5. 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 nonrisk factors, including an unreasonable risk to a potentially exposed or susceptible subpopulation identified by EPA as relevant to this Risk Evaluation, under the conditions of use.

EPA is proposing to determine that carbon tetrachloride presents an unreasonable risk of injury to health under the conditions of use. This determination is based on the information in previous sections of this Risk Evaluation, the appendices and supporting documents of carbon tetrachloride, in accordance with TSCA section 6(b), as well as TSCA's best available science (TSCA section 26(h)) and weight of scientific evidence standards (TSCA section 26(i)), and relevant implementing regulations in 40 CFR part 702.

The conditions of use evaluated for carbon tetrachloride are listed in Table 1-4 of the risk evaluation (Ref. 1). EPA's draft unreasonable risk determination for carbon tetrachloride is driven by risks associated with the following conditions of use, considered singularly or in combination with other exposures:

- Manufacturing (Domestic Manufacture)
- Manufacturing (Import, including loading/unloading and repackaging)
- Processing as a reactant in the production of hydrochlorofluorocarbon, hydrofluorocarbon, hydrofluoroolefin, and perchloroethylene
- Processing: Incorporation into formulation, mixtures or reaction products (petrochemicals-derived manufacturing; agricultural products manufacturing; other basic organic and inorganic chemical manufacturing)
- Processing: Repackaging for use in laboratory chemicals
- Processing: Recycling
- Industrial/commercial use as an industrial processing aid in the manufacture of petrochemicals-derived products and agricultural products
- Industrial/commercial use in the manufacture of other basic chemicals (including chlorinated compounds used in solvents, adhesives, asphalt, and paints and coatings)
- Industrial/commercial use in metal recovery
- Industrial/commercial use as an additive
- Industrial/commercial use in specialty uses by the Department of Defense
- Industrial/commercial use as a laboratory chemical
- Disposal

Consistent with the statutory requirements of TSCA section 6(a), EPA will propose risk management regulatory action to the extent necessary so that carbon tetrachloride no longer presents an unreasonable risk. Therefore, it is expected that EPA's risk management action likely will focus on the conditions of use that drive the unreasonable risk. However, it should be noted that, under TSCA section 6(a), EPA is not limited to regulating the specific activities found to drive unreasonable risk and may select from among a suite of risk management requirements in

section 6(a) related to manufacture (including import), processing, distribution in commerce, commercial use, and disposal as part of its regulatory options to address the unreasonable risk. As a general example, EPA may regulate upstream activities (e.g., processing, distribution in commerce) to address downstream activities (e.g., consumer uses) driving unreasonable risk, even if the upstream activities do not drive the unreasonable risk.

5.1 Background

5.1.1 Background on Policy Changes Relating to the Whole Chemical Risk Determination and Assumption of PPE Use by Workers

From June 2020 to January 2021, EPA published risk evaluations on the first ten chemical substances, including for carbon tetrachloride in November 2020. The risk evaluations included individual unreasonable risk determinations for each condition of use evaluated. The determinations that particular conditions of use did not present an unreasonable risk were issued by order under TSCA section 6(i)(1).

In accordance with Executive Order 13990 ("Protecting Public Health and the Environment and Restoring Science to Tackle the Climate Crisis") and other Administration priorities (Refs. 2, 3, 4, and 5), EPA reviewed the risk evaluations for the first ten chemical substances to ensure that they meet the requirements of TSCA, including conducting decision-making in a manner that is consistent with the best available science and weight of the scientific evidence.

As a result of this review, EPA announced plans to revise specific aspects of certain of the first ten risk evaluations in order to ensure that the risk evaluations appropriately identify unreasonable risks and thereby can help ensure the protection of health and the environment (Ref. 6). To that end, EPA has reconsidered two key aspects of the risk determinations for carbon tetrachloride published in November 2020. First, EPA proposes that the appropriate approach to these determinations is to make an unreasonable risk determination for carbon tetrachloride as a whole chemical substance, rather than making unreasonable risk determinations separately on each individual condition of use evaluated in the risk evaluation. Second, EPA proposes that the risk determination shall explicitly state that it does not rely on assumptions regarding the use of personal protective equipment (PPE) in making the unreasonable risk determination under TSCA section 6; rather, the use of PPE will be considered during risk management. Making unreasonable risk determinations based on the baseline scenario without assuming PPE should not be viewed as an indication that EPA believes there are no occupational safety protections in place at any location or that there is widespread noncompliance with applicable OSHA standards. EPA understands that there could be occupational safety protections in place at workplace locations; however, not assuming use of PPE reflects EPA's recognition that unreasonable risk may exist for subpopulations of workers that may be highly exposed because they are not covered by OSHA standards, or their employers are out of compliance with OSHA standards, or because many of OSHA's chemical-specific permissible exposure limits largely

adopted in the 1970's are described by OSHA as being "outdated and inadequate for ensuring protection of worker health."[1]

