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Draft TSCA Screening Level Approach for Assessing Ambient Air and Water Exposures to Fenceline Communities Version 1.0

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Docket

Supporting information can be found in public docket: https://www.regulations.gov/docket/EPA-HQ-OPPT-2021-0415.

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EXECUTIVE SUMMARY

Background

The United States Environmental Protection Agency (EPA) published 10 final risk evaluations between 2020 and 2021 under the Toxic Substances Control Act (TSCA) as amended by the Frank R. Lautenberg Chemical Safety for the 21st Century Act in June 2016. TSCA section 6(b)(4)(A) requires the Agency to "conduct risk evaluations…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 potentially exposed or susceptible subpopulation identified as relevant to the risk evaluation by the Administrator, under the conditions of use." However, during the course of finalizing many of these first 10 risk evaluations, a policy decision was made, at that time, for EPA's Office of Chemical Safety and Pollution Prevention (OCSPP) to not assess certain exposure pathways (including, but not limited to, ambient air, ambient water, and drinking water) that fall under the jurisdiction of other EPA-administered laws. As a result, there are instances where EPA did not evaluate potential exposures and associated potential risks to the general population or certain subsets of the general population.

What Is EPA Doing in This Work?

EPA developed a proposed screening level methodology to evaluate potential exposures and associated potential risks to human receptors in proximity to (1) facilities releasing chemicals undergoing risk evaluation under TSCA section 6 to the ambient air, and (2) waterbodies receiving facility releases (direct or indirect) of chemicals undergoing risk evaluation under TSCA section 6. EPA considers these receptors a subset of the general population and categorizes them as "fenceline communities" throughout this work. Additionally, one or more receptors comprising fenceline communities can be of any age, including reproductive age, health status, or other factors like chemical sensitivity and therefore may also be considered potentially exposed or susceptible subpopulations (PESS).[1]

For purposes of the proposed screening level methodology, EPA limits the proximity of receptors evaluated to those less than or equal to 10,000 meters from a facility releasing chemicals undergoing risk evaluation under TSCA section 6 to the ambient air. For evaluated aquatic exposure routes, proximity is limited to the extent of the identified waterbody receiving a facility discharge and therefore does not have a specific distance associated with the human receptor. Therefore, for purposes of this report, EPA is defining "fenceline communities" as follows:

> *Members of the general population that are in proximity to air emitting facilities or a receiving waterbody, and who therefore may be disproportionately exposed to a chemical undergoing risk evaluation under TSCA section (6). For the air pathway, proximity goes out to 10,000 meters from an air emitting source. For the water pathway, proximity does not refer to a specific distance measured form a receiving waterbody, but rather to those members of the general population that may interact with the receiving waterbody and thus may be exposed.*

The proposed screening level methodology, as presented in this work, will go through public and peer review (including review by the Scientific Advisory Committee on Chemicals [SACC]) for comments

[1] TSCA section 3(12) states that "*the term 'potentially exposed or susceptible subpopulation' 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.*" (15 U.S.C. §2602).

on the proposed methodology as well as recommended revisions or improvements to the methodology. Following public and peer review, EPA will review comments, recommendations, and improvements; modify the proposed screening level methodology, as appropriate, and utilize the resulting final screening level methodology as a framework to conduct screening level analyses for seven of the first 10 chemicals for which EPA published risk evaluations between 2020 and 2021, and listed in Table_ES 2, to help determine if there are potential risks to fenceline communities from the air and water pathways that were previously not assessed. Although the focus of this work is screening level analyses for seven of the first 10 chemicals for which EPA published risk evaluations between 2020 and 2021, the final screening level methodology framework can also be applied to future chemicals undergoing risk evaluation under TSCA section 6.

EPA also provides three case study chemicals in this work to illustrate the application of the proposed screening level methodology described in this document. Two case studies are provided for the air pathway screening level methodology (1-bromopropane [1-BP] and methylene chloride [MC]) and two case studies are provided for the water pathway screening level methodology (MC and n-methyl-2-pyrrolidone [NMP]). The three case studies are carried through the processes of the environmental release assessment, exposure assessment, risk calculations, and associated risk characterizations based on the proposed screening level methodologies. While all three case study chemicals are chemicals for which EPA published risk evaluations between 2020 and 2021, the results as presented in this work are not final agency actions and will not be used as presented to support risk management actions or associated rulemaking activities resulting from the published risk evaluations at this time.

