening produced cancer risk estimates for ambient air exposures that indicated an increased cancer risk for five COUs (Table 4-33) at or above 1 in 1,000,000 to 1 in 10,000 (*i.e.,* 1×10^{-6} to 1×10^{-4}) as far as 1,000 m from a modeled release point. Considering all the relevant risk-related information and uncertainties, EPA has preliminarily determined that 1,1,2-trichloroethane exposures to the general population do not significantly contribute to unreasonable risk due to acute non-cancer, chronic non-cancer, and cancer risk from inhalation exposure under these COUs for reasons discussed below.

EPA used NEI and TRI data to assess ambient air inhalation risks to the general population. EPA used HEM to evaluate exposures and characterize risk to populations living near releasing facilities. Risk estimates based on HEM utilized 2017 TRI-reported releases and NEI-reported releases (2017, and 2020). HEM combines U.S. Census data with estimated ambient air concentrations to calculate maximum individual risks and the number of people within each census block with cancer risk above certain benchmarks. These HEM results were calculated using the daily averages of hourly estimated concentrations averaged across 365 days that account for the conditions of that specific facility location, such as prevailing winds and local meteorology.

Because stack information was not available in TRI, default release areas for fugitive emissions and default stack parameters for point sources were used in modeling of releases reported to TRI. Some of these assumptions could have resulted in high-end estimated concentrations. In this assessment, reported TRI releases were consistently higher than NEI releases for facilities that reported to both databases, driving higher risk estimates for certain COUs based on TRI data. Additionally, EPA also assumed TRI releases occur at one location, which could result in higher or lower risk estimates depending on the specific locations of the releases, size of the facility, and population distribution around the facility. Because both NEI and TRI provide high-quality data, and a larger number of TRI-reported release years were reasonably available and included in this assessment, EPA considered the risk estimates derived using both datasets in this risk determination.

For risk to the general population, EPA typically considers an increased cancer risk above 1 in 1,000,000 to 1 in 10,000 (*i.e.,* 1×10^{-6} to 1×10^{-4}). Again, these estimates are not treated as a bright-line and other risk-based factors are considered (*e.g.,* confidence in the hazard and exposure characterization, duration, magnitude, uncertainty, and populations exposed, especially because fenceline populations exposed are considered PESS in this draft risk evaluation) for the purpose of making an unreasonable risk determination. The Agency's analytical framework under TSCA is similar to other EPA programs (*e.g.,* the Clean Air Act, Comprehensive Environmental Response, Compensation, and Liability Act [CERCLA]), which include consideration of other relevant risk-related information and uncertainties such as the overall incidence of cancer as well as the number of persons exposed within each individual lifetime risk range. As required by TSCA, EPA specifically considers PESS.

EPA's analysis indicated acute non-cancer risk estimates were above the benchmark for all exposure scenarios and release datasets (Section 4.3.4.1.1) indicating no acute non-cancer risk to the general population for 1,1,2-trichloroethane. Facility-specific census block analysis results indicated chronic non-cancer risk estimates above the benchmark MOE within populated census blocks in the domain of TRI facilities values for all COUs assessed (Section 4.3.4.1.2). EPA has preliminarily determined that 1,1,2-trichloroethane does not significantly contribute to the unreasonable risk to the general population from acute or chronic inhalation exposure via the ambient air pathway.

Initial radial distance analysis identified cancer risk estimates greater than the benchmark of 1×10^{-6} but less than 1×10^{-4} as far as 1,000 m from the modeled release point from the following COUs:

- Processing – Processing as a reactant – Plastic manufacturing;
- Processing – Processing as a reactant – Petrochemical manufacturing;
- Processing – Processing as a reactant – All other chemical product manufacturing;
- Industrial use – Solvents;
- Disposal.

Further analysis of the radial distance results with an examination of facility specific census block data was conducted to determine if populations reside at locations where risk estimates are greater than the cancer risk benchmark upper range. Results indicate that four of the five COUs have calculated risk estimates for cancer effects less than the benchmark value of 1×10^{-6}: (1) Processing – Processing as a reactant – Plastic manufacturing; (2) Processing – Processing as a reactant – Petrochemical manufacturing; (3) Processing – Processing as a reactant – All other chemical product manufacturing; and (4) Disposal. Analysis with the 2020 census and facility specific census block data indicates there are no individuals within the general population residing at locations where risk estimates are greater than the benchmark of 1×10^{-6} for these five COUs (Table 4-35). The Industrial Use – Solvents COU did result in cancer risk estimates slightly greater than the benchmark of 1×10^{-6} but less than 1×10^{-4} based on both TRI and 2017 NEI release datasets (*i.e.*, 1.5×10^{-6}). This excess cancer risk estimate is associated with a census block 190 m from the facility with an estimated population of 52 persons. Due to potential biases toward high exposures as discussed in section 4.3.4.1.5—combined with a maximum cancer risk only slightly above the lower end of the cancer benchmark range and an estimated cancer incidence of 4.1×10^{-5}—EPA is preliminarily determining that this COU does not significantly contribute to the unreasonable risk of 1,1,2-trichloroethane via the ambient air pathway for the general population. It is also important to note that the one facility associated with this COU discontinued their use of 1,1,2-trichloroethane after 2019 (EPA-HQ-OPPT-2018-0421-0051; Section 4.1.3.1.3) and based on 2020 census data, there no populations exposed from any facility associated with this COU above or within the cancer benchmark range using more recent release reporting years.

Using reported releases from the 2017 NEI dataset, a facility-specific release under the Manufacturing – Domestic manufacture COU resulted in a cancer risk estimate greater than the benchmark of 1×10^{-6} (Figure 4-10); however, the 2020 NEI dataset indicated that this facility was not in the top 10 reported releases and calculated cancer risk estimates were below the benchmark of 1×10^{-6}. For this facility, the two census blocks with risk estimates greater than 1×10^{-6} using the 2017 NEI dataset do not have residences and there are unpopulated census blocks in most directions from the release point (Figure 4-10). Although the 2020 census data used by the HEM indicated six people reside in a census block with cancer risk there is an absence of visually identifiable residences. For this site there is a significant decrease in releases from 2017 to 2020, where the 2020 NEI dataset results in no individuals within the general population residing at locations where risk estimates are greater than 1×10^{-6} but less than 1×10^{-4} for any COUs (Section 4.3.4.1.3).

Risk estimates for incidental dermal and oral exposures to 1,1,2-trichloroethane were assessed with both facility-specific releases identified in TRI/DMR and generic scenario releases from TSCA OESs. The assessments for these exposures were represented by the facility within that OES with the highest estimated 30Q5 surface water concentration and generic scenarios were represented by the high-end release scenario and low flow scenario for each OES. Facility specific and generic scenario incidental dermal acute MOEs were all above benchmark for adult, youth, and child lifestages (Section 4.3.4.2). The results from high-end scenarios from both facility specific and generic scenario releases result in robust confidence that incidental dermal exposure from 1,1,2-trichloroethane does not preliminarily contribute to the unreasonable risk for all COUs with releases to water. Similarly, risk estimates for incidental oral exposures resulted in MOEs above benchmark for both facility-specific and generic scenario OESs with the assessment of these high-end scenarios resulting in robust confidence that incidental oral ingestion of 1,1,2-trichloroethane does not preliminarily significantly contribute to the unreasonable risk for all COUs with water releases (Section 4.3.4.3). EPA has preliminarily determined that 1,1,2-trichloroethane does not significantly contribute to the unreasonable risk from incidental dermal and oral exposures to the general population.

Assessment of risk from acute and chronic non-cancer and chronic cancer risk from drinking water exposure was conducted with facility-specific data and generic scenarios. All MOEs based on facility-specific and generic scenario for acute and chronic non-cancer drinking water exposure were above benchmark (Section 4.3.4.4.1 and Section 4.3.4.4.2). Associated lifetime cancer risks ranged from 1.9×10^{-8} to 1.2×10^{-5} across all facility-specific OESs with 10 facilities representing 5 OESs with lifetime cancer risks higher than the benchmark of 1.0×10^{-6} for chronic cancer drinking water exposures. Six of these 10 facilities have no downstream drinking water intakes within 250 km whereas the remaining 4 facilities have no intakes less than 70 km from those facilities. Reductions in 1,1,2-trichloroethane concentrations due to the large distances between release and intakes, the lack of downstream intakes for other facilities, and available drinking water monitoring data provides robust confidence that no facility-specific releases pose lifetime cancer risk to drinking water (Section 4.3.4.4.1). All estimated lifetime cancer risks are below the benchmark of 1.0×10^{-6} and therefore indicate no identified risk. Although the assessment of lifetime cancer risk for drinking water from generic scenarios do not have specific drinking water intakes identified, there is robust confidence that no risk is present as these estimates indicate no lifetime cancer risk very near to a hypothetical discharge (Section 4.3.4.4.2). EPA has preliminarily determined that 1,1,2-trichloroethane does not significantly contribute to the unreasonable risk from general population drinking water exposures.

Bioaccumulation and trophic transfer within aquatic food webs are expected to be limited. Physical and chemical properties of 1,1,2-trichloroethane, such as, solubility, logK_{OW}, and volatility suggest limited uptake in fishes (Table 2-1). Both modeled and empirical studies on 1,1,2-trichloroethane

bioaccumulation indicate a limited ability for this compound to accumulate in fishes (Section 2.2.1). No reasonably available studies report evidence of 1,1,2-trichloroethane in tissues of wild-caught fish or other organisms and modeled bioaccumulation estimates indicate a low BAF factor. EPA has robust confidence that low bioaccumulation potential and lack of empirical evidence for 1,1,2-trichloroethane accumulation at any trophic levels indicate that exposure via fish ingestion are not anticipated (Section 5.3.4.3).

Overall, EPA has robust confidence in risk estimates that were calculated using release data reported to both TRI, DMR, and NEI and that the risks are representative of actual exposures to the general population living near releasing facilities. Due to the use of high-end but relevant assumptions and data, EPA has robust confidence that risk estimates support a realistic and health-protective preliminary finding of no unreasonable risk to the general population. Additionally, the use of HEM for air releases allowed for the characterization of populations living near facilities and provided strong evidence for distances that are most relevant for general population exposure. Additional information on EPA's overall confidence and uncertainties regarding the general population risk assessment can be found in Sections 4.3.4.1.5, 4.3.4.2, 4.3.4.3, and 4.3.4.4.

6.2 Environment

Based on the draft risk evaluation for 1,1,2-trichloroethane—including the risk estimates, the environmental effects of 1,1,2-trichloroethane, the exposures, the physical and chemical properties of 1,1,2-trichloroethane—EPA has preliminarily determined that 1,1,2-trichloroethane does not present unreasonable risk of injury to the environment. The Agency expects 1,1,2-trichloroethane to be released to the environment via air, surface water, sediment, biosolids, and landfills. Environmental risk of 1,1,2-trichloroethane to aquatic organisms was assessed by COUs for the water pathway with either facility-specific release scenarios or generic scenario releases with surface water, sediment, and sediment pore water exposures near wastewater treatment outflows. For terrestrial species, environmental risk of 1,1,2-trichloroethane in air was assessed using high-end exposure concentrations in a screening assessment. Environmental risk of 1,1,2-trichloroethane to terrestrial organisms via exposures to soils via landfill, biosolids, air to soil deposition, and dietary exposure via bioaccumulation in fish was assessed based on weight of evidence approaches related to monitoring data, physical and chemical properties, fugacity modeling, and release information.

The Agency expects that environmental releases of 1,1,2-trichloroethane from consumer use will be negligible and not expected to exceed hazard to ecological receptors. The Disposal COU is represented with multiple OESs (Table 3-6) and encompasses 1,1,2-trichloroethane contained in a waste stream collected from facilities and 1,1,2-trichloroethane contained in wastewater discharged by occupational users and disposed consumer products and articles.

Risk quotients can provide a risk profile by presenting a range of estimates for different environmental hazard effects for different COUs. An RQ equal to 1 indicates that the exposures are the same as the concentration that has been shown to cause effects. An RQ is less than 1 when the exposure is less than the effect concentration. This generally indicates that there is not risk of injury to the environment that would support a determination of unreasonable risk for 1,1,2-trichloroethane. An RQ is greater than 1 when the exposure is greater than the effect concentration. This generally indicates that there is risk of injury to the environment that would support a determination of unreasonable risk for 1,1,2-trichloroethane. In addition to RQ values, when an RQ is 1 or greater the Agency evaluates the number of days that a concentration exceeded a hazard threshold to align the durations of 1,1,2-trichloroethane exposure to the acute or chronic exposure durations that lead to adverse population effects before making a determination of unreasonable risk. Risk was also characterized for specific receptor groups

without the calculation of risk quotients to support conclusions (Table 5-3). Consistent with EPA's determination of unreasonable risk to human health, the RQ is not treated as a bright-line and other risk-based factors may be considered (*e.g.,* confidence in the hazard and exposure characterization, duration, magnitude, uncertainty) for purposes of making an unreasonable risk determination.

6.2.1 Populations and Exposures EPA Assessed for the Environment

EPA estimated environmental exposures to both aquatic and terrestrial species based on releases of 1,1,2-trichloroethane and concentrations of 1,1,2-trichloroethane in the environment as part of its environmental risk assessment. For aquatic organisms inhabiting the water column and benthic zone, EPA estimated exposures from surface water and sediment (including pore water). EPA also estimated exposure to algae from surface water. Inhalation exposure of terrestrial mammals to 1,1,2-trichloroethane via the ambient air pathway were conducted via modeling.