Separately, EPA is conducting a screening approach to assess potential risks from the air and water pathways for several of the first 10 chemicals, including this chemical. For carbon tetrachloride the exposure pathways that were or could be regulated under other EPA-administered statutes were excluded from the final risk evaluation for this chemical. This resulted in the ambient air and ambient water pathways for carbon tetrachloride not being assessed. The goal of the recently-developed screening approach is to remedy this exclusion and to identify if there are risks that were unaccounted for in the carbon tetrachloride risk evaluation. While this analysis is underway, EPA is not incorporating the screening-level approach into this draft revised unreasonable risk determination. If the results suggest there is additional risk, EPA will determine if the risk management approaches being contemplated for carbon tetrachloride will protect against these risks, or if the risk evaluation will need to be formally supplemented or revised.

Further discussion of the rationale for the whole chemical approach is found in the Federal Register Notice in the docket accompanying this revised carbon tetrachloride unreasonable risk determination and further discussion of the proposed decision to not rely on assumptions regarding the use of PPE is provided in the Federal Register Notice and in Section 5.2.4 below. With respect to the carbon tetrachloride risk evaluation, EPA did not amend, nor does a whole chemical approach or change in assumptions regarding PPE require amending, the underlying scientific analysis of the risk evaluation in the risk characterization section of the risk evaluation.

With regard to the specific circumstances of carbon tetrachloride, as further explained below, EPA proposes that a whole chemical approach is appropriate for carbon tetrachloride in order to protect health and the environment. The whole chemical approach is appropriate for carbon tetrachloride, because there are benchmark exceedances for multiple conditions of use (spanning across most aspects of the chemical lifecycle–from manufacturing (including import), processing, industrial and commercial use, and disposal) for health of workers and occupational non-users, and the health effects associated with carbon tetrachloride exposures are irreversible (specifically cancer from chronic inhalation and dermal exposures and liver toxicity from chronic inhalation exposures). Because these chemical-specific properties cut across the conditions of use within the scope of the risk evaluation and a substantial amount of the conditions of use drive the unreasonable risk, it is therefore appropriate for the Agency to propose a determination that the whole chemical presents an unreasonable risk. In addition, as discussed below in Section 5.2.4, in proposing this risk determination, EPA believes it is appropriate to evaluate the levels of risk present in baseline scenarios where PPE is not assumed to be used by workers. EPA is revising the assumption for carbon tetrachloride that workers always or properly use PPE, although the Agency does not question the information received regarding the occupational safety practices often followed by many industry respondents.

[1] As noted on OSHA's Annotated Table of Permissible Exposure Limits: "OSHA recognizes that many of its permissible exposure limits (PELs) are outdated and inadequate for ensuring protection of worker health. Most of OSHA's PELs were issued shortly after adoption of the Occupational Safety and Health (OSH) Act in 1970, and have not been updated since that time" (Ref. 7).

As explained in the Federal Register Notice, the revisions to the unreasonable risk determination would be based on the existing risk characterization section of the risk evaluation (Section 4 of this Risk Evaluation), as amended by a July 2022 errata (Ref. 8), and do not involve additional technical or scientific analysis. The discussion of the issues in this draft revision to the risk determination supersedes any conflicting statements in the prior carbon tetrachloride risk evaluation (November 2020) and the response to comments document (*Summary of External Peer Review and Public Comments and Disposition for Carbon Tetrachloride (Methane, Tetrachloro), November 2020*). EPA also views the peer reviewed hazard and exposure assessments and associated risk characterization as robust and upholding the standards of best available science and weight of the scientific evidence, per TSCA sections 26(h) and (i).