Finally, EPA provides a brief description of how results from the screening level analysis may further inform or support the Agency's risk management actions and associated rulemaking outcomes under TSCA resulting from published risk evaluations for chemicals undergoing risk evaluation. The descriptions are presented as hypothetical examples in the Introduction (Section 1) only to provide insight into the next steps following completion of a screening level analysis. Although these examples describe potential risk management actions/rulemaking outcomes, neither the outcomes described in the examples, nor the results from screening level analysis, are final agency actions as presented in this work. All proposed risk management actions/rulemaking activities and supporting documentation for such actions, including any screening level analyses conducted, will go through public comment prior to finalization.

What Is EPA Not Doing in This Work?

EPA is not providing any risk conclusions related to fenceline communities for any chemical substance in this work. Similarly, EPA is not providing any risk management actions or rulemaking activities for any chemical substance in this work.

This work is intended to present a proposed methodology for conducting screening level analyses for chemicals undergoing risk evaluation under TSCA section 6. All case study chemicals included in this work are presented for illustrative purposes only to demonstrate the applicability and efficacy of the proposed methodology and do not represent final agency actions in relation to environmental release assessments, exposure assessments, or risk characterizations.

The proposed methodology presented in this work is limited to certain air and water pathways previously not assessed in published risk evaluations. This work does not include proposed methodology for other pathways previously not assessed (*e.g.*, disposal, land use, groundwater-derived drinking water sources like wells, fish consumption) in published risk evaluations. Other components of published risk evaluations including, but not limited to, hazard identification, development of hazard endpoints, and assessment of occupational exposure, ecological exposure, and consumer exposure will not be revisited as part of supplemental screening level analyses for fenceline communities.

EPA is not providing a proposed methodology for conducting screening level analyses for aggregate/cumulative exposures in this work. However, EPA believes the design of the proposed methodology presented in this work is sufficiently flexible to allow addition of expanded capacities to evaluate concepts like aggregate/cumulative exposures. Additionally, the Agency invites suggestions as part of the charge for the SACC on what such expanded capacities could look like for future risk evaluations.

EPA is not providing a proposed methodology for conducting screening level analyses to address potential environmental justice concerns in this work. Although the Agency is not conducting an environmental justice analysis of fenceline communities as part of this work, the Agency anticipates the proposed screening level methodology can serve as a baseline analysis which can identify potential environmental justice concerns and inform future environmental justice analyses that assess racial and economic disparities in risk exposure under baseline and policy scenarios. Additionally, EPA invites suggestions as part of the charge for the SACC on what such expanded capacities could look like for future risk evaluations.

Overall Approach Summary

The proposed screening level methodology presented in this work uses reasonably available data, information, and models to quantify environmental releases, evaluate exposures to fenceline communities and characterize risks associated with such releases and exposures for certain air and water pathways previously not evaluated in published risk evaluations. The overall approach for the screening level methodology is summarized in Table_ES 1 and is intended to be applied to 7 of the first 10 chemicals undergoing risk evaluation under TSCA section 6, as summarized in Table_ES 2, as well as future chemicals undergoing risk evaluation under TSCA section 6, across the conditions of use considered in the associated risk evaluations.

When assessing exposures for industrial/commercial conditions of use (COUs), EPA generally defines an occupational exposure scenario or scenarios (OES for both) to capture the basic, underlying source of exposure for a given COU. Although the proposed screening level methodology does not involve evaluation of occupational exposures, EPA carries the OES label through this work to allow categorization of multiple facilities which may be involved with a single COU. A mapping of OES to the conditions of use (COU) in published risk evaluations for the three case study chemicals is provided in Appendix E.

Overall Results Summary

EPA provides three case study chemicals (1-BP, MC, and NMP) in this work to illustrate the application of the proposed screening level methodology described in this document. The three case studies are carried through the processes of the environmental release assessment, exposure assessment, risk calculations, and associated risk characterizations based on the proposed screening level methodology. While all three case study chemicals are chemicals for which EPA published risk evaluations between 2020 and 2021, the results, as presented in this work, are not final agency actions and will not be used as presented to support risk management actions or associated rulemaking activities resulting from the published risk evaluations at this time.