6.2.2 Summary of Environmental Effects

EPA has preliminarily determined that none of COUs assessed significantly contribute to unreasonable risk to the environment presented by 1,1,2-trichloroethane as environmental concentrations are well below identified environmental hazard thresholds. Reasonably available data for 1,1,2-trichloroethane has allowed for the identification of hazard thresholds for a variety of receptor groups (aquatic and terrestrial) and exposure durations (acute and chronic) that increase confidence in the risk determination for this chemical (Table 5-2). EPA and preliminarily determined that the effects of 1,1,2-trichloroethane to aquatic organisms, including fish, benthic invertebrates, and algae, do not present an unreasonable risk to the environment.

EPA has preliminarily determined that the effects of 1,1,2-trichloroethane to terrestrial organisms—including soil-dwelling invertebrates and plants via 1,1,2-trichloroethane in soil as well as soil from biosolids—do not present an unreasonable risk to the environment. EPA has also preliminarily determined that the effects to terrestrial organisms, including terrestrial mammals via inhalation and tropic transfer from fish ingestion do not present an unreasonable risk to the environment. More information about the Agency's confidence in the aquatic, terrestrial, and trophic transfer hazard assessments are provided in Section 5.3.5 of this draft risk evaluation.

6.2.3 Basis for No Unreasonable Risk to the Environment

Based on the draft risk evaluation for 1,1,2-trichloroethane, including the risk estimates, the environmental effects of 1,1,2-trichloroethane, the exposures, physical and chemical properties of 1,1,2-trichloroethane, as well as the consideration of uncertainties, EPA has preliminarily determined that 1,1,2-trichloroethane does not present unreasonable risk of injury to the environment.

6.2.3.1 Aquatic Species

For aquatic organisms, surface water and sediment (including pore water) were characterized by comparing hazard thresholds from exposures due to industrial releases. A screening-level assessment was conducted with facility-specific TRI or DMR data to produce modeled concentrations of 1,1,2-trichloroethane in surface water (Section 5.3.3.1.1) and sediment (Section 5.3.3.2.1). COUs where facility-specific reported releases were not available were represented with generic scenario releases to produce high-end modeled concentration of 1,1,2-trichloroethane in surface water (Section 5.3.3.1.2) and sediment (Section 5.3.3.2.2). EPA's confidences in the aquatic exposure assessment for the surface water and sediment pathways are moderate-to-robust as they represent conservative modeling and monitoring information to inform screening assessments. Modeled 1,1,2-trichloroethane concentrations resulting from facility specific reported releases and generic scenario releases are represented within Table 5-5 and no concentrations resulted in RQs greater than 1 for acute or chronic exposures. Although

no monitored/measured data from direct releases linked to COUs were reasonably available, data from the WQP indicates that the highest reported concentration of 1,1,2-trichloroethane (10.8 µg/L; (U.S. EPA, 2026g)) within water is two orders of magnitude less than COCs representing acute aquatic animals, chronic vertebrates, chronic invertebrates, or algae (Table 5-2). No measured concentrations of 1,1,2-trichloroethane greater than the levels of detection have been reported within sediment (Section 5.3.3.2.3). Exposure pathways to surface water and sediment for the Disposal COU were considered for 5 different scenarios (OES #11 to #15 represented within Table 3-6) and considered using DMR-reported data (Table 5-4 and Table 5-5).

6.2.3.2 Terrestrial Species

For terrestrial organisms, IIOAC modeling was used to assess inhalation exposures to terrestrial mammals via the ambient air pathway using the COU with the highest resulting concentration from fugitive and stack emissions 100 m from the release source as a screening-level analysis (Section 5.3.4.1). Review of reasonably available monitoring data, such as the AMTIC archive monitoring data from 2018 to 2022, indicates a maximum concentration of 51.9 µg/m^3 from 226 AMTIC monitoring sites with a total of 46,675 samples and 97.7% reporting values below the minimum detection limit (0.005–1.64 µg/m^3). Concentrations of 1,1,2-trichloroethane from monitored ambient air sampling represent all contributing sources and are not directly linked to COUs but were used contextualize the IIOAC modeling results (Section 5.3.4.1). EPA's confidence in the exposure assessment for the air pathway is robust with modeling and monitoring data informing the exposure characterization. The assessment of risk to terrestrial invertebrates and plants via soil exposure is based on moderate confidence that 1,1,2-trichloroethane will be present at concentrations in soils based well below hazard thresholds identified for plants and soil invertebrates on the monitoring data, physical and chemical properties, fugacity modeling, and release data.

Monitoring data suggest that for its current uses 1,1,2-trichloroethane is not likely to be present in soils from landfills, biosolids, or air deposition (Section 5.3.4). No reasonably available studies report evidence of 1,1,2-trichloroethane in tissues of wild-caught fish or other organisms and modeled bioaccumulation estimates indicate a low BAF factor. EPA has robust confidence that low bioaccumulation potential and lack of empirical evidence for 1,1,2-trichloroethane accumulation at any trophic levels indicate that exposure via fish ingestion is not anticipated (Section 5.3.4.3).

EPA assessed risk to terrestrial organisms from 1,1,2-trichloroethane for terrestrial mammal via air inhalation through the use of a screening-level assessment with IIOAC modeling. EPA assessed risk to terrestrial organisms from 1,1,2-trichloroethane deposition from air to soil, biosolids to soil, and trophic transfer. Overall, the Agency has preliminarily determined that there is no significant contribution to unreasonable risk from 1,1,2-trichloroethane to terrestrial species. The results of the screening-level assessment support EPA's preliminary determination that there is no significant contribution to unreasonable risk to mammals from air inhalation.

Exposure pathways with media of release leading to air deposition to soil, biosolids to soils, and trophic transfer do not significantly contribute to the unreasonable risk presented by 1,1,2-trichloroethane to the environment. This is based on multiple lines of evidence including physical and chemical properties, fugacity modeling, reasonably available environmental monitoring, and release data. The physical and chemical properties of 1,1,2-trichloroethane suggest moderate-to-high mobility based on log K_{OW} and log K_{OC} with a Henry's Law constant indicating volatilization from the soil surface and limited potential for uptake in fishes (Table 2-1 and Section 4.1.3). Fugacity modeling (Section 2.2.1) indicates that air deposition to soil is not a significant pathway for 1,1,2-trichloroethane and is supported, in part, by reasonably available environmental monitoring data within soil and low affinity to partition to

particulate matter versus its existing as a vapor. Presence of 1,1,2-trichloroethane within biosoilds is expected to be limited based on removal from wastewater treatment processes predominately through volatilization and significant biodegradation in some WWTPs (Section 2.2).

Although 1,1,2-trichloroethane is not expected to be disposed of in non-hazardous landfills it can be present in landfills due to the biodegradation of other chlorinated ethanes, such as 1,1,1,2-tetrachloroethane. The main pathways assessed for the Disposal COU were represented with five OESs for surface water, fugitive, and stack air releases previously detailed by screening-level approaches for aquatic species (Section 3.1.1.1) and air inhalation for terrestrial species within the current section. Both modeled and empirical studies on 1,1,2-trichloroethane bioaccumulation indicate a limited ability for this compound to accumulate in fishes (Section 2.2.1). This is strengthened by review of the data landscape for fish tissue monitoring concluding that studies do not identify evidence of 1,1,2-trichloroethane in tissues of wild-caught fish or other organisms (Section 5.3.4.3).

6.3 Supporting Basis for the Preliminary Risk Determination

Table 6-7 summarizes the basis for this unreasonable risk determination of injury to human health presented in this draft 1,1,2-trichloroethane risk evaluation. The bolded and shaded numbers indicate estimates which were used to inform the significant contributions to unreasonable risk. Table 6-7 identifies the duration of exposure (*e.g.,* acute, intermediate, or chronic duration) and the exposure route to workers and/or ONUs. The APFs of the PPE in parentheses for workers represent the minimum necessary measures required, when other exposure controls (*e.g.,* engineering controls) are not in place, so that the risk is no longer unreasonable. PPE is not included where the exposed population would not be expected to wear PPE (*e.g.,* ONUs). For this preliminary unreasonable risk determination, EPA considered the effects of 1,1,2-trichloroethane to human health for workers, ONUs, and the general population, as well as effects of 1,1,2-trichloroethane to human health and the environment from the exposures associated with the COUs, risk estimates, and uncertainties in the analysis. See Sections 4.3 and 5.3 of this draft risk evaluation for a summary of risk estimates.

6065 **Table 6-7. Supporting Basis for the Preliminary Unreasonable Risk Determination for Human Health for Occupational COUs**

COU		OES	Population – SEG	Exp. Route	Exp. Level [b]	Human Health Effects (with APF to Address Risk) [a]			
Life Cycle Stage	Category/ Subcategory					Acute Non-Cancer (Benchmark MOE = 100 for Inhalation and 30 for Dermal) [c]	Intermediate Non-Cancer (Benchmark MOE = 30)	Chronic Non-Cancer (Benchmark MOE = 300)	Lifetime Cancer [d] (Benchmark = 1E−04)
Manufacturing	Domestic manufacture	Manufacturing as a Non-Isolated Byproduct	Worker	Dermal	CT	1,356	76	**82**	9.4E−05
					HE	237	**13**	14	5.4E−04
			Worker – operator [e]	Inhalation	CT	353	48	**51** (APF 10)	4.0E−06
					HE	**18** (APF 10)	**2.4** (APF 25)	2.6	2.9E−02
			Worker – logistics technician [f]	Inhalation	CT	3,142	429	459	4.4E−07
					HE	43	5.9	6.3	1.2E−04
			Worker – maintenance technician [g]	Inhalation	CT	1.1E04	1,480	1,585	1.3E−07
					HE	**6.1** (APF 25)	0.83	0.89	8.5E−04
			Worker – laboratory technician [h]	Inhalation	CT	9,757	1,330	1,424	1.4E−07
					HE	**50** (APF 10)	**6.8** (APF 10)	7.3	1.0E−04
			ONU	Inhalation	CT	1.4E04	1,852	1,983	1.03E−07
					HE	420	57	61	1.23E−05
	Import	Import-Repackaging for Laboratory Chemical Use	Worker	Dermal	CT	621	44	**47**	**1.4E−04**
					HE	69	**4.7**	5.0	1.5E−03
			Worker	Inhalation	CT	**33** (APF 10)	**5.5** (APF 10)	**5.9** (APF 1,000)	**1.1E−04** (APF 10)
					HE	5.3	0.89	0.95	7.4E−04
			ONU	Inhalation	CT	**33**	**5.5**	**5.9**	**1.1E−04**
					HE	5.3	0.89	0.95	7.4E−04

COU		OES	Population – SEG	Exp. Route	Exp. Level [b]	Human Health Effects (with APF to Address Risk) [a]			
Life Cycle Stage	Category/ Subcategory					Acute Non-Cancer (Benchmark MOE = 100 for Inhalation and 30 for Dermal) [c]	Intermediate Non-Cancer (Benchmark MOE = 30)	Chronic Non-Cancer (Benchmark MOE = 300)	Lifetime Cancer [d] (Benchmark = 1E−04)
Processing	Intermediate in: Plastic manufacturing; Petrochemical manufacturing; All other chemical product manufacturing	Processing as a Reactant	Worker	Dermal	CT	463	26	**28**	**2.4E−04**
					HE	103	**5.8**	6.2	1.2E−03
			Worker – operator [e]	Inhalation	CT	353	4.8	**51** (APF 10)	1.4E−05
					HE	**18** (APF 10)	**2.4** (APF 25)	2.6	3.5E−04
			Worker – logistics technician [f]	Inhalation	CT	3,142	429	459	1.5E−06
					HE	43	5.9	6.3	1.5E−04
			Worker – maintenance technician [g]	Inhalation	CT	1.1E04	1,480	1,585	4.5E−07
					HE	**6.1** (APF 25)	0.83	0.89	1.0E−03
			Worker – laboratory technician [h]	Inhalation	CT	9,757	1,330	1,424	5.0E−07
					HE	**50** (APF 10)	**6.8** (APF 10)	7.3	1.3E−04
			ONU	Inhalation	CT	1.4E04	1,852	1,983	3.58E−07
					HE	420	57	61	1.49E−05
	Repackaging	Import-Repackaging for Laboratory Chemical Use	Worker	Dermal	CT	621	44	**47**	**5.4E−04**
					HE	69	**4.7**	5.0	1.5E−04
				Inhalation	CT	**33** (APF 10)	**5.5** (APF 10)	**5.9** (APF 1,000)	**1.1E−04** (APF 10)
					HE	5.3	0.89	0.95	7.4E−04
			ONU	Inhalation	CT	**33**	**5.5**	**5.9**	**1.1E−04**
					HE	5.3	0.89	0.95	7.4E−04
	Recycling	Processing as a Reactant	Worker	Dermal	CT	463	26	**28**	**2.4E−04**
					HE	103	**5.8**	6.2	1.2E−03
			Worker – operator [e]	Inhalation	CT	353	48	**51** (APF 10)	1.4E−05
					HE	**18** (APF 10)	**2.4** (APF 25)	2.6	3.5E−04
			Worker – logistics technician [f]	Inhalation	CT	3,142	429	459	1.5E−06
					HE	43	5.9	6.3	1.5E−04