5.1.2 Background on Unreasonable Risk Determination

In each risk evaluation under TSCA section 6(b), EPA determines whether a chemical substance presents an unreasonable risk of injury to health or the environment, under the conditions of use. The unreasonable risk determination does not consider costs or other nonrisk factors. In making the unreasonable risk determination, EPA considers relevant risk-related factors, including, but not limited to: the effects of the chemical substance on health and human exposure to such substance under the conditions of use (including cancer and non-cancer risks); the effects of the chemical substance on the environment and environmental exposure under the conditions of use; the population exposed (including any potentially exposed or susceptible subpopulations (PESS)); the severity of hazard (including the nature of the hazard, the irreversibility of the hazard); and uncertainties. EPA also takes into consideration the Agency's confidence in the data used in the risk estimate. This includes an evaluation of the strengths, limitations, and uncertainties associated with the information used to inform the risk estimate and the risk characterization. This approach is in keeping with the Agency's final rule, *Procedures for Chemical Risk Evaluation Under the Amended Toxic Substances Control Act* (82 FR 33726, July 20, 2017). [2]

This section describes the draft revised unreasonable risk determination for carbon tetrachloride, under the conditions of use in the scope of the Risk Evaluation for carbon tetrachloride. This draft revised unreasonable risk determination is based on the risk estimates in the final Risk Evaluation, which may differ from the risk estimates in the draft Risk Evaluation due to peer review and public comments.

5.2 Unreasonable Risk to Human Health

5.2.1 Human Health

EPA's carbon tetrachloride risk evaluation identified liver toxicity and cancer adverse effects from chronic inhalation and dermal exposures as well as liver toxicity from acute dermal

[2] This draft revised risk determination is being issued under TSCA section 6(b) and the terms used, such as unreasonable risk, and the considerations discussed are specific to TSCA. Other EPA programs have different statutory authorities and mandates and may involve risk considerations other than those discussed here.

exposures to carbon tetrachloride. The health risk estimates for all conditions of use are in Table 4-15 of this Risk Evaluation, as amended by the July 2022 errata (Ref. 8).

In developing the exposure assessment for carbon tetrachloride, EPA analyzed reasonably available information to ascertain whether some human receptor groups may have greater exposure or susceptibility than the general population to the hazard posed by carbon tetrachloride. For the carbon tetrachloride risk evaluation, EPA identified the following groups as Potentially Exposed or Susceptible Subpopulations: workers and ONUs, including men and women of reproductive age, and adolescents; and those who metabolize carbon tetrachloride to reactive metabolites faster than others, including those with elevated (moderate-high) alcohol usage, older adults, and those with antioxidant or zinc deficient diets (Section 4.3 and Tables 4-3, 4-4, 4-5, and 4-6 of this Risk Evaluation).

EPA evaluated exposures to workers and ONUs using reasonably available monitoring and modeling data for inhalation and dermal exposures, as applicable, given their greater exposure potential to carbon tetrachloride. It should be noted that EPA assumed that ONUs do not have direct contact with carbon tetrachloride; therefore, cancer and non-cancer effects from dermal exposures to carbon tetrachloride are not expected and were not evaluated. For each condition of use assessed, risks were estimated based on central tendency and high-end exposure estimates of carbon tetrachloride particles in air based on workplace monitoring studies. The description of the data used for human health exposure is in Section 2.4 of this Risk Evaluation. Uncertainties in the analysis are also discussed in Section 4.4 of this Risk Evaluation and considered in the draft revised unreasonable risk determination.

The Consumer Product Safety Commission (CPSC) banned the use of carbon tetrachloride in consumer products (excluding unavoidable residues not exceeding 10 ppm atmospheric concentration) in 1970. As a result of CPSC's ban, EPA does not consider the use of carbon tetrachloride-containing consumer products produced before 1970 to be known, intended, or reasonably foreseen. While carbon tetrachloride is used in the manufacturing of other chlorinated compounds that may be subsequently added to commercially available products, EPA expects that consumer use of such products would present only negligible exposure to carbon tetrachloride given the high volatility of carbon tetrachloride and the extent of reaction and efficacy of the separation/purification process for purifying final products. As discussed in Section 1.4.2.3, EPA had sufficient basis to conclude during problem formulation that industrial, commercial, and consumer uses of carbon tetrachloride in commercially available aerosol and non-aerosol adhesives and sealants, paints and coatings, and cleaning and degreasing solvent products would present only de minimis exposures or otherwise insignificant risks and did not warrant further evaluation or inclusion in the risk evaluation. Therefore, EPA did not evaluate hazards or exposures to consumers or bystanders in this risk evaluation, and there is no unreasonable risk determination for these populations.

EPA currently is examining whether there are risks not accounted for in the risk evaluation by analyzing exposures to fenceline communities. As described earlier, in Section 5.1.1, while this analysis is underway, EPA is not incorporating the screening-level approach into this draft revised unreasonable risk determination.