The 1-BP case study presented in this work includes evaluation of 15 air pathway OES. Additional risks[2] were identified for 14 of the 15 OES and are summarized in Table_ES 3. An analysis of the water pathway for 1-BP was conducted in the published problem formulation and discussed in the published risk evaluation. To summarize, the analysis found that exposure to 1-BP via the water pathway is not expected for 1-BP due to physical-chemical and fate properties of 1-BP, along with low reported releases to water (5 lbs total in a year for all facilities). Since exposure via the water pathway is not expected for 1-BP, EPA does not intend to conduct screening level analysis of the water pathway for fenceline communities.

The MC case study presented in this work includes evaluation of 17 air pathway OES. Additional risks were identified for 8 of the 17 OES and are summarized in Table_ES 4. EPA also evaluated 13 water pathway OES for MC. Additional risk was identified for one of the 13 OES evaluated for the drinking water pathway but none for the incidental oral/dermal pathways as summarized in Table_ES 5.

The NMP case study presented in this work includes evaluation of six water pathway OES. There were no additional risks identified for any of these OES as summarized in Table_ES 6. Although this work currently does not include evaluation of the air pathway for NMP, as shown in Table_ES 2, NMP is included among the seven of the first 10 chemicals undergoing risk evaluation for which EPA will conduct a screening level analysis using the final screening level analysis framework for the air pathway.

Table_ES 1. EPA's Overall Approach for Assessing Exposures and Associated Risks for Fenceline Communities

Assessment Step	Air Pathway	Water Pathway
Release Assessment	• Use 2019 Toxics Release Inventory (TRI) Data. • Where no 2019 TRI data are available, estimate releases based on past TRI data, estimation methods used in final risk evaluations, and TRI surrogate data (TRI data from other OES).	• Use release scenarios from final risk evaluations, which incorporate direct and indirect release data from both TRI and Discharge Monitoring Report (DMR) information depending on chemical.
Exposure Assessment	• Use the American Meteorology Society/Environmental Protection Agency Regulatory Model (AERMOD) to estimate ambient air exposure concentrations for receptors at eight finite distances and one area distance out to 10,000 meters from a facility releasing the chemical evaluated to the ambient air. • When applicable, use the Indoor Environmental Concentrations in Buildings with Conditioned and	• Use modeled surface water concentrations from final risk evaluations to evaluate drinking water and incidental oral/dermal exposure; surface water concentrations were estimated using the Exposure and Fate Assessment Tool (E-FAST) 2014.

[2] Additional risks are indicated when the calculated margin of exposure (MOE) is less than the benchmark MOE for non-cancer effects or when calculated inhalation unit risks (IUR) are greater than the benchmark IUR of 1×10^{-06} for cancer effects.

Assessment Step	Air Pathway	Water Pathway
	Unconditioned Zones (IECCU) to estimate indoor air exposure concentrations for residents that live above or adjacent to a releasing facility.	
Risk Characterization	• Use human health hazard endpoints from the final risk evaluations applied to the above scenarios for a continuous-exposure basis.	

Table_ES 2. Seven of the First 10 Chemicals, and Associated Pathways, for Which EPA Intends to Conduct Screening Level Analyses

	Air Pathway	Water Pathway
Case study chemicals	• 1-Bromopropane (1-BP) • Methylene chloride (MC)	• n-Methylpyrrolidone (NMP) • Methylene chloride (MC)
Additional chemicals subject to screening level analyses	• n-Methylpyrrolidone (NMP) • Trichloroethylene (TCE) • Perchloroethylene (PCE) • Carbon tetrachloride (CTC) • 1,4-Dioxane (1,4D)	• Trichloroethylene (TCE) • Tetrachloroethylene (PCE) • Carbon tetrachloride (CTC) • (1,4-Dioxane water pathways will be examined via a separate Supplement to the published Risk Evaluation)

Table_ES 3. Summary of Additional Risks Identified for the 1-BP Air Pathway

1-BP Air Pathway OESs	Additional Risk Identified?
Manufacturing	Yes
Import	Yes
Processing-Formulation	Yes
Processing-Incorporate into Articles	Yes
Processing as Reactant	Yes
Repackaging	Yes
Degreasing	Yes
Aerosol Spray Degreaser/Cleaner	Yes
Dry-Cleaning	Yes
Spot-Cleaning/Stain Remover	Yes
Spray Adhesives	No
Other Uses – Cutting Oil	Yes
Asphalt Extraction	Yes