COU		OES	Population – SEG	Exp. Route	Exp. Level [b]	Human Health Effects (with APF to Address Risk) [a]			
Life Cycle Stage	Category/ Subcategory					Acute Non-Cancer (Benchmark MOE = 100 for Inhalation and 30 for Dermal) [c]	Intermediate Non-Cancer (Benchmark MOE = 30)	Chronic Non-Cancer (Benchmark MOE = 300)	Lifetime Cancer [d] (Benchmark = 1E−04)
Processing	Recycling	Processing as a Reactant	Worker – maintenance technician [g]	Inhalation	CT	1.1E04	1480	1,585	4.5E−07
					HE	**6.1** (APF 25)	0.83	0.89	1.0E−03
			Worker – laboratory technician [h]	Inhalation	CT	9,757	1,330	1,424	5.0E−07
					HE	**50** (APF 10)	**6.8** (APF 10)	7.3	1.3E−04
			ONU	Inhalation	CT	1.4E04	1,852	1,983	3.58E−07
					HE	420	57	61	1.49E−05
	Incorporation into a formulation, mixture, or reaction product; Formulation of adhesives and sealants	Formulation of Adhesives and Sealants	Worker	Dermal	CT	1,303	73	**79**	8.6E−05
					HE	237	**13**	14	5.1E−04
			Worker – operator [e]	Inhalation	CT	353	48	**51** (APF 10)	1.4E−05
					HE	**18** (APF 10)	**2.4** (APF 25)	2.6	3.5E−04
			Worker – logistics technician [f]	Inhalation	CT	3,142	429	459	1.5E−06
					HE	43	5.9	6.3	1.5E−04
			Worker – maintenance technician [g]	Inhalation	CT	1.1E04	1,480	1,585	4.5E−07
					HE	**6.1** (APF 25)	0.83	0.89	1.0E−03
			Worker – laboratory technician [h]	Inhalation	CT	9,757	1,330	1,424	5.0E−07
					HE	**50** (APF 10)	**6.8** (APF 10)	7.3	1.3E−04
			ONU	Inhalation	CT	1.4E04	1,853	1,984	3.6E−07
					HE	420	57	61	1.5E−05
Distribution in Commerce	Distribution in commerce	Distribution in Commerce	Qualitatively assessed						
Industrial and Commercial Use	Adhesives and sealants	Industrial and Commercial Use of Adhesives and Sealants	Worker	Dermal	CT	5,193	292	313	2.1E−05
					HE	1,384	78	83	8.7E−07
			Worker	Inhalation [i]	CT	**5.3**	**0.72**	**0.77** (APF 1,000)	**9.2E−04** (APF 10)
					HE	**0.61** (APF 1,000)	**8.4E−02** (APF 1,000)	9.0E−02	1.0E−02
			ONU	Inhalation [i]	CT	**27**	**3.7**	**3.9**	**1.8E−04**
					HE	24	3.3	3.5	2.6E−04

COU		OES	Population – SEG	Exp. Route	Exp. Level [b]	Human Health Effects (with APF to Address Risk) [a]			
Life Cycle Stage	Category/ Subcategory					Acute Non-Cancer (Benchmark MOE = 100 for Inhalation and 30 for Dermal) [c]	Intermediate Non-Cancer (Benchmark MOE = 30)	Chronic Non-Cancer (Benchmark MOE = 300)	Lifetime Cancer [d] (Benchmark = 1E−04)
Industrial use	Solvents	Open-Top Vapor Degreasing	Worker	Dermal	CT	154	**8.7**	**9.3**	**7.2E−04**
					HE	62	**3.5**	3.7	2.0E−03
			Worker	Inhalation	CT	**0.77** (APF 1,000)	**0.11** (APF 1,000)	**0.11** (APF 10,000)	**6.3E−03** (APF 10,000)
					HE	5.8E−02	7.9E−03	8.4E−03	0.11
			ONU	Inhalation	CT	**77**	**11**	**11**	6.3E−05
					HE	0.90	0.12	0.13	7.0E−03
		Cold Cleaning	Worker	Dermal	CT	154	**8.7**	**9.3**	**7.2E−04**
					HE	62	**3.5**	3.7	2.0E−03
			Worker	Inhalation	CT	**0.53** (APF 1,000)	**7.3E−02** (APF 1,000)	**7.8E−02** (APF 10,000)	**9.1E−03** (APF 1,000)
					HE	0.32	4.3E−02	7.8E−02	2.0E−02
			ONU	Inhalation	CT	**0.53**	**7.3E−02**	**7.8E−02**	**9.1E−03**
Commercial Use	Other uses – Laboratory chemical	Use of Laboratory Chemicals	Worker	Dermal	CT	621	44	**47**	**1.4E−04**
					HE	69	**4.7**	5.0	1.5E−03
			Worker	Inhalation	CT	4,146	565	605	1.2E−06
					HE	21	2.9	3.1	3.0E−04
			ONU	Inhalation	CT	4,146	565	605	1.2E−06
Disposal	Disposal	Disposal to Incineration	Worker	Dermal	CT	462	26	**28**	**2.4E−03**
					HE	103	**5.8**	6.2	1.2E−03
			Worker – logistics technician	Inhalation	CT	3,142	429	459	1.5E−06
					HE	43	**5.9** (APF 10)	6.3	1.5E−04
			Worker – logistics technician ONU	Inhalation	CT	3,142	429	459	1.5E−06
					HE				
			Worker – maintenance technician	Inhalation	CT	1.1E04	1,480	1,585	4.5E−07
					HE	**6.1** (APF 10)	0.83	0.89	1.0E−03

COU		OES	Population – SEG	Exp. Route	Exp. Level [b]	Human Health Effects (with APF to Address Risk) [a]			
Life Cycle Stage	Category/ Subcategory					Acute Non-Cancer (Benchmark MOE = 100 for Inhalation and 30 for Dermal) [c]	Intermediate Non-Cancer (Benchmark MOE = 30)	Chronic Non-Cancer (Benchmark MOE = 300)	Lifetime Cancer [d] (Benchmark = 1E−04)
Disposal	Disposal	Disposal to Incineration	Worker – maintenance technician ONU	Inhalation	CT	1.1E04	1,480	1,585	4.5E−07
					HE				
		Waste Handling, Treatment, and Disposal (POTW and Non-POTW WWT)	Worker	Dermal	CT	462	26	**28**	**2.4E−04**
					HE	103	**5.8**	6.2	1.2E−03
			Worker (1,2-DCA surrogate data)	Inhalation	CT	40	5.4	5.8	1.2E−04
					HE	7.7	1.1	1.1	8.2E−04
			Worker (1,1,2-TCA analogous data)	Inhalation	CT	75	**10**	**11** (APF 50)	6.5E−05
					HE	**38** (APF 10)	**5.2** (APF 10)	5.5	1.7E−04
			ONU (1,2-DCA surrogate data)	Inhalation	CT	121	16	18	4.0E−05
					HE	43	5.8	6.2	1.5E−04
			ONU (1,1,2-TCA analogous data)	Inhalation	CT	2.0E04	2,749	2,943	2.4E−07
		Waste Handling, Treatment, and Disposal (Landfill)	Worker	Dermal	CT	462	26	**28**	**2.4E−04**
					HE	103	**5.8**	6.2	1.2E−03
			Worker (landfill)	Inhalation	CT	1.1E06	1.6E05	1.7E05	4.3E−09
					HE	3.1E05	4.2E04	4.5E04	2.0E−08
			ONU (landfill)	Inhalation	CT	1.1E06	1.6E05	1.7E05	4.3E−09

1,1,2-TCA = 1,1,2-trichloroethane; 1,2-DCA = 1,2-dichloroethane; APF = assigned protection factor; Exp. = exposure; MOE = margin of exposure; NE = not estimated; OES = occupational exposure scenario; ONU = occupational non-user; POTW = publicly owned treatment works; Repro = reproductive; SEG = similar exposure group; WWT = wastewater treatment

[a] This value is the protection factor of personal protective equipment required to raise the acute MOE above the benchmark of 30. The Assigned Protection Factors (APF) associated with different types of respirators based on function (air-purifying, powered air purifying, supplied air) and fit (quarter mask, half-mask, full-face piece, helmet/hood, loose-fitting facepiece) are presented above. It should be noted that certain respirators are only applicable to specific types of inhalation exposure. See the OSHA Small Entity Compliance Guide for the Respiratory Protection Standard (accessed July 21, 2026) for detailed descriptions on the respirators corresponding to the APFs in the table.

[b] CT = central tendency; HE = high-end

[c] **Bolded and shaded text** indicates that a risk estimate significantly contributes to unreasonable risk for 1,1,2-trichloroethane.

COU		OES	Population – SEG	Exp. Route	Exp. Level [b]	Human Health Effects (with APF to Address Risk) [a]			
Life Cycle Stage	Category/ Subcategory					Acute Non-Cancer (Benchmark MOE = 100 for Inhalation and 30 for Dermal) [c]	Intermediate Non-Cancer (Benchmark MOE = 30)	Chronic Non-Cancer (Benchmark MOE = 300)	Lifetime Cancer [d] (Benchmark = 1E−04)

[d] For the manufacturing as a byproduct OES, EPA calculated the cancer estimates using Vinyl Institute provided data on years of service for workers at manufacturing facilities (8.9 years central tendency; 33 years high-end) (EPA-HQ-OPPT-2018-0427-0181). For all other OES, EPA calculated cancer estimates using working years from the Bureau of Labor Statistics (BLS) data (31 years central tendency; 40 years high-end) (U.S. Census Bureau, 2019; U.S. BLS, 2014).
[e] The test order generally indicated that operators wore half-face air purifying respirators during open loop sample tasks (APF 10), and full-face air purifying respirators during other tasks (APF 50). Use of a respirator was documented for only a subset of workers monitored in the test order study. Additional details are provided in Section 4.3.2.1.1.
[f] The test order generally indicated that logistics technicians wore half- or full-face respirators during loading or offloading tasks which required connecting and disconnecting process lines to railcars, barges, and trucks (APF 10 or 50). Use of a respirator was documented for a subset of workers monitored in the test order study, including workers with the highest full-shift and task-based exposures. Additional details are provided in Section 4.3.2.1.1.
[g] The test order generally indicated that maintenance technicians wore full-face airline respirators of APF 1,000 during major maintenance tasks (*e.g.,* line breaks and other equipment openings). Use of a respirator was documented for a subset of workers monitored in the test order study. Additional details are provided in Section 4.3.2.1.1.
[h] The test order generally indicated that laboratory technicians wore full-face air-purifying respirators during handling and disposing of hazardous waste (APF 50). Use of a respirator was documented for only one worker monitored in the test order study. Additional details are provided in Section 4.3.2.1.1.
[i] The ratio between TCE and 1,1,2-trichloroethane is 50% TCE and 10% 1,1,2-trichloroethane (5:1), with other resulting MOEs from other ratios represented within (Table 4-27).

6066
6067

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APPENDICES

Appendix A KEY ABBREVIATIONS AND ACRONYMS

7Q10	Lowest 7-day flow (on average) in a 10-year period
30Q5	Lowest 30 consecutive days of flow over a 5-year period
AAD	Acute absorbed dose
AADR	Acute absorbed dose rate
ACGIH	American Conference of Governmental Industrial Hygienists
ADC	Average daily concentration
AERMOD	American Meteorological Society (AMS)/EPA Regulatory Model
AMTIC	Ambient Monitoring Technology Information Center
APF	Assigned protection factor
BAF	Bioaccumulation factor
BCF	Bioconcentration factor
BLS	Bureau of Labor Service (U.S.)
BMC	Benchmark concentration
BMCL	Lower confidence limit of the BMC
BMD	Benchmark dose
BMDL	Lower confidence limit of the BMD
CAD	Chronic absorbed dose
CASRN	Chemical Abstracts Service Registry Number
CBI	Confidential business information
CDR	Chemical Data Reporting
COC	Concentration of concern
COU	Condition of use
CSF	Cancer slope factor
DMR	Discharge Monitoring Report
EPA	Environmental Protection Agency (U.S.)
ESD	Emission scenario document
GS	Generic scenario
HEC	Human equivalent concentration
HED	Human equivalent dose
HEM	Human Exposure Model
HERO	Health and Environmental Research Online (Database)
HLC	Henry's Law constant
IIOAC	Integrated Indoor-Outdoor Air Calculator (Model)
IRIS	Integrated Risk Information System (EPA)
IUR	Inhalation unit risk
K_{OC}	Organic carbon:water partition coefficient
K_{OW}	Octanol: water partition coefficient
LADC	Lifetime average daily concentration
LADD	Lifetime average daily dose
LCD	Life cycle diagram
LCx	Lethal concentration at which x% of test organisms die
LOAEL	Lowest-observed-adverse-effect level
LOAEC	Lowest-observed-adverse-effect concentration
LOD	Limit of detection
LOQ	Limit of quantification

MOE	Margin of exposure
NAICS	North American Industry Classification System
ND	Non-detect
NEI	National Emissions Inventory
NESHAP	National Emission Standards for Hazardous Air Pollutants
NIOSH	National Institute for Occupational Safety and Health
NOAEL	No-observed-adverse-effect level
NOAEC	No-observed-adverse-effect concentration
NPDES	National Pollutant Discharge Elimination System
NPDWR	National Primary Drinking Water Regulation
NTP	National Toxicology Program
OCSPP	Office of Chemical Safety and Pollution Prevention (EPA)
OECD	Organisation for Economic Co-operation and Development
OEHHA	Office of Environmental Health Hazard Assessment (California)
OES	Occupational exposure scenario
OEV	Occupational exposure value
ONU	Occupational non-user
OPPT	Office of Pollution Prevention and Toxics (EPA)
OSHA	Occupational Safety and Health Administration (U.S.)
PBPK	Physiologically based pharmacokinetic
PBZ	Personal breathing zone
PEL	Permissible exposure limit
PESS	Potentially exposed or susceptible subpopulations
POD	Point of departure
POTW	Publicly owned treatment works
PPE	Personal protective equipment
PSC	Point Source Calculator
RCRA	Resource Conservation and Recovery Act
RMSLE	Root mean squared log error
RQ	Risk quotient
SACC	Science Advisory Committee on Chemicals
SDS	Safety data sheet
SEG	Similar exposure group
SIC	Standard Industrial Classification
SSD	Species sensitivity distribution
STEL	Short-term exposure limit
TDAR	T-cell 1324 dependent antigen response
TLV	Threshold Limit Value
TRI	Toxics Release Inventory
TRV	Toxicity reference value
TSCA	Toxic Substances Control Act
TSD	Technical support document
TWA	Time-weighted average
UF	Uncertainty factor
U.S.	United States
WQP	Water Quality Portal
WWT	Wastewater treatment