5.2.2 Non-Cancer Risk Estimates

The risk estimates for non-cancer effects (expressed as margins of exposure or MOEs) refer to adverse health effects associated with health endpoints other than cancer, including to the body's organ systems, such as reproductive/developmental effects, cardiac and lung effects, and kidney and liver effects. The MOE is the point of departure (POD) (an approximation of the no-observed adverse effect level (NOAEL) or benchmark dose level (BMDL)) and the corresponding human equivalent concentration (HEC) for a specific health endpoint divided by the exposure concentration for the specific scenario of concern. Section 3.2.5 presents the PODs for acute and chronic non-cancer effects for carbon tetrachloride and Section 4.2 of this Risk Evaluation presents the MOEs for acute and chronic non-cancer effects; however, this Risk Evaluation contained a typographical error in the acute dermal POD. This error was corrected in an errata made available to the public in the docket July 2022 and the changes to the risk estimates for acute dermal exposures are reflected in Table 5-1 below (Ref. 8).

The MOEs are compared to a benchmark MOE. The benchmark MOE accounts for the total uncertainty in a POD, including, as appropriate: (1) the variation in sensitivity among the members of the human population (i.e., intrahuman/intraspecies variability); (2) the uncertainty in extrapolating animal data to humans (i.e., interspecies variability); (3) the uncertainty in extrapolating from data obtained in a study with less-than-lifetime exposure to lifetime exposure (i.e., extrapolating from subchronic to chronic exposure); and (4) the uncertainty in extrapolating from a lowest observed adverse effect level (LOAEL) rather than from a NOAEL. A lower benchmark MOE (e.g., 30) indicates greater certainty in the data (because fewer of the default uncertainty factors (UFs) relevant to a given POD as described above were applied). A higher benchmark MOE (e.g., 1000) would indicate more uncertainty for specific endpoints and scenarios. However, these are often not the only uncertainties in a risk evaluation. The benchmark MOEs for acute inhalation and acute dermal risks for carbon tetrachloride are 10 and 30, respectively. The benchmark MOE for chronic non-cancer risks for carbon tetrachloride is 30. Additional information regarding the non-cancer hazard identification is in Section 3.2.4.1 and the benchmark MOE is in Section 4.2.1 of this Risk Evaluation.

5.2.3 Cancer Risk Estimates

EPA presents in this Risk Evaluation two approaches for assessment of carcinogenic risk from carbon tetrachloride: a linear extrapolation approach for adrenal gland and brain tumors in conjunction with a threshold approach for assessing risks for liver tumors. This is based on considerations for the modes of action for the different cancers evaluated. More information describing the reasons for the two approaches and the overall cancer mode of action conclusions is in Section 3.2.4.3 of this Risk Evaluation.

For adrenal gland and brain tumors, EPA used a linear extrapolation approach. The basis for this approach is described in detail in Section 3.2.4.3.2, with the cancer inhalation unit risk and dermal slope factor described in Section 3.2.5.2.5. Using this approach, 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 and other regulatory agencies are an

increased cancer risk above benchmarks ranging from 1 in 1,000,000 to 1 in 10,000 (i.e., $1x10^{-6}$ to $1x10^{-4}$) depending on the subpopulation exposed. For example, in this Risk Evaluation, EPA used $1x10^{-4}$ as the benchmark for the cancer risk to individuals in industrial and commercial work places. The $1x10^{-4}$ value is not a bright line and EPA has discretion to make an unreasonable risk determination for the chemical substance based on other benchmarks as appropriate.

For liver tumors, EPA used a threshold approach for assessing risks. Section 3.2.5.2.6 presents the PODs for liver cancer effects for carbon tetrachloride and Section 4.2 presents the MOEs for liver cancer effects. Like non-cancer effects, the MOEs for cancer effects are compared to a benchmark MOE. The benchmark MOE for liver cancer risks for carbon tetrachloride is 300 (accounting for interspecies and intraspecies variability) (Section 4.2.1 of this Risk Evaluation).

5.2.4 Determining Unreasonable Risk of Injury to Health

Calculated risk estimates (MOEs or cancer risk estimates) can provide a risk profile of carbon tetrachloride by presenting a range of estimates for different health effects for different conditions of use. A calculated MOE that is less than the benchmark MOE supports a determination of unreasonable risk of injury to health, based on non-cancer or certain cancer effects. Similarly, a calculated added cancer risk estimate that is greater than the cancer benchmark supports a determination of unreasonable risk of injury to health from cancer. These calculated risk estimates alone are not bright-line indicators of unreasonable risk. Whether EPA makes a determination of unreasonable risk for the chemical substance depends upon other risk-related factors, such as the endpoint under consideration, the reversibility of effect, exposure-related considerations (e.g., duration, magnitude, frequency of exposure, or population exposed), and the confidence in the information used to inform the hazard and exposure values.