Appendix B REGULATORY AND ASSESSMENT HISTORY

B.1 Federal Laws and Regulations

Table_Apx B-1. Federal Laws and Regulations

Statutes/ Regulations	General Description of Regulation	Description of Authority/Regulation
EPA statutes/regulations		
Toxic Substances Control Act (TSCA) – section 6(b)	EPA is directed to identify high-priority chemical substances for risk evaluation; and conduct risk evaluations on at least 20 high priority substances no later than three and one-half years after the date of enactment of the Frank R. Lautenberg Chemical Safety for the 21st Century Act.	1,1,2-Trichloroethane is one of the 20 chemicals EPA designated as a High-Priority Substance for risk evaluation under TSCA (84 FR 71924, December 30, 2019). Designation of 1,1,2-trichloroethane as a high-priority substance constitutes the initiation of the risk evaluation on the chemical.
TSCA – section 8(a)	The TSCA section 8(a) CDR Rule requires manufacturers (including importers) to give EPA basic exposure-related information on the types, quantities, and uses of chemical substances produced domestically and imported into the United States.	1,1,2-Trichloroethane manufacturing (including importing), processing, and use information is reported under the CDR rule (85 FR 20122, April 2, 2020).
TSCA – section 8(b)	EPA must compile, keep current, and publish a list (the TSCA Inventory) of each chemical substance manufactured (including imported) or processed in the United States.	1,1,2-Trichloroethane was on the initial TSCA Inventory and therefore was not subject to EPA's new chemicals review process under TSCA Section 5 (60 FR 16309, March 29, 1995).
TSCA – section 8(d)	Provides EPA with authority to issue rules requiring producers, importers, and (if specified) processors of a chemical substance or mixture to submit lists and/or copies of ongoing and completed, unpublished health and safety studies.	Eight health and safety studies were received for 1,1,2-trichloroethane (2021) (U.S. EPA, ChemView).
TSCA – section 8(e)	Manufacturers (including importers), processors, and distributors must immediately notify EPA if they obtain information that supports the conclusion that a chemical substance or mixture presents a substantial risk of injury to health or the environment.	One risk report was received for 1,1,2-trichloroethane (1992) (U.S. EPA, ChemView).
TSCA – section 4	Provides EPA with authority to issue rules and orders requiring manufacturers (including importers) and processors to test chemical substances and mixtures.	Fourteen chemical data submissions from test rules or enforceable consent agreements were received for 1,1,2-trichloroethane: acute inhalation toxicity with histopathology, reproduction and fertility effects, prenatal developmental toxicity, immunotoxicity, pharmacokinetics, carcinogenicity, and neurotoxicity (1985–2006) (U.S. EPA, ChemView).

Statutes/ Regulations	General Description of Regulation	Description of Authority/Regulation
Emergency Planning and Community Right-to-Know Act (EPCRA) – section 313	Requires annual reporting from facilities in specific industry sectors that employ 10 or more full-time equivalent employees and that manufacture, process, or otherwise use a TRI-listed chemical in quantities above threshold levels. A facility that meets reporting requirements must submit a reporting form for each chemical for which it triggered reporting, providing data across a variety of categories, including activities and uses of the chemical, releases and other waste management (*e.g.,* quantities recycled, treated, combusted) and pollution prevention activities (under section 6607 of the Pollution Prevention Act). These data include on- and off-site data as well as multimedia data (*i.e.,* air, land, and water).	1,1,2-Trichloroethane is a listed substance subject to reporting requirements under 40 CFR 372.65 effective as of January 1, 1987.
CAA – section 111(b)	Requires EPA to establish new source performance standards (NSPS) for any category of new or modified stationary sources that EPA determines causes, or contributes significantly to, air pollution, which may reasonably be anticipated to endanger public health or welfare. The standards are based on the degree of emission limitation achievable through the application of the best system of emission reduction (BSER) which (taking into account the cost of achieving reductions and environmental impacts and energy requirements) EPA determines has been adequately demonstrated.	1,1,2-Trichloroethane is subject to the NSPS for equipment leaks of volatile organic compounds (VOCs) in the synthetic organic chemicals manufacturing industry for which construction, reconstruction or modification began after January 5, 1981 (40 CFR Part 60, Subparts VV, NNN, and RRR).
CAA – section 112(b)	Contains the original list of 189 HAPs. Under 112(c) of the CAA, EPA must identify and list source categories that emit HAP and then set emission standards for those listed source categories under CAA section 112(d). CAA section 112(b)(3)(A) specifies that any person may petition the Administrator to modify the list of HAP by adding or deleting a substance. Since 1990, EPA has removed 2 pollutants from the original list leaving 187 at present.	1,1,2-Trichloroethane is listed as a HAP (42 U.S.C. Section 7412).
CAA – section 112(d)	Directs EPA to establish, by rule, NESHAPs for each category or subcategory of listed major sources and area sources of HAP (listed pursuant to section 112(c)). The standards must require the maximum degree of emission reduction that EPA determines is achievable by each particular source category. This is generally referred to as maximum achievable control technology (MACT).	EPA has established NESHAPs for a number of source categories that emit 1,1,2-trichloroethane to air.

Statutes/ Regulations	General Description of Regulation	Description of Authority/Regulation
CAA – sections 112(d) and 112(f)	Risk and technology review (RTR) of section 112(d) national emission standards for hazardous air pollutants (NESHAP). Section 112(f)(2) requires EPA to conduct risk assessments for each source category subject to section 112(d) NESHAP that require maximum achievable control technology (MACT), and to determine if additional standards are needed to reduce remaining risks. Section 112(d)(6) requires EPA to review and revise the emission standards, as necessary, taking into account developments in practices, processes, and control technologies.	EPA has promulgated a number of RTR NESHAP and will do so, as required, for the remaining source categories with NESHAP.
Clean Water Act (CWA) – section 304(a)(1)	Requires EPA to develop and publish ambient water quality criteria (AWQC) reflecting the latest scientific knowledge on the effects on human health that may be expected from the presence of pollutants in any body of water.	In 2015, EPA published updated AWQC for 1,1,2-trichloroethane, including a recommendation of 9.9 (µg/L) for "Human Health for the consumption of Water + Organism" and 650 (µg/L) for "Human Health for the consumption of Organism Only" for states and authorized tribes to consider when adopting criteria into their water quality standards (80 FR 36986, June 29, 2015).
Clean Water Act (CWA) – sections 301, 304, 306, 307 and 402	Clean Water Act Section 307(a) establishes a list of toxic pollutants or combination of pollutants under the CWA. The statute specifies a list of families of toxic pollutants also listed at 40 CFR 401.15. The list of "priority pollutants" lists the individual chemical names within the toxic pollutants and is found in 40 CFR Part 423 Appendix A. These are pollutants (along with non-conventional pollutants) for which best available technology effluent limitations must be established on either a national basis through rules (CWA sections 301(b), 304(b), 307(b), 306) or on a case-by-case best professional judgement basis in National Pollutant Discharge Elimination System (NPDES) permits, see CWA section 402(a)(1)(B). EPA identifies the best available technology that is economically achievable (BAT) for that industry after considering statutorily prescribed factors and sets regulatory requirements based on the performance of that technology.	Under CWA Section 304, 1,1,2-trichloroethane is included in the list of total toxic organics (TTO) (40 CFR 413.02(i)).
Safe Drinking Water Act (SDWA) – section 1412	Requires EPA to publish a non-enforceable maximum contaminant level goal (MCLG) for a contaminant for which EPA makes the determination that the contaminant: 1. may have an adverse effect on the health of persons; 2. is	1,1,2-Trichloroethane is subject to NPDWR under the SDWA with a MCLG of 0 and an enforceable MCL of 0.005 mg/L (Section 1412; 57 FR 31776 July 17, 1992).

Statutes/ Regulations	General Description of Regulation	Description of Authority/Regulation
	known to occur or there is a substantial likelihood that the contaminant will occur in public water systems with a frequency and at levels of public health concern; and 3. in the sole judgement of the Administrator, regulation of the contaminant presents a meaningful opportunity for health risk reductions for persons served by public water systems. When EPA publishes an MCLG, EPA must also promulgate a National Primary Drinking Water Regulation (NPDWR) which includes either an enforceable maximum contaminant level (MCL), or a required treatment technique. Public water systems are required to comply with NPDWRs.	
Resource Conservation and Recovery Act (RCRA) – section 3001	Directs EPA to develop and promulgate criteria for identifying the characteristics of hazardous waste, and for listing hazardous waste, taking into account toxicity, persistence, and degradability in nature, potential for accumulation in tissue and other related factors such as flammability, corrosiveness, and other hazardous characteristics.	1,1,2-Trichloroethane is included on the list of hazardous wastes pursuant to RCRA 3001. RCRA Hazardous Waste Code: U227 (40 CFR 261.33); F002, F024, F025 (40 CFR 261.31)
Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) – sections 102(a) and 103	Authorizes EPA to promulgate regulations designating as hazardous substances those substances which, when released into the environment, may present substantial danger to public health or welfare or the environment. EPA must also promulgate regulations establishing the quantity of any hazardous substance, the release of which must be reported under section 103. Section 103 requires persons in charge of vessels or facilities to report to the National Response Center if they have knowledge of a release of a hazardous substance above the reportable quantity threshold.	1,1,2-Trichloroethane is a hazardous substance under CERCLA. Releases of 1,1,2-trichloroethane in excess of 100 pounds must be reported (40 CFR 302.4).
Superfund Amendments and Reauthorization Act (SARA)	Requires the Agency to revise the hazardous ranking system and update the National Priorities List of hazardous waste sites, increases state and citizen involvement in the Superfund program and provides new enforcement authorities and settlement tools.	1,1,2-Trichloroethane is listed on SARA (accessed July 21, 2026), an amendment to CERCLA, and the CERCLA Priority List of Hazardous Substances. This list includes substances most commonly found at facilities on the CERCLA National Priorities List (NPL) that have been deemed to pose the greatest threat to public health.
Other federal statutes/regulations		

Statutes/ Regulations	General Description of Regulation	Description of Authority/Regulation
Federal Food, Drug, and Cosmetic Act (FFDCA)	Provides the FDA with authority to oversee the safety of food, drugs and cosmetics.	The FDA regulates 1,1,2-trichloroethane in bottled water. The maximum permissible level of 1,1,2-trichloroethane in bottled water is 0.005 mg/L (21 CFR 165.110).
Occupational Safety and Health Act (OSHA)	Requires employers to provide their workers with a place of employment free from recognized hazards to safety and health, such as exposure to toxic chemicals, excessive noise levels, mechanical dangers, heat or cold stress or unsanitary conditions (29 U.S.C section 651 et seq.). Under the Act, OSHA can issue occupational safety and health standards including such provisions as PEL, exposure monitoring, engineering and administrative control measures, and respiratory protection.	In 1980, OSHA issued occupational safety and health standards for 1,1,2-trichloroethane that included a PEL of 10 ppm or 45 mg/m^3 as an 8-hour TWA (29 CFR 1910.1001).
Hazardous Materials Transportation Act (HMTA)	Section 5103 of the Act directs the Secretary of Transportation to: • Designate materials (including explosives, radioactive material, infectious substances, flammable or combustible liquids, solids or gases, toxic, oxidizing or corrosive materials, and compressed gases) as hazardous when the Secretary determines that transporting the materials in commerce may pose an unreasonable risk to health and safety or property. • Issue regulations for the safe transportation, including security, of hazardous material in intrastate, interstate, and foreign commerce.	The Department of Transportation (DOT) has designated 1,1,2-trichloroethane as a hazardous material, and there are special requirements for marking, labeling and transporting it (49 CFR 172.101)
All hyperlinks/URLs included in table were accessed July 21, 2026.		