In Section 4.2.1 of the carbon tetrachloride risk characterization, central nervous system effects and liver toxicity were identified as the most sensitive endpoints for non-cancer adverse effects from acute or chronic inhalation and dermal exposures for all conditions of use. EPA also considered cancer risk estimates from chronic dermal or inhalation exposures in the unreasonable risk determination. The carbon tetrachloride risk determination considers the uncertainties associated with the reasonably available information to justify the linear cancer dose-response model and the threshold dose-response model when compared to other available models. Addressing unreasonable risk by using the cancer endpoint will also address the risk from other endpoints resulting from acute or chronic inhalation or dermal exposures.

When making a determination of unreasonable risk for the chemical substance, the Agency has a higher degree of confidence where uncertainty is low. For example, EPA has high confidence in the hazard and exposure characterizations when the basis for characterizations is measured data or monitoring data or a robust model and the hazards identified for risk estimation are relevant for conditions of use. This Risk Evaluation discusses major assumptions and key uncertainties according to steps of the risk assessment process including: exposure assessment, hazard assessment, and risk characterization. For the human health risk estimation, key assumptions and uncertainties are related to the estimates for ONU inalation exposures. A source of uncertainty related to human health hazard includes lack of reasonably available monitoring data for many of

the conditions of use evaluated. An additional source of uncertainty in the dermal risk assessment is the inhalation to dermal route-to-route extrapolations. Another source of uncertainty for the human health hazard is the evidence in support of a mode of action for carcinogenesis of carbon tetrachloride for the different types of tumors observed in animal and human studies. Important assumptions and key sources of uncertainty in the risk characterization are described in more detail in Section 4.4 of this Risk Evaluation.

When determining the unreasonable risk for a chemical substance, EPA considers the central tendency and high-end exposure levels in occupational settings. Risk estimates based on high-end exposure levels (e.g., 95th percentile) are generally intended to cover individuals or sub-populations with greater exposure (PESS) as well as to capture individuals with sentinel exposure, and risk estimates at the central tendency exposure are generally estimates of average or typical exposure (Section 4.4 of this Risk Evaluation).

As shown in Section 4 of this Risk Evaluation, when characterizing the risk to human health from occupational exposures during risk evaluation under TSCA, EPA believes it is appropriate to evaluate the levels of risk present in baseline scenarios where PPE is not assumed to be used by workers. It should be noted that, in some cases, baseline conditions may reflect certain mitigation measures, such as engineering controls, in instances where exposure estimates are based on monitoring data at facilities that have engineering controls in place. This approach of not assuming PPE use by workers considers the risk to potentially exposed or susceptible subpopulations (workers and ONUs) who may not be covered by Occupational Safety and Health Administration (OSHA) standards, such as self-employed individuals and public sector workers who are not covered by a State Plan. In addition, EPA risk evaluations may characterize the levels of risk present in scenarios considering applicable OSHA requirements (e.g., chemical-specific PELs and/or chemical-specific health standards with PELs and additional ancillary provisions), as well as scenarios considering industry or sector best practices for industrial hygiene that are clearly articulated with the Agency. EPA's evaluation of risk under scenarios that, for example, incorporate use of engineering or administrative controls, or personal protective equipment, serves to inform its risk management efforts. By characterizing risks using scenarios that reflect different levels of mitigation, EPA risk evaluations can help inform potential risk management actions by providing information that could be used to tailor risk mitigation appropriately to address worker exposures where the Agency has found unreasonable risk. In particular, EPA can use the information developed during its risk evaluation to determine whether alignment of EPA's risk management requirements with existing OSHA requirements or industry best practices will adequately address unreasonable risk required by TSCA.

When undertaking unreasonable risk determinations as part of TSCA risk evaluations, EPA cannot assume as a general matter that an applicable OSHA requirement or industry practice is consistently and always properly applied. Mitigation scenarios included in the carbon tetrachloride risk evaluation (e.g., scenarios considering use of various personal protective equipment (PPE)) likely represent what is happening already in some facilities. However, the Agency cannot assume that all facilities will have adopted these practices for the purposes of making the TSCA risk determination.

Therefore, EPA conducts baseline assessments of risk and makes its determination of unreasonable risk from a baseline scenario that is not based on an assumption of compliance with OSHA standards, including any applicable exposure limits or requirements for use of respiratory protection or other PPE. Making unreasonable risk determinations based on the baseline scenario should not be viewed as an indication that EPA believes there are no occupational safety protections in place at any location, or that there is widespread non-compliance with applicable OSHA standards. Rather, it reflects EPA's recognition that unreasonable risk may exist for subpopulations of workers that may be highly exposed because they are not covered by OSHA standards, such as self-employed individuals and public sector workers who are not covered by a State Plan, or because their employer is out of compliance with OSHA standards, or because many of OSHA's chemical-specific permissible exposure limits largely adopted in the 1970's are described by OSHA as being "outdated and inadequate for ensuring protection of worker health," or because EPA finds unreasonable risk for purposes of TSCA notwithstanding existing OSHA requirements.