B.2 State Laws and Regulations

Table_Apx B-2. State Laws and Regulations

State Actions	Description of Regulation	
State Air Regulations	Michigan Initial Risk Screening Level (IRSL) (Michigan Administrative Code R.336.1229 List of Screening Levels)	0.063 µg/m^3 (annual)
	Allowable Ambient Levels (AALs): New Hampshire (Env-A 1400: Regulated Toxic Air Pollutants).	State AALs: 277 µg/m^3 (24-hour); 184 µg/m^3 (annual)
	New York Annual Guidance Concentration (AGC) (6 NYCRR Part 212)	State AGC: 1.4 µg/m^3
	Rhode Island (Air Pollution Regulation No. 22)	State AAL: 10 µg/m^3 (24-hour)
	Texas Effect Screening Levels (ESLs)	State ESL: 100 ppb

State Actions	Description of Regulation	
State Drinking Water Standards and Guidelines	New Jersey (7:10 N.J Admin. Code § 5.2)	State MCL: 3 µg/L
State Right-to-Know Acts	New Jersey (N.J.A.C. 7:1G) and Pennsylvania (P.L. 734, No. 159 and 34 Pa. Code § 323).	
Chemicals of High Concern to Children	Several states have adopted reporting laws for chemicals in children's products containing 1,1,2-trichloroethane, including Maine (38 MRSA Chapter 16-D) and Minnesota (Toxic Free Kids Act Minn. Stat. 116.9401 to 116.9407).	
Other	California listed 1,1,2-trichloroethane on Proposition 65 on October 1, 1990, due to cancer. (Cal Code Regs. Title 27, § 27001). 1,1,2-Trichloroethane is listed as a Candidate Chemical under California's Safer Consumer Products Program (Health and Safety Code § 25252 and 25253). California issued a Health Hazard Alert for 1,1,2-trichloroethane (Hazard Evaluation System and Information Service, 2016). California lists 1,1,2-trichloroethane as a designated priority chemical for biomonitoring (California SB 1379). 1,1,2-Trichloroethane is on the MA Toxic Use Reduction Act (TURA) list of 2019 (301 CMR 41.03).	
All hyperlinks in this table were accessed July 21, 2026.		

B.3 International Laws and Regulations

Table_Apx B-3. International Laws and Regulations

Country/ Organization	Requirements and Restrictions
Canada	1,1,2-Trichloroethane is on the Domestic Substances List (Government of Canada. Substance List by Threshold) and is subject to reporting to the National Pollutant Release Inventory (NPRI).
European Union	In 2010, a restriction of sale and use 1,1,2-trichloroethane as a substance or constituent of other substances, or in mixtures in concentrations equal to or greater than 0.1% or was added to Annex XVII of regulation (EC) No 552/2009 - REACH (Registration, Evaluation, Authorization and Restriction of Chemicals). The restriction included a provision requiring that products be marked 'For use in industrial installations only' (European Chemicals Agency (ECHA) database).
Australia	1,1,2-Trichloroethane was assessed under Human Health II of the Inventory Multi-Tiered Assessment and Prioritisation (IMAP). There were no uses reported in Australia. International uses include adhesives, lacquer and coating formulations; and aerosol paints; as a solvent in the manufacture of organic materials (fats, oils, waxes, resins); as an intermediate in the production of vinylidene chloride (1,1-dichloroethylene) and tetrachloroethanes. (NICNAS, 2013, Ethane, 1,1,2-trichloro-: Human health tier II assessment).
Japan	1,1,2-Trichloroethane is regulated in Japan under the following legislation: • Act on the Evaluation of Chemical Substances and Regulation of Their Manufacture, etc. (Chemical Substances Control Law; CSCL) • Act on Confirmation, etc. of Release Amounts of Specific Chemical Substances in the Environment and Promotion of Improvements to the Management Thereof

Country/ Organization	Requirements and Restrictions	
	• Industrial Safety and Health Act (ISHA) • Air Pollution Control Law • Water Pollution Control Law • Soil Contamination Countermeasures Act • (National Institute of Technology and Evaluation [NITE] Chemical Risk Information Platform [CHRIP]).	
Institute for Occupational Safety and Health of the German Social Accident Insurance (IFA) GENTIS International Limit Values for Chemical Agents Database	Australia, Belgium, Canada, Ireland, Japan, Norway, Singapore, South Korea, Spain	TWA: 10 ppm
	Austria	TWA: 10 ppm STEL: 50 ppm
	Denmark, Finland, South Africa	TWA: 10 ppm STEL: 20 ppm
	Germany, New Zealand	TWA: 1 ppm STEL: 2 ppm
	Poland	TWA: 40 mg/m^3
	Switzerland	TWA: 2 ppm STEL: 10 ppm
STEL = short-term exposure limit; TWA = time-weighted average All hyperlinks/URLs included in table were accessed July 21, 2026.		

B.4 History

Table_Apx B-4. Assessment History of 1,1,2-Trichloroethane

Authoring Organization	Publication[a]
EPA publications	
U.S. EPA, Integrated Risk Information System (IRIS)	*IRIS Summary. 1,1,2-Trichloroethane*; CASRN 79-00-5
U.S. EPA, Office of Chemical Safety and Pollution Prevention (OCSPP)	*Final Scope of the Risk Evaluation for 1,1,2-Trichloroethane CASRN 79-55-5* (2020)
U.S. EPA, Office of Pollution Prevention and Toxics (OPPT)	Chemview (TSCA submissions – chemical test rule data and substantial risk reports)
U.S. EPA, Superfund Health Risk Technical Support Center, National Center for Environmental Assessment, Office of Research and Development	*Provisional Peer Reviewed Toxicity Values for 1,1,2-Trichloroethane (CASRN 79-00-5)*
Other U.S.−based organizations	
Agency for Toxic Substances and Disease Registry (ATSDR)	*Toxicological Profile for 1,1,2-Trichloroethane CAS#: 79-00-5, March 2021*
Centers for Disease Control and Prevention (CDC)	*National Report on Human Exposure to Environmental Chemicals*
National Cancer Institute (NCI)	National Cancer Institute (NCI) 1978. Bioassay of 1,1,2-Trichloroethane for Possible Carcinogenicity (CAS No. 79-00-5)

Authoring Organization	Publication[a]
	(NCI-CG-TR-55). U.S. Department of Health, Education, And Welfare.
National Institute for Occupational Safety and Health (NIOSH)	*Current Intelligence Bulletin 27: Chloroethanes Review of Toxicity*
NIOSH	*1,1,2-Trichloroethane. NIOSH Pocket Guide to Chemical Hazards*. Atlanta, GA: National Institute for Occupational Safety and Health, Centers for Disease Control and Prevention. 2019.
National Toxicology Program (NTP), National Institute of Environmental Health Sciences (NIEHS), National Institutes of Health (NIH)	*1,1,2-Trichloroethane: Target Organs and Levels of Evidence for TR-074*
Occupational Safety and Health Administration (OSHA)	1,1,2-Trichloroethane
International	
ECHA European Union Risk Assessment Report	https://echa.europa.eu/information-on-chemicals/information-from-existing-substances-regulation
[a] All hyperlinks/URLs included in table were accessed July 21, 2026.	

6850

Appendix C LIST OF TECHNICAL SUPPORT DOCUMENTS AND SUPPLEMENTAL FILES

This appendix includes a list of and citations for all technical support documents and supplemental files included in this draft risk evaluation (document "01"). These include discipline-specific assessments, systematic review results, risk calculations, and modeling outputs. Files are numbered to correspond with the filenames uploaded to the docket: EPA-HQ-OPPT-2018-0421.

Associated **Technical Support Documents** – Provide additional details and information on physical chemistry, fate, exposure, releases, and hazard assessments.

02. *Draft Chemistry, Fate, Release, and Exposure Assessment for 1,1,2-Trichloroethane* (U.S. EPA, 2026g)
03. *Draft Human Health and Environmental Hazard Assessment for 1,1,2-Trichloroethane* (U.S. EPA, 2026w)

Associated Systematic Review Protocol and Data Quality Evaluation and Data Extraction Documents – Provide additional detail and information on systematic review methodologies used as well as the data quality evaluations and extraction criteria and results.

04. *Draft Systematic Review Protocol for 1,1,2-Trichloroethane* (U.S. EPA, 2026aj)
05. *Draft Data Quality Evaluation and Data Extraction Information for Physical and Chemical Properties for 1,1,2-Trichloroethane* (U.S. EPA, 2026m)
06. *Draft Data Quality Evaluation and Data Extraction Information for Environmental Fate and Transport for 1,1,2-Trichloroethane* (U.S. EPA, 2026k)
07. *Draft Data Quality Evaluation and Data Extraction Information for Environmental Release and Occupational Exposure for 1,1,2-Trichloroethane* (U.S. EPA, 2026l)
08. *Draft Data Quality Evaluation and Data Extraction Information for Dermal Absorption for 1,1,2-Trichloroethane* (U.S. EPA, 2026j)
09. *Draft Data Quality Evaluation Information for General Population, Consumer, and Environmental Exposure for 1,1,2-Trichloroethane* (U.S. EPA, 2026o)
10. *Draft Data Extraction Information for General Population, Consumer, and Environmental Exposure for 1,1,2-Trichloroethane* (U.S. EPA, 2026i)
11. *Draft Data Quality Evaluation Information for Human Health Hazard Epidemiology for 1,1,2-Trichloroethane* (U.S. EPA, 2026q)
12. *Draft Data Quality Evaluation Information for Human Health Hazard Animal Toxicology for 1,1,2-Trichloroethane* (U.S. EPA, 2026p)
13. *Draft Data Quality Evaluation Information for Environmental Hazard for 1,1,2-Trichloroethane* (U.S. EPA, 2026n)
14. *Draft Data Extraction Information for Environmental Hazard and Human Health Hazard Animal Toxicology and Epidemiology for 1,1,2-Trichloroethane* (U.S. EPA, 2026h)

Associated Supplemental Files – Provide additional details and information on fate, release, exposure, hazard, and risk assessments.

15. *Draft Air Releases for 1,1,2-Trichloroethane* (U.S. EPA, 2026d)
16. *Draft Land Releases for 1,1,2-Trichloroethane* (U.S. EPA, 2026x)
17. *Draft Water Releases for 1,1,2-Trichloroethane* (U.S. EPA, 2026av)
18. *Draft Number of Sites for 1,1,2-Trichloroethane* (U.S. EPA, 2026y)

19. *Draft Repackaging Environmental Release and Occupational Exposure Model for 1,1,2-Trichloroethane* (U.S. EPA, 2026af)
20. *Draft Formulation of Adhesives and Sealants Environmental Release Model for 1,1,2-Trichloroethane* (U.S. EPA, 2026u)
21. *Draft Open-Top Vapor Degreasing Environmental Release Model for 1,1,2-Trichloroethane* (U.S. EPA, 2026ab)
22. *Draft Use of Adhesives and Sealants Environmental Release Model for 1,1,2-Trichloroethane* (U.S. EPA, 2026at)
23. *Draft Use of Laboratory Chemicals Environmental Release Model for 1,1,2-Trichloroethane* (U.S. EPA, 2026au)
24. *Draft Occupational Risk Calculator for 1,1,2-Trichloroethane* (U.S. EPA, 2026z)
25. *Draft Estimates of Number of Workers and ONUs for 1,1,2-Trichloroethane* (U.S. EPA, 2026t)
26. *Draft Dermal Monte Carlo Exposure Model for 1,1,2-Trichloroethane* (U.S. EPA, 2026r)
27. *Draft Acute and Chronic Risk Inhalation Risk Calculator for Consumer Air for 1,1,2-Trichloroethane* (U.S. EPA, 2026c)
28. *Draft Dermal Risk Calculator Using Fraction Absorbed for 1,1,2-Trichloroethane* (U.S. EPA, 2026s)
29. *Draft CEM Outputs for 1,1,2-Trichloroethane* (U.S. EPA, 2026f)
30. *Safety Data Sheets and Technical Information for Products Containing 1,1,2-Trichloroethane* (U.S. EPA, 2026ax)
31. *Draft AMTIC Monitoring Data for 1,1,2-Trichloroethane* (U.S. EPA, 2026e)
32. *Draft Tier 1 Ambient Air Analysis Model Files for 1,1,2-Trichloroethane* (U.S. EPA, 2026al)
33. *Draft Tier 2 Ambient Air Analysis Model Files for 1,1,2-Trichloroethane* (U.S. EPA, 2026an)
34. *Draft Tier 3 Ambient Air Analysis Model Files for 1,1,2-Trichloroethane* (U.S. EPA, 2026ar)
35. *Draft Tier 1 Ambient Air Analysis-Results and Risk Calcs for 1,1,2-Trichloroethane* (U.S. EPA, 2026ak)
36. *Draft Tier 2 Ambient Air Analysis-Results and Risk Calcs by Industry Sector for 1,1,2-Trichloroethane* (U.S. EPA, 2026am)
37. *Draft Tier 3 Ambient Air Analysis-TRI Dataset ReadMe File for 1,1,2-Trichloroethane* (U.S. EPA, 2026ao)
38. *Draft Tier 3 Ambient Air Analysis-TRI Dataset Release Summary by OES for 1,1,2-Trichloroethane* (U.S. EPA, 2026ap)
39. *Draft Tier 3 Ambient Air Analysis-TRI Dataset Results Summary for 1,1,2-Trichloroethane* (U.S. EPA, 2026aq)
40. *Draft Tier 3 Ambient Air Max Cancer Results by OES and dataset for 1,1,2-Trichloroethane* (U.S. EPA, 2026as)
41. *Draft Surface Water Concentration Modeling and Environmental Exposure for 1,1,2-Trichloroethane* (U.S. EPA, 2026ai)
42. *Draft General Population Surface Water Pathway Exposure Estimates for 1,1,2-Trichloroethane* (U.S. EPA, 2026v)
43. *Draft Surface Water and Sediment Monitoring Data for 1,1,2-Trichloroethane* (U.S. EPA, 2026ah)
44. *Draft Point Source Calculator Modeling for 1,1,2-Trichloroethane* (U.S. EPA, 2026ae)
45. *Draft PBPK Model Review for 1,1,2-Trichloroethane* (U.S. EPA, 2026ad)
46. *Draft PBPK Model Code and Data for 1,1,2-Trichloroethane* (U.S. EPA, 2026ac)
47. *Draft OECD 428 Dermal Absorption Study Report for 1,1,2-Trichloroethane* (Labcorp Early Development, 2023)
48. *Draft OECD 428 Dermal Absorption Study Excel Calculations for 1,1,2-Trichloroethane* (U.S. EPA, 2026aa)

Appendix D POTENTIALLY EXPOSED OR SUSCEPTIBLE SUBPOPULATIONS

Considerations related to PESS can influence the selection of relevant exposure pathways, the sensitivity of derived hazard values, the inclusion of particular human populations, and the discussion of uncertainties throughout the assessment. Evaluation of the qualitative and quantitative evidence for PESS begins as part of the systematic review process, where any available relevant published studies and other data are identified. If adequate and complete, this evidence informs the derivation of exposure estimates and human health hazard endpoints/values that are protective of PESS.