The draft revised unreasonable risk determination for carbon tetrachloride is based on the peer reviewed risk characterization (Section 4 of this Risk Evaluation) and on the July 2022 errata, which was developed according to TSCA section 26(h) requirements to make science-driven decisions, consistent with the best available science (Ref. 8). Proposing changes to the risk determination to a whole chemical approach does not impact the underlying data and analysis presented in the risk characterization of the risk evaluation. Section 4.2.8 and Table 4-15 of this Risk Evaluation, as amended by the July 2022 errata, summarize the risk estimates with and without PPE, and informed the draft revised unreasonable risk determination (Ref. 8).

5.3 Unreasonable Risk to the Environment

5.3.1 Environment

EPA calculated a risk quotient (RQ) to compare environmental concentrations against an effect level. The environmental concentration is determined based on the levels of the chemical released to the environment (e.g., surface water, sediment, soil, biota) under the conditions of use, based on the fate properties, release potential, and reasonably available environmental monitoring data. The effect level is calculated using concentrations of concern that represent hazard data for aquatic and sediment-dwelling, organisms. Physical-chemical properties of carbon tetrachloride were considered for the risk of injury to terrestrial organisms. Section 4.1 of this Risk Evaluation provides more detail regarding the environmental risk characterization for carbon tetrachloride.

5.3.2 Determining Unreasonable Risk of Injury to the Environment

Calculated risk quotients (RQs) can provide a risk profile by presenting a range of estimates for different environmental hazard effects for different conditions of use. An RQ equal to 1 indicates that the exposures are the same as the concentration that causes effects. An RQ less than 1, when the exposure is less than the effect concentration, generally indicates that there is not risk of injury to the environment that would support a determination of unreasonable risk for the chemical substance. An RQ greater than 1, when the exposure is greater than the effect

concentration, generally indicates that there is risk of injury to the environment that would support a determination of unreasonable risk for the chemical substance. Consistent with EPA's human health evaluations, 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.

To characterize the exposure to carbon tetrachloride by aquatic organisms, modeled data were used to represent surface water concentrations near facilities actively releasing carbon tetrachloride to surface water. EPA considered the biological relevance of the species to determine the concentrations of concern for the location of surface water concentration data to produce RQs, as well as timing and seasonality of the exposure. While the RQ was exceeded (RQ>1) from chronic exposure of carbon tetrachloride to amphibians at five facilities, additional characterization of risk based on seasonal exposure data indicated one of the exceedances did not occur during time periods relevant to amphibian development. For the four facilities with RQ exceedances relevant to amphibian development during two separate reporting periods, risk was not consistent across facilities, and it is not possible to predict with any certainty whether risk will or will not occur during months key to amphibian development in future years. Uncertainties related to these particular estimates are discussed in Section 4.4.2 and 4.4.3. EPA's analysis indicates that significant environmental exposures are not expected to exceed the acute and chronic COCs for aquatic species, as presented in Section 4.1.1 and Table 4-2.

The toxicity of carbon tetrachloride to sediment-dwelling invertebrates is similar to the toxicity to aquatic invertebrates. Carbon tetrachloride is most likely present in the pore waters and not absorbed to the sediment organic matter because carbon tetrachloride has low partitioning to organic matter. The concentrations in sediment pore water are similar to or less than the concentrations in the overlying water, and concentrations in the deeper part of sediment are lower than the concentrations in the overlying water. EPA identified one low quality study on sediment-dwelling organisms; there is uncertainty due to the lack of ecotoxicity studies specifically for sediment-dwelling organisms and limited sediment monitoring data. Therefore, for sediment-dwelling organisms the risk estimates, based on the highest ambient surface water concentration, do not drive the unreasonable risk determination for carbon tetrachloride.

Based on its physical-chemical properties, carbon tetrachloride does not partition to or accumulate in soil. Therefore, EPA did not identify risks of injury to terrestrial organisms from exposure to carbon tetrachloride through soil or land-applied biosolids that would drive the unreasonable risk determination for carbon tetrachloride.