EPA has identified a list of specific PESS factors that may contribute to a group having increased exposure or biological susceptibility, such as those presented in the table below. For 1,1,2-trichloroethane, the Agency identified how the risk evaluation addressed these factors as well as any remaining uncertainties. Details how EPA considered both chemical-specific and general information for these factors, which are described in detail in the *Draft Chemistry, Fate, Release, and Exposure Assessment for 1,1,2-Trichloroethane* (U.S. EPA, 2026g) and *Draft Human Health and Environmental Hazard Assessment for 1,1,2-Trichloroethane* (U.S. EPA, 2026w).

Table_Apx D-1. PESS Factors Considered in the Risk Evaluation

PESS Factor	Examples[a]
Lifestage	Embryo/fetus, pregnant, children, adults of reproductive age, older adults
Pre-existing disease	Obesity, cardiovascular disease, diabetes, immunocompromised
Lifestyle activities	Smoking, alcohol consumption, physical activity
Occupational and consumer exposures	High end duration and frequency workers/ONUs; DIYers
Geography/site-specific	Fenceline, residence/school location, historical releases
Sociodemographic status	Race/ethnicity, socioeconomic status, sex/gender, education
Nutrition	Diet, malnutrition, subsistence fishing
Genetics/epigenetics	Genetic polymorphisms such as for the aldehyde dehydrogenase-2 metabolism enzyme
Unique activities	Open burning, sweat lodge/purification ceremonies (tribal)
Aggregate exposures	Multiple routes, multiple pathways, multiple COUs
Other chemical and non-chemical stressors	Stress, adverse childhood experiences, built environment, chemical co-exposures

COU = condition of use; ONU = occupational non-user; DIYer = do-it-yourself consumer user (*i.e.,* hobbyist)
[a] Examples are not intended to be exhaustive but are illustrative of considerations for a TSCA risk evaluation.

Appendix E UPDATES TO THE 1,1,2-TRICHLOROETHANE CONDITIONS OF USE TABLE

After publication of the final scope (U.S. EPA, 2020b), EPA received updated submissions from the 2020 CDR cycle prior to releasing this draft risk evaluation. In addition to new submissions received under the 2020 CDR cycle, some industry code names were updated for the 2020 CDR cycle. Therefore, the Agency amended the description of certain 1,1,2-trichloroethane COUs based on those new submissions.

Table_Apx E-1 summarizes the changes to the COUs based on the new reporting codes in the 2020 CDR cycle and any other information reasonably available to EPA since the publication of the final scope document in 2020.

These COU descriptions incorporate CDR submissions from the 2016, 2020, and 2024 CDR cycles. If EPA receives new information on the 1,1,2-trichloroethane COUs during the comment period for the draft risk evaluation, then that information will be considered and if appropriate, incorporated into the final COU descriptions.

Table_Apx E-1. Changes to Categories and Subcategories of COUs Between Final Scope and Draft Risk Evaluation

Life Cycle Stage and Category in the Final Scope Document	Subcategory in the Final Scope Document	Occurred Change	Revised COU in the 2026 Draft Risk Evaluation
Processing – Processing as a reactant	Intermediate in: Plastic manufacturing; Petrochemical manufacturing; All other chemical product manufacturing	Amended COU to "Processing – As a reactant" based on updated nomenclature	Processing – As a reactant – Intermediate in: Plastic manufacturing; Petrochemical manufacturing; All other chemical product manufacturing
Not included	Not included	Added "Processing – Repackaging" subcategory based on reasonably available information	Processing – Repackaging
Not included	Not included	Added "Processing – Incorporation into a formulation, mixture, or reaction product" subcategory based on CDR data	Processing – Incorporation into a formulation, mixture, or reaction product – Formulation of adhesives and sealants
Not included	Not included	Added "Industrial use – Other – Solvents" based on NEI data	Industrial use – Other – Solvents
Industrial use – Adhesives and sealants AND Commercial use – Adhesives and sealants	Adhesives and sealants	Combined into: "Industrial and commercial use – Adhesives and sealants"	Industrial and commercial use – Adhesives and sealants

EPA is including additional information about some of the changes to COUs from the final scope of the risk evaluation (U.S. EPA, 2020b) below:

- Based on reasonably available information, EPA is identifying "*Processing – Repackaging*" as a COU to account for transfer from one container to another (*i.e.,* for the minimal quantities used from lab use) upstream of laboratory use.
- "*Industrial use – Other – Solvents*:" EPA notes that industrial use of solvents was not identified in the 2020 final scope document but is now identifying it as a COU since the use was reported in the 2020 CDR cycle.

Appendix F CONDITIONS OF USE DESCRIPTIONS

The following descriptions are intended to include examples of uses, so as not to exclude other activities that may also be included in the COUs of the chemical substance. To better describe the COU, EPA considered CDR submissions from recent CDR cycles for 1,1,2-trichloroethane (CASRN 79-00-5), and the descriptions reflect what the Agency identified as the best fit for that submission. Examples of articles, products, or activities are included in the following descriptions to help describe the COU but are not exhaustive. EPA uses the terms "articles" and "products" or "product mixtures" in the following descriptions and is generally referring to articles and products as defined by 40 CFR part 751.

F.1 Manufacturing – Domestic Manufacture

Domestic manufacture means to manufacture or produce 1,1,2-trichloroethane within the Unites States, including to manufacture 1,1,2-trichloroethane as a byproduct. This includes but is not limited to 1,1,2-trichloroethane being produced as a byproduct during an ethylene oxychlorination chemical process to manufacture 1,2-dichloroethane and loading (but not transport) associated with the manufacturing and/or production of 1,1,2-trichloroethane. For purposes of this draft 1,1,2-trichloroethane risk evaluation, this includes the production of 1,1,2-trichloroethane, including production intended for export. Note that the final scoping document (U.S. EPA, 2020b) indicated EPA planned to evaluate 1,1,2-trichloroethane produced as a byproduct during the manufacture of 1,2-dichloroethane (CASRN 107-06-2) in the risk evaluation for 1,2-dichloroethane. Instead, as noted above, EPA is including 1,1,2-trichloroethane produced as a byproduct during the manufacture of 1,2-dichloroethane in this draft 1,1,2-trichloroethane risk evaluation.

F.2 Manufacturing – Import

Import refers to the import of 1,1,2-trichloroethane, including 1,1,2-trichloroethane-containing products and articles (including those with 1,1,2-trichloroethane as a trace amount or as an impurity), into the customs territory of the United States. This COU includes loading/unloading and repackaging associated with the import of 1,1,2-trichloroethane. In general, chemicals may be imported into the United States in bulk via water, air, land, and intermodal shipments. 1,1,2-Trichloroethane may be imported neat or as a component in a formulation.

F.3 Processing – As a Reactant – Intermediate In: Plastic Manufacturing; Petrochemical Manufacturing; All Other Chemical Product Manufacturing

This COU refers to the use of 1,1,2-trichloroethane as a feedstock in the production of another chemical via a chemical reaction in which 1,1,2-trichloroethane is consumed to form a product, although trace amounts of 1,1,2-trichloroethane may be present in the product as an impurity. This includes but is not limited to processing as an intermediate in plastic and petrochemical manufacturing and processing as an intermediate in formulation of adhesives and sealants. This COU includes processing of 1,1,2-trichloroethane as an intermediate in the production of 1,1-dichloroethylene (CASRN 75-35-4) and 1,2-dichloroethylene (CASRN 540-59-0).

F.4 Processing – Repackaging

This COU refers to preparation of 1,1,2-trichloroethane for distribution into commerce in a different form, state, or quantity than originally received or stored by various industrial sectors, including chemical product and preparation manufacturing, wholesale and retail trade, and laboratory chemicals manufacturing. This COU includes transferring 1,1,2-trichloroethane from a bulk storage container into smaller containers. The type and size of container vary depending on customer requirement. This COU

would not apply to the relabeling or redistribution of a chemical substance without removing the chemical substance from the original container it was supplied in.

F.5 Processing – Recycling

This COU refers to the process of treating generated waste streams (*i.e.*, which would otherwise be disposed of as waste), containing 1,1,2-trichloroethane, that are collected, either on-site or at a third-party site, for commercial purposes. 1,1,2-Trichloroethane can be recycled via reclamation of evaporated 1,1,2-trichloroethane after application to a substrate. Recycling of 1,1,2-trichloroethane may occur when byproduct 1,1,2-trichloroethane is separated from a product stream to be recycled at the same facility or at a different facility.

F.6 Processing – Incorporation into a Formulation, Mixture, or Reaction Product – Formulation of Adhesives and Sealants

This COU refers to the preparation of a product; that is, the incorporation of 1,1,2-trichloroethane into a formulation, mixture, or reaction product that occurs when a chemical substance is added to a product (or product mixture) after its manufacture, for distribution in commerce—in this case in the formulation of adhesives and sealants.

F.7 Distribution in Commerce

Under TSCA, "distribution in commerce" and "distribute in commerce" are defined under TSCA section 3(5): "The terms 'distribute in commerce' and 'distribution in commerce' when used to describe an action taken with respect to a chemical substance or mixture or article containing a substance or mixture mean to sell, or the sale of, the substance, mixture, or article in commerce; to introduce or deliver for introduction into commerce, or the introduction or delivery for introduction into commerce of, the substance, mixture, or article; or to hold, or the holding of, the substance, mixture, or article after its introduction into commerce." In this draft risk evaluation, distribution in commerce includes the transportation associated with the moving of 1,1,2-trichloroethane or 1,1,2-trichloroethane-containing products and/or articles between sites manufacturing processing or recycling 1,1,2-trichloroethane or 1,1,2-trichloroethane-containing products and/or articles, to final use sites, or for final disposal of 1,1,2-trichloroethane or 1,1,2-trichloroethane-containing products and/or articles.

F.8 Industrial Use – Solvents

This COU refers to the industrial use of 1,1,2-trichloroethane as a solvent to dissolve oils, greases, and other surface contaminants from textiles, glassware, metal surfaces, and other articles, including manufactured parts (*e.g.*, metal manufacturing). This is a use of 1,1,2-trichloroethane after it has already been incorporated into the solvents, *i.e.,* as opposed to upstream processing, (*e.g.*, when 1,1,2-trichloroethane is processed into the solvents). The industrial use of solvents containing 1,1,2-trichloroethane includes, but is not limited to solvent degreasing (cold cleaner dip tank), aerosol spray degreasers for electrical systems, brake cleaners, and other non-aerosol cleaners/degreasers. These solvents may be spray-applied (aerosolized) or wipe-applied in liquid form.

F.9 Industrial and Commercial Use – Adhesives and Sealants

This COU refers to the industrial and commercial use of 1,1,2-trichloroethane in adhesives, sealants, and caulks to promote bonding between substances, promote adhesion of surfaces, and/or prevent seepage of moisture or air. This is a use of 1,1,2-trichloroethane after it has already been incorporated into the adhesive and sealant; that is, as opposed to upstream processing (*e.g.*, when 1,1,2-trichloroethane is processed into the adhesive and sealant). Adhesives and sealants are used in a variety of industrial and

commercial sectors, including in the aerospace sector, and 1,1,2-trichloroethane may be present in two-component adhesive products at a concentration of less than 10%. In the aerospace sector, one example is a use of 1,1,2-trichloroethane as a component of proprietary acrylic and methacrylate adhesive formulations used by civil aviation and Department of War customers.

F.10 Commercial Use – Other – Laboratory Chemical

This COU refers to the use of 1,1,2-trichloroethane as a laboratory chemical, such as for chemical standards, research, equipment calibration, and sample preparation. This COU refers to 1,1,2-trichloroethane as it is used in a commercial sector, as opposed to upstream processing (*e.g.,* when 1,1,2-trichloroethane is repackaged for laboratory use). A safety data sheet (SDS) for 1,1,2-trichloroethane indicates recommended use as a laboratory chemical (ThermoFisher Scientific, 2018). The Agency notes that the same applications and methods used for quality control can be applied in industrial and commercial settings, and that research can be conducted in non-commercial laboratories. All of these laboratory activities are included in this COU.

F.11 Consumer Use – Adhesives and Sealants

This COU refers to the use of 1,1,2-trichloroethane in adhesives and sealants available to consumers. This is a use of 1,1,2-trichloroethane after it has already been incorporated into the adhesive and sealant; that is, as opposed to upstream processing (*e.g.*, when 1,1,2-trichloroethane is processed into the adhesive or sealant). This includes, but is not limited to, 1,1,2-trichloroethane present in two-component adhesive products at a concentration of 0.1 to 1.0%.

F.12 Disposal

Each of the COUs of 1,1,2-trichloroethane may generate waste streams of the chemical. For purposes of the 1,1,2-trichloroethane risk evaluation, this COU generally refers to the 1,1,2-trichloroethane in a waste stream that is collected from facilities and commercial sites and is unloaded at and treated or disposed at third-party sites. This COU includes 1,1,2-trichloroethane contained in wastewater released from an occupational COU and discharged to a POTW or other, non-POTW for treatment. Releases of 1,1,2-trichloroethane are expected to occur to other environmental media, such as migration to water sources, through waste disposal (*e.g.,* disposal of formulations containing 1,1,2-trichloroethane or transport containers). Disposal may also include destruction and removal by incineration. Recycling of 1,1,2-trichloroethane and 1,1,2-trichloroethane-containing products is considered a different COU. Environmental releases from manufacturing and processing sites that treat or dispose of waste onsite are generally assessed in each COU.

Appendix G OCCUPATIONAL EXPOSURE VALUE DERIVATION

Based on the available hazard and exposure profile for 1,1,2-trichloroethane, EPA has calculated a draft 8-hour time-weighted average (TWA) occupational exposure value. The calculated values may be used to support risk management efforts for 1,1,2-trichloroethane under TSCA section 6(a) (15 U.S.C. 2605). EPA calculated a value rounded to 0.001 ppm (0.005 mg/m^3) for inhalation exposures to 1,1,2-trichloroethane as an 8-hour TWA and for consideration in workplace settings (see Appendix G.1 below) based on the chronic non-cancer human equivalent concentration (HEC) point of departure (POD) for olfactory epithelium lesions. Note, this occupational exposure value is derived via the calculation in Appendix G.2 based on the benchmark MOE (including a total uncertainty factor [UF] of 300) and does not factor in the confidences and uncertainties which inform EPA's preliminary unreasonable risk determination as discussed in Section 6. EPA expects that at the occupational exposure value of 0.001 ppm (0.005 mg/m^3), workers and occupational non-users (ONUs) also would be protected against health effects from acute and chronic duration occupational hazard concerns, including cancer. As described in Appendix G.2G.1, the current OSHA PEL, NIOSH REL, TLV, and CAL PEL are all 10 ppm.

TSCA requires risk evaluations to be conducted without consideration of cost and other non-risk factors, and thus this occupational exposure value represents a risk-only number. EPA may consider cost and other non-risk factors, such as analytical and technological feasibility, the availability of alternatives, and the potential for critical or essential uses during risk management. Any existing chemical exposure limit (ECEL) established for occupational safety risk management purposes may differ from the occupational exposure value presented in this appendix based on consideration of the unreasonable risk identified and non-risk factors consistent with TSCA section 6(c).

This draft calculated value for 1,1,2-trichloroethane represents the exposure concentration at which the corresponding MOEs fall below the benchmark MOE for exposed workers and ONUs. The draft value is derived based on HECs described in Section 1.1.1, reflecting the best available science. The values that are based on the best available science and protective of human health effects. This draft value is expressed relative to benchmarks and standard occupational scenario assumptions of an 8 hours per day, 5 days per week exposures, for a total of 250 days exposure per year across a 40-year working life. The calculated value is intended to protect against new cases of olfactory epithelium lesions.

A summary table of available monitoring methods from OSHA, NIOSH, and EPA is included below in Appendix G.1 and Table_Apx G-1). That table presents validated methods from governmental agencies and is not intended to be a comprehensive list of available air monitoring methods for 1,1,2-trichloroethane.

G.1 Summary of Air Sampling Analytical Methods Identified

EPA conducted a search to identify relevant NIOSH, OSHA, and EPA analytical methods used to monitor for the presence of 1,1,2-trichloroethane in air (Table_Apx G-1). This table presents validated methods from governmental agencies and is not intended to be a comprehensive list of available air monitoring methods for 1,1,2-trichloroethane. The sources used for the search included the following:

1. NIOSH Manual of Analytical Methods (NMAM); 5th Edition
   - URL: https://www.cdc.gov/niosh/nmam/default.html (accessed July 21, 2026)
2. NIOSH NMAM 4th Edition
   - URL: https://www.cdc.gov/niosh/docs/2003-154/default.html (accessed July 21, 2026)
3. OSHA Index of Sampling and Analytical Methods
   - URL: https://www.osha.gov/dts/sltc/methods/ (accessed July 21, 2026)

4. EPA Environmental Test Method and Monitoring Information
   - URL: https://www.epa.gov/measurements-modeling/index-epa-test-methods (accessed July 21, 2026)

Additionally, EPA reviewed the analytical method utilized in the Test Order Inhalation Monitoring Study (Stantec ChemRisk, 2024). Table_Apx G-1 also provides a summary of identified methods, including the method utilized in the Inhalation Monitoring Study. As described in this table, the approved Final Study Plan for 1,1,2-Trichloroethane utilized a modified NIOSH 1003 capable of detecting below the standard NIOSH 1003 method. This method utilized Assay Technology 525 TraceAir® II activated charcoal passive badges and gas chromatography with mass spectrometry (GC/MS), which is a more sensitive analytical technique. The laboratory method validation report is included in Appendix K of the Final Study Report (Stantec ChemRisk, 2024). The modified method is capable of achieving a limit of detection (LOD) below the occupational exposure value (OEV) of 0.001 ppm. Other methods (NIOSH Method 1003, OSHA Method 11) are not capable of achieving an LOD or limit of quantification (LOQ) below the OEV.

Table_Apx G-1. Limit of Detection (LOD) and Limit of Quantification (LOQ) Summary for Air Sampling Analytical Methods Identified for 1,1,2-Trichloroethane

Air Sampling Analytical Methods	Year Published	LOD (ppm)	LOQ (ppm)	Notes	Source
NIOSH Method 1003 Modified	2024	6E−05	8.1E−05	Method reports the LOQ as 12 ng/sample; equivalent airborne concentration (ppm) is based on an 8-hour sampling duration.	(Stantec ChemRisk, 2024)
NIOSH Method 1003[a,]	2003 (Issue 3)	3E−03	9E−03	Method reports the LOD as 1.0 µg and LOQ as 3.0 µg per sample and provides procedures for collecting air samples between 2–60 L with a flow rate of 0.01–0.2 L/min LOD and LOQ provided in this table are based on a sample collection rate of 0.125 L/min, which maximize the volume of air at 60 L)for an 8-hour (480-minute) sample.[b]	NIOSH NMAM 4th Edition
OSHA Method 11	1980	0.026	0.026	Method is based on an earlier NIOSH method.	OSHA Occupational Chemical Database

NIOSH = National Institute for Occupational Safety and Health; ppm = parts per million
All hyperlinks/URLs included in table accessed July 21, 2026.
[a] It is common for laboratories to acquire updated equipment from the equipment used by NIOSH to develop Method 1003. Modern equipment can offer dramatically greater performance compared with the equipment available when NIOSH 1003 was published. This can result in significantly lower LOQ/LODs. However, NIOSH does not necessarily continually update the method, and labs are using the same general procedures but with more sensitive analytical detectors. Therefore, the lab is permitted to report its method as "modified NIOSH Method 1003". The lab will include a record of how it modifies the method in its results.
[b] Lowest concentrations quantifiable for 2-, 4-, or 8-hour samples are 0.125, 0.063, and 0.05 mg/m^3, respectively, at maximum flow rate with the unmodified method.

Summary of Existing Occupational Exposure Limits

OSHA set a permissible exposure limit (PEL) as an 8-hour TWA for 1,1,2-trichloroethane of 45 mg/m^3 (or 10 ppm) in 1971 (https://www.osha.gov/annotated-pels; accessed June 12, 2026). Prior to establishing an OSHA PEL, OSHA goes through a process that includes both risk assessment and feasibility assessment analyses before selecting a level that will substantially reduce risk under the Occupational Safety and Health Act. EPA's calculated occupational exposure value is based on available toxicological and human health information more recent than the OSHA PEL.

Other governmental agencies and independent groups have also set recommended exposure limits for 1,1,2-trichloroethane (Table_Apx G-2). Available occupational limit values (TWA) vary, with the lowest value being 5.5 mg/m^3 (Germany – AGS, Germany – DFG, New Zealand) and the highest value being 56 mg/m^3 (Belgium, Spain). Similarly, derived short-term exposure values range from 11 mg/m^3 (Germany – AGS, Germany – DFG, New Zealand) to 275 mg/m^3 (Austria). Relevant to the United States, the OSHA PEL is 10 ppm as an 8-hour TWA for 1,1,2-trichloroethane, with a skin notation indicating potential for dermal absorption (OSHA; accessed March 5, 2026). The NIOSH Recommended Exposure Limit (REL) is 10 ppm as a TWA for up to a 10-hour workday, with a skin notation indicating potential for dermal absorption (https://www.cdc.gov/niosh/npg/; accessed March 5, 2026). The American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Value (TLV) is 10 ppm TWA (https://www.acgih.org/112-trichloroethane/; accessed March 5, 2026). There are no short-term or ceiling limits provided by OSHA, NIOSH, or ACGIH.

Table_Apx G-2. Summary of Occupational Exposure Limits for 1,1,2-Trichloroethane

Country	Limit Value (8-Hour TWA)		STEL (15-Minute)		Notes/Reference[a]
	ppm	mg/m^3	ppm	mg/m^3	
U.S. EPA Proposed Values	0.001	0.005	–	–	- Draft values derived in Appendix G.2 of this draft risk evaluation
Australia	10	55	–	–	- GESTIS – International Limit Values
Austria	10	55	50	275	- GESTIS – International Limit Values
Belgium	10	56	–	–	- GESTIS – International Limit Values
Canada – Ontario	10	–	–	–	- GESTIS – International Limit Values
Canada – Quebec	10	–	–	–	- GESTIS – International Limit Values
Denmark	10	54	20	108	- GESTIS – International Limit Values
Finland	10	55	20	110	- GESTIS – International Limit Values
Germany (AGS)	1	5.5	2	11	- GESTIS – International Limit Values
Germany (DFG)	1	5.5	2	11	- GESTIS – International Limit Values
Ireland	10	45	–	–	- GESTIS – International Limit Values
Japan (JSOH)	10	55	–	–	- GESTIS – International Limit Values
New Zealand	1	5.5	2	11	- GESTIS – International Limit Values
Norway	10	54	–	–	- GESTIS – International Limit Values
Poland	–	40	–	–	- GESTIS – International Limit Values
Singapore	10	55	–	–	- GESTIS – International Limit Values
South Africa	20	–	–	–	- GESTIS – International Limit Values
South Africa Mining	10	45	20	90	- GESTIS – International Limit Values
South Korea	10	–	–	–	- GESTIS – International Limit Values
Spain	10	56	–	–	- GESTIS – International Limit Values

Country	Limit Value (8-Hour TWA)		STEL (15-Minute)		Notes/Reference[a]
	ppm	mg/m³	ppm	mg/m³	
Switzerland	2	11	10	55	- GESTIS – International Limit Values
USA – NIOSH	10	45	–	–	- NIOSH (1994)
USA – OSHA	10	45	–	–	- Adopted in 1971 - OSHA
USA – ACGIH TLV	10	55			-ACGIH (1992)

[a] All websites/hyperlinks provided in this table were last accessed on June 12, 2026.
"–" indicates that no value is available.

G.2 Occupational Exposure Value Calculations

This section presents the calculations used to estimate the occupational exposure values using inputs derived in this draft risk evaluation. Multiple values are presented below for hazard endpoints based on different exposure durations. For 1,1,2-trichloroethane, the most sensitive occupational exposure value of the three values calculated below is based on lesions in the olfactory epithelium following chronic exposures and the resulting non-cancer 8-hour TWA is rounded to 0.005 mg/m^3 (0.001 ppm). The draft occupational exposure value is derived based on HECs described in Section 1.1.1 and reflects the best available science. The HECs used in the equations are derived in this draft risk evaluation and the *Draft Human Health and Environmental Hazard Assessment for 1,1,2-Trichloroethane* (U.S. EPA, 2026g).

While EPA has retained significant figures in the below OEV calculations, EPA may round the value during risk management to avoid false precision.