When making a determination of unreasonable risk, EPA has a higher degree of confidence where uncertainty is low. For example, EPA has high confidence in the hazard and exposure characterizations when the basis for the characterizations is measured or monitoring data or a robust model and the hazards identified for risk estimation are relevant for conditions of use. Where EPA has made assumptions in the scientific evaluation, the degree to which these assumptions are conservative (i.e., more protective) is also a consideration.

EPA considered uncertainties in its determination of unreasonable risk for carbon tetrachloride. Key assumptions and uncertainties in the environmental risk estimation are related to data used

for the characterization of environmental exposure (*e.g.*, model input parameters, inability to cross-walk reporting sites to conditions of use) and environmental hazard (*e.g.*, inability to obtain full scientific reports). Assumptions and key sources of uncertainty in the risk characterization are detailed in Sections 4.4.2 and 4.4.3 of this Risk Evaluation.

Therefore, based on this Risk Evaluation, EPA did not identify risks of injury to the environment that would drive the unreasonable risk determination for carbon tetrachloride.

5.4 Additional Information regarding the Basis for the Unreasonable Risk Determination

Table 5-1 summarizes the basis for the draft revised determination of unreasonable risk of injury to health presented by carbon tetrachloride. In this table, a checkmark indicates the type of effect and the exposure route to the population evaluated for each condition of use that drives the unreasonable risk determination. As explained in Section 5.2, for the draft revised unreasonable risk determination, EPA considered the effects on human health of exposure to carbon tetrachloride at the central tendency and high-end, the exposures from the condition of use, the risk estimates, and the uncertainties in the analysis. See Section 4.2.8 of this Risk Evaluation for a summary of risk estimates.

Table 5-1. Conditions of Use Included in the Unreasonable Risk Determination for Human Health[3]

Life Cycle Stage	Category [a]	Subcategory [b]	Population	Exposure Route	Human Health Effects					
					Acute Non-cancer		Chronic Non-cancer		Cancer	
					High End	Central Tendency	High End	Central Tendency	High End	Central Tendency
Manufacturing	Domestic manufacture	Domestic manufacture	Worker	Inhalation			✓		✓	✓
			Worker	Dermal	✓		✓	✓	✓	✓
			ONU	Inhalation			✓		✓	✓
	Import	Import	Worker	Inhalation			✓		✓	✓
			Worker	Dermal	✓		✓	✓	✓	✓
			ONU	Inhalation						✓
Processing	Processing as a reactant/intermediate	Hydrochlorofluorocarbons (HCFCs), Hydrofluorocarbon (HFCs) and Hydrofluoroolefin (HFOs), Perchloroethylene (PCE)	Worker	Inhalation			✓		✓	✓
			Worker	Dermal	✓		✓	✓	✓	✓
			ONU	Inhalation			✓		✓	✓

[3] The checkmarks indicate the type of effect and the exposure route to the population evaluated for each condition of use that supports the draft revised unreasonable risk determination for carbon tetrachloride. This table is based on Table 4-15 of this Risk Evaluation, as amended by the July 2022 errata (Ref. 8).

Life Cycle Stage	Category [a]	Subcategory [b]	Population	Exposure Route	Human Health Effects					
					Acute Non-cancer		Chronic Non-cancer		Cancer	
					High End	Central Tendency	High End	Central Tendency	High End	Central Tendency
		Reactive ion etching (i.e., semi-conductor manufacturing)[c]								
Processing	Incorporation into formulation, mixture or reaction products	Petrochemicals - derived manufacturing; Agricultural products manufacturing; Other basic organic and inorganic chemical manufacturing	Worker	Inhalation			✓		✓	✓
			Worker	Dermal	✓		✓	✓	✓	✓
			ONU	Inhalation			✓		✓	✓
Processing	Processing - Repackaging	Laboratory chemicals	Worker	Inhalation			✓		✓	✓
			Worker	Dermal	✓		✓	✓	✓	✓
			ONU	Inhalation						✓
Processing	Recycling	Recycling	Worker	Inhalation			✓		✓	✓
			Worker	Dermal	✓		✓	✓	✓	✓
			ONU	Inhalation						✓
Distribution in commerce[c]	Distribution	Distribution in commerce								
Industrial/	Petrochemicals-derived products	Processing aid	Worker	Inhalation			✓		✓	✓