Lifetime Cancer Occupational Exposure Value

The draft cancer IUR value is 0.0163 per ppm based on liver tumors, with a moderate confidence summary (Table 4-22). The EV_{cancer} identified below is the concentration at which the extra cancer risk is equivalent to the benchmark cancer risk of 1×10^{-4}:

$$EV_{cancer} = \frac{Benchmark_{Cancer}}{IUR} \times \frac{AT_{IUR}}{ED \times E \times WY} \times \frac{\mathrm{IR_{resting}}}{\mathrm{IR_{workers}}}$$

$$= \frac{1 \times 10^{-4}}{0.0163\ per\ ppm} * \frac{24\frac{h}{d} \times \frac{365d}{y} \times 78y}{8\frac{h}{d} \times \frac{250d}{y} \times 40y} \times \frac{0.6125\frac{\mathrm{m^3}}{hr}}{1.25\frac{\mathrm{m^3}}{hr}} = 0.026\ \mathrm{ppm}$$

$$\mathrm{EV_{cancer}}\left(\frac{\mathrm{mg}}{\mathrm{m^3}}\right) = \frac{EV\ ppm \times MW}{Molar\ Volume} = \frac{0.026\ \mathrm{ppm} \times 133.4\frac{g}{mol}}{24.45\frac{L}{mol}} = 0.14\ \frac{\mathrm{mg}}{\mathrm{m^3}}$$

Where:

Molar Volume = 24.45 L/mol, the volume of a mole of gas at 1 atm and 25 °C
MW = Molecular weight of 1,1,2-trichloroethane is 133.41 g/mole

Acute Non-Cancer Occupational Exposure Value

The acute occupational exposure value (EV_{acute}) was calculated as the concentration at which the acute margin of exposure (MOE) would equal the benchmark MOE for acute occupational exposures. The acute non-cancer HEC for 1,1,2-trichloroethane is 1.1 ppm with a total uncertainty factor of 100 due to the use of a LOAEC value instead of a NOAEC value, based on necrosis in the olfactory epithelium:

$$EV_{acute} = \frac{HEC_{acute}}{TotalUF_{acute}} \times \frac{AT_{HEC\ acute}}{ED} \times \frac{IR_{resting}}{IR_{workers}}$$

$$= \frac{1.1\ \text{ppm}}{100} \times \frac{\frac{24h}{d}}{\frac{8h}{d}} \times \frac{0.6125\ \frac{\text{m}^3}{h}}{1.25\ \frac{\text{m}^3}{h}} = 0.016\ \text{ppm} = 0.087\ \frac{\text{mg}}{\text{m}^3}$$

Intermediate Non-Cancer Occupational Exposure Value

The intermediate occupational exposure value ($EV_{intermediate}$) was calculated as the concentration at which the intermediate MOE would equal the benchmark MOE for intermediate occupational exposure using the following equation:

The intermediate HEC for 1,1,2-trichloroethane is 0.11 ppm and the intermediate benchmark MOE is 30 due to the use of a BMCL value, based on lesions in the olfactory epithelium.

$$EV_{intermediate} = \frac{HEC_{intermediate}}{TotalUF_{ntermediate}} \times \frac{AT_{HEC\ intermediate}}{ED \times EF} \times \frac{IR_{resting}}{IR_{workers}}$$

$$= \frac{0.11\ \text{ppm}}{30} \times \frac{24h/d \times 30d}{8h/d \times 22d} \times \frac{0.6125\ \text{m}^3/h}{1.25\ \text{m}^3/h} = 0.007\ \text{ppm}$$

$$EV_{intermdiate}\ \left(\frac{\text{mg}}{\text{m}^3}\right) = \frac{EV\ ppm \times MW}{Molar\ Volume} = \frac{0.007\ \text{ppm} \times 133.4 \frac{g}{mol}}{24.45 \frac{L}{mol}} = 0.038\ \frac{\text{mg}}{\text{m}^3}$$

Chronic Non-Cancer Occupational Exposure Value

The chronic occupational exposure value ($EV_{chronic}$) was calculated as the concentration for lesions in the olfactory epithelium at which the chronic MOE would equal the benchmark MOE for 8-hour working lifetime (chronic) occupational exposures with the following equation:

The chronic non-cancer HEC for 1,1,2-trichloroethane is 0.11 ppm and the total uncertainty factor (UF) of 300 due to the use of a BMCL value and the use of an intermediate duration study POD for the chronic duration, based on lesions in the olfactory epithelium. The 1,1,2-trichloroethane risk evaluation includes an applied 10× UF as no suitable studies were identified for a chronic non-cancer POD. This UF was applied based on the assumption that effects from a given compound in a subchronic study occur at a 10-fold higher concentration than in a corresponding chronic study if one were available.

$$\text{EV}_{\text{chronic}} = \frac{\text{HEC}_{\text{chronic}}}{TotalUF_{chronic}} \times \frac{\text{AT}_{\text{HEC chronic}}}{ED \times EF \times WY} \times \frac{\text{IR}_{\text{resting}}}{\text{IR}_{\text{workers}}}$$

$$= \frac{0.11 \text{ ppm}}{300} \times \frac{\frac{24h}{d} \times \frac{365d}{y} \times 40\ y \times 0.6125 \frac{\text{m}^3}{h}}{\frac{8h}{d} \times \frac{250d}{y} \times 40\ y \times 1.25 \frac{\text{m}^3}{h}} = 0.001 \text{ ppm} = 0.005 \frac{\text{mg}}{\text{m}^3}$$

The parameters used in the above equations are described here. Numerical values chosen for the parameters are described in relevant sections of this draft risk evaluation and *Draft Human Health and Environmental Hazard Assessment for 1,1,2-Trichloroethane* (U.S. EPA, 2026w).

Where:

$AT_{HECchronic}$	=	Averaging time for the POD/HEC used for evaluating non-cancer, chronic occupational risk, based on study conditions and/or HEC adjustments (24 hours/day for 365 days/year) and assuming the number of years matches the high-end working years (WY, 40 years) for a worker
$AT_{HECintermediate}$	=	Averaging time for the POD/HEC used for evaluating non-cancer, intermediate occupational risk, based on study conditions and/or any HEC adjustments (24 hours/day for 30 days)
$AT_{HECacute}$	=	Averaging time for the POD/HEC used for evaluating non-cancer, acute occupational risk, based on study conditions and/or any HEC adjustments (24 hours/day)
AT_{IUR}	=	Averaging time for the cancer IUR, based on study conditions and any adjustments (24 hours/day for 365 days/year) and averaged over a lifetime (78 years)
$TotalUF_{chronic}$	=	Chronic non-cancer total uncertainty factor of 300
$TotalUF_{intermediate}$	=	Intermediate non-cancer total uncertainty factor of 30
$TotalUF_{acute}$	=	Acute non-cancer total uncertainty factor of 100
$Benchmark_{cancer}$	=	Benchmark for excess lifetime cancer risk
EV_{acute}	=	occupational exposure value based on olfactory epithelium necrosis
$EV_{intermediate}$	=	occupational exposure value based on lesions in the olfactory epithelium
$EV_{chronic}$	=	occupational exposure value based on lesions in the olfactory epithelium
EV_{cancer}	=	Draft occupational exposure value based on excess cancer
ED	=	Exposure duration (8 hours/day)
EF	=	Exposure frequency: 1 day/year for acute, 22 days/year for intermediate, 250 days/year for chronic and lifetime
$HEC_{acute,\ intermediate,\ or\ chronic}$	=	Human equivalent concentration for acute, intermediate, or chronic occupational exposure scenarios
IUR	=	Inhalation unit risk (per mg/m^3 and per ppm)
IR	=	Inhalation rate (default is 1.25 m^3/h for workers and 0.6125 m^3/h for the general population at rest)
WY	=	Working years per lifetime at the 95th percentile (40 years)
Molar Volume	=	24.45 L/mol, the volume of a mole of gas at 1 atm and 25 °C
MW	=	Molecular weight of 1,1,2-trichloroethane is 133.41 g/mole

Unit conversion:

1 ppm = 5.46 mg/m^3 (based on the molecular weight of 133.41 g/mol for 1,1,2-trichloroethane)

Appendix H SENSITIVITY ANALYSIS FOR NON-DETECTS IN INHALATION EXPOSURE MONITORING DATA

As described in Appendix G.1, not all air sampling analytical methods for 1,1,2-trichloroethane are able to detect concentrations below the OEV of 0.001 ppm. As such, where there are a large number of samples below the LOD (>10%), which exceeds the OEV, EPA has performed a sensitivity analysis to address uncertainty from the underlying dataset. The Agency considers this assessment relevant to add additional characterization to the resulting inhalation and risk estimates and provides support when making an unreasonable risk determination when the LOD is at or above the OEV. This analysis is performed in addition to the standard method of replacing values below the limit of detection.

For 1,1,2-trichloroethane, EPA identified one OES (Disposal to POTW/Non-POTW WWT) that utilized data with a high LOD and a high number of non-detects (NDs) (Section 4.3.2.1.11).

Although the test-order inhalation data utilized for most of the OES in this assessment had non-detects (27–38% of samples) for some SEGs, the LOD achieved in this monitoring study was well below the OEV (LOD range: $<6\times10^{-5}$ to $<7\times10^{-5}$ ppm). Additionally, the percentage of NDs was too low for the replacement method to impact the calculation of the 50th and 95th percentile for this dataset. This is illustrated in Appendix L of the Final Study Report, which shows the resulting 50th and 95th percentile statistics as calculated by various substitution methods (Stantec ChemRisk, 2024).

Sensitivity Analysis for POTW/Non-POTW WWT Inhalation Monitoring Data

As described in Section 4.3.2.1.11, as part of the assessment of occupational exposures for this OES, EPA considered surrogate monitoring data from wastewater treatment that was specific to 1,2-dichloroethane. Vapor pressure adjustment was performed to account for the differences in vapor pressure between the two chemicals (1,1,2-trichloroethane vapor pressure: 23 mmHg; 1,2-dichloroethane vapor pressure: 78.9 mmHg). Within this dataset, 50% of worker (n = 70) and 75% of ONU samples (n = 3) were below the LOD; the LOD ranged from 0.024 to 0.28 ppm (see Table 4-7 for more details). EPA prepared a sensitivity analysis where values below the LOD were replaced with a lower bound of 0 and an upper bound of the full LOD, which represents the full potential distribution of potential true values for the monitoring data. Additionally, EPA presented estimates where values below the LOD were replaced with the OEV (0.001 ppm). The resulting exposure and risk estimates are presented in Table_Apx H-1.

Table_Apx H-1. Inhalation Exposure and Risk Estimates for Sensitivity Analysis of NDs for Surrogate Monitoring Data (1,2-Dichloroethane) Utilized in the POTW/Non-POTW WWT Assessment[a]

Exposure Group	Method Utilized to Replace ND Values [b]	Exposure Level	8-Hour TWA (ppm)	Acute Non-Cancer (Benchmark MOE = 100)	Intermediate Non-Cancer (Benchmark MOE = 30)	Chronic Non-Cancer (Benchmark MOE = 300)	Chronic Cancer (Benchmark = 1E−04)
Worker [c]	NDs = LOD ÷ 2 [d]	CT	4.1E−02	**40**	**5.4**	**5.8**	**1.2E−04**
		HE	0.21	**7.7**	**1.1**	**1.1**	**8.2E−04**
	NDs = 0	CT	1.3E−03	1,244	170	**182**	3.9E−06
		HE	0.21	**7.7**	**1.1**	**1.1**	**8.2E−04**
	NDs = 0.001 (OEV)	CT	1.3E−03	1,244	170	**182**	3.9E−06
		HE	0.21	**7.7**	**1.1**	**1.1**	**8.2E−04**
	NDS = LOD	CT	8.2E−02	**20**	**2.7**	**2.9**	**2.5E−04**

Exposure Group	Method Utilized to Replace ND Values [b]	Exposure Level	8-Hour TWA (ppm)	Acute Non-Cancer (Benchmark MOE = 100)	Intermediate Non-Cancer (Benchmark MOE = 30)	Chronic Non-Cancer (Benchmark MOE = 300)	Chronic Cancer (Benchmark = 1E−04)
		HE	0.21	**7.7**	**1.1**	**1.1**	**8.2E−04**
ONU [e]	NDs = LOD ÷ 2 [d]	CT	1.3E−02	121	**16**	**18**	4.0E−05
		HE	3.8E−02	**43**	**5.8**	**6.2**	**1.5E−04**
	NDs = 0	CT	0	N/A	N/A	N/A	N/A
		HE	1.2E−02	135	**18**	**20**	4.7E−05
	NDs = 0.001 (OEV)	CT	1.0E−03	1,617	221	**236**	3.0E−06
		HE	1.2E−02	135	**18**	**20**	4.7E−05
	NDS = LOD	CT	1.3E−02	121	**16**	**18**	4.0E−05
		HE	7.7E−02	**21**	**2.9**	**3.1**	**3.0E−04**

CT = central tendency; HE = high-end; LOD = limit of detection; ND = non-detect; OEV = occupational exposure value; ONU = occupational non-user; TWA = time-weighted average
[a] Risk estimates that exceed the benchmark (*i.e.,* non-cancer risks less than the risk benchmark and cancer risks exceeding the cancer risk benchmark) are **bolded and shaded**.
[b] Describes the specific methods utilized to replace NDs (*e.g.,* values <LOD) as part of the sensitivity analysis.
[c] LOD range for workers 0.024–0.28 ppm; only 1 sample had an LOD < 0.2 ppm.
[d] This represents the current method used to replace values below the LOD in the risk characterization, as described in Section 4.1.1.2. These risk estimates are the same as those presented in Table 4-27.
[e] LOD for ONUs were 0.024 and 0.21 ppm.

As illustrated by Table_Apx H-1, EPA notes that risk estimates for workers at the high-end exposure estimate did not change per the sensitivity analysis. Chronic noncancer risk estimates at central tendency exposures were still below the benchmark MOE (300)—even when NDs were replaced with 0 or 0.001 ppm. Therefore, EPA has greater certainty that risks calculated from this data are not due to the high limit of detection. However, cancer estimates were above the cancer benchmark (indicating no unreasonable risk) when NDs were replaced with a 0 or 0.001 ppm, but below the cancer benchmark when the full LOD or LOD/2 was used to replace NDs. As such, potential cancer risks from this dataset may be driven by the high LOD.

For ONUs, acute inhalation risk estimates at the high-end exposure estimates were above the MOE (100) when NDs were replaced with 0 or 0.001 ppm (indicating no unreasonable risk), but below the MOE (100) when NDs were replaced with LOD or LOD/2. As such, potential acute inhalation risks from this dataset may be driven by the high limit of detection. ONU intermediate inhalation risk estimates at high-end exposures were still below the benchmark MOE (30) even when NDs were replaced with 0. ONU chronic non-cancer inhalation risk estimates at the central tendency were below the benchmark MOE (300) for all sensitivity analysis methods except the use of 0, which resulted in an exposure estimate of 0 ppm (and therefore no risk estimates could be calculated). Cancer risk estimates at the central tendency exposure estimate were above the cancer benchmark for all substitution methods, including use of full LOD. Based on the results of this sensitivity analysis, EPA has higher confidence that potential intermediate, chronic non-cancer, and cancer risks are not driven by the high limit of detection.