Life Cycle Stage	Category [a]	Subcategory [b]	Population	Exposure Route	Human Health Effects					
					Acute Non-cancer		Chronic Non-cancer		Cancer	
					High End	Central Tendency	High End	Central Tendency	High End	Central Tendency
commercial use	and agricultural products manufacturing		Worker	Dermal	✓		✓	✓	✓	✓
			ONU	Inhalation						✓
		Additive	Worker	Inhalation			✓		✓	✓
			Worker	Dermal	✓		✓	✓	✓	✓
			ONU	Inhalation						✓
Industrial/ commercial use	Other basic organic and inorganic chemical manufacturing	Manufacturing of chlorinated compounds used in solvents for cleaning and degreasing	Worker	Inhalation			✓		✓	✓
		Manufacturing of chlorinated compounds used in adhesives and sealants	Worker	Dermal	✓		✓	✓	✓	✓
		Manufacturing of chlorinated compounds used in paints and coatings	ONU	Inhalation			✓		✓	✓
		Manufacturing of other chlorinated compounds (i.e.,								

Life Cycle Stage	Category [a]	Subcategory [b]	Population	Exposure Route	Human Health Effects					
					Acute Non-cancer		Chronic Non-cancer		Cancer	
					High End	Central Tendency	High End	Central Tendency	High End	Central Tendency
		elimination of nitrogen trichloride in the production of chlorine and caustic) Manufacturing of chlorinated compounds used in asphalt								
Industrial/commercial use	Other uses	Processing aid (i.e., metal recovery)	Worker	Inhalation			✓		✓	✓
			Worker	Dermal	✓		✓	✓	✓	✓
			ONU	Inhalation						✓
		Specialty uses (i.e., DoD uses)	Worker	Inhalation					✓	
			Worker	Dermal	✓		✓	✓	✓	✓
			ONU	Inhalation						

Life Cycle Stage	Category [a]	Subcategory [b]	Population	Exposure Route	Human Health Effects					
					Acute Non-cancer		Chronic Non-cancer		Cancer	
					High End	Central Tendency	High End	Central Tendency	High End	Central Tendency
Industrial/commercial use	Laboratory chemicals	Laboratory chemicals	Worker	Dermal	✓		✓	✓	✓	✓
Disposal	Disposal	Industrial pre-treatment Industrial wasterwater treatment Publicly owned treatment works (POTW) Underground injection Municipal landfill Hazardous landfill Other land disposal Municipal waste incinerator Hazardous waste incinerator Off-site waste transfer	Worker	Inhalation			✓		✓	✓
			Worker	Dermal	✓		✓	✓	✓	✓
			ONU	Inhalation						✓
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.										

Life Cycle Stage	Category [a]	Subcategory [b]	Population	Exposure Route	Human Health Effects					
					Acute Non-cancer		Chronic Non-cancer		Cancer	
					High End	Central Tendency	High End	Central Tendency	High End	Central Tendency

[a] These categories of conditions of use appear in the Life Cycle Diagram, reflect CDR codes, and broadly represent additional information regarding all conditions of use of carbon tetrachloride.
[b] These subcategories reflect more specific information regarding the conditions of use of carbon tetrachloride.
[c] For conditions of use that do not drive the unreasonable risk determination, EPA is not making condition-of-use-specific risk determinations and is not issuing a final order under TSCA section 6(i)(1). EPA does not consider this revised risk determination to constitute a final agency action at this point in time.

5.5 References

1. EPA Risk Evaluation for Carbon Tetrachloride. EPA Document #740-R1-8014. November 2020.

2. Executive Order 13985. Advancing Racial Equity and Support for Underserved Communities Through the Federal Government. *Federal Register* (86 FR 7009, January 25, 2021).

3. Executive Order 13990. Protecting Public Health and the Environment and Restoring Science to Tackle the Climate Crisis. *Federal Register* (86 FR 7037, of January 25, 2021).

4. Executive Order 14008. Tackling the Climate Crisis at Home and Abroad. *Federal Register* (86 FR 7619, February 1, 2021).

5. Presidential Memorandum. Memorandum on Restoring Trust in Government Through Scientific Integrity and Evidence-Based Policymaking. *Federal Register* (86 FR 8845, February 10, 2021).

6. EPA Press Release. EPA Announces Path Forward for TSCA Chemical Risk Evaluations. June 30, 2021. https://www.epa.gov/newsreleases/epa-announces-path-forward-tsca-chemical-risk-evaluations.

7. Occupational Safety and Health Administration. Permissible Exposure Limits – Annotated Tables. Accessed June 13, 2022. https://www.osha.gov/annotated-pels.

8. EPA. Correction of Dermal Acute Hazard and Risk Values in the Final Risk Evaluation for Carbon Tetrachloride. Memo. July 27, 2022. Docket EPA-HQ-OPPT-2019-0499-0064. https://www.regulations.gov/document/EPA-HQ-OPPT-2019-0499-0064.