1-BP Air Pathway OESs	Additional Risk Identified?
Recycling and Disposal	Yes
Co-Resident Receptors (Dry-Cleaning)	Yes

Table_ES 4. Summary of Additional Risks Identified for the MC Air Pathway

MC Air Pathway OESs	Additional Risk Identified?
Manufacturing	No
Processing-Reactant	Yes
Processing-Incorporate into Formulation, Mixture, or Reaction Product	Yes
Repackaging	No
Batch Open-Top Degreasing	No
Cleaner/Degreaser-Unknown	Yes
Commercial Aerosol Products	No
Fabric Finishing	No
Spot Cleaning	No
Cellulose Triacetate Film Production	Yes
Flexible Polyurethane Foam Production	Yes
Laboratory Use	No
Plastic Product Manufacturing	Yes
Lithographic Printing Plate Cleaning	No
Miscellaneous Non-aerosol Industrial and Commercial Use	Yes
Waste Handling, Disposal, Treatment, Recycling	No
Paint Remover	Yes

Table_ES 5. Summary of Additional Risks Identified for the MC Water Pathway

MC Water Pathway OESs	Additional Risk Identified?		
	Drinking Water	Incidental Oral	Incidental Dermal
Manufacturing	No	No	No
Import and Repackaging	No	No	No

MC Water Pathway OESs	Additional Risk Identified?		
	Drinking Water	Incidental Oral	Incidental Dermal
Processing as a Reactant	No	No	No
Processing: Formulation	No	No	No
Polyurethane Foam	No	No	No
Plastics Manufacturing	No	No	No
CTA Film Manufacturing	No	No	No
Lithographic Printer Cleaner	No	No	No
Spot Cleaner	No	No	No
Recycling and Disposal	Yes	No	No
Other	No	No	No
DOD	No	No	No
WWTP	No	No	No

Table_ES 6. Summary of Additional Risks Identified for the NMP Water Pathway

NMP Water Pathway OESs	Additional Risk Identified?		
	Drinking Water	Incidental Oral	Incidental Dermal
Chemical Processing, Excluding Formulation	No	No	No
Electronics Manufacturing	No	No	No
Formulation	No	No	No
Metal Finishing	No	No	No
Disposal and Recycling	No	No	No
Cleaning	No	No	No

1 INTRODUCTION

The United States Environmental Protection Agency (EPA) published 10 risk evaluations between 2020 and 2021 under the Frank R. Lautenberg Chemical Safety for the 21st Century Act (Lautenberg Act). The Lautenberg Act amended the Toxic Substances Control Act (TSCA) in June 2016. Each of these TSCA section 6(b) risk evaluations underwent public comment and peer review (including review by the Scientific Advisory Committee on Chemicals, SACC) prior to publication. The published risk evaluations can be accessed online at Chemicals Undergoing Risk Evaluation under TSCA.

During the course of finalizing many of these first 10 risk evaluations, a policy decision was made, at that time, for EPA's Office of Chemical Safety and Pollution Prevention (OCSPP) to not assess certain exposure pathways (including, but not limited to, ambient air, ambient water, and drinking water) that fall under the jurisdiction of other EPA-administered laws. As a result, there are instances where EPA did not evaluate potential exposures and associated potential risks to the general population or certain subsets of the general population.

To examine whether the policy decision to exclude certain exposure pathways from the published risk evaluations may have caused EPA to miss potential exposures and associated potential risks from the air or water pathways, EPA developed this proposed screening level methodology to evaluate potential exposures and associated potential risks to human receptors in proximity to (1) facilities releasing chemicals undergoing risk evaluation under TSCA section 6 to the ambient air, and (2) waterbodies receiving facility releases (direct or indirect) of chemicals undergoing risk evaluation under TSCA section 6. EPA considers these receptors a subset of the general population and categorizes them as "fenceline communities" throughout this work. Additionally, one or more receptors making up fenceline communities can be of any age—including reproductive age, health status, or other factors like chemical sensitivity—therefore, they may also be considered potentially exposed or susceptible subpopulations (PESS).[3]

For purposes of the proposed screening level methodology, EPA limits the proximity of human receptors evaluated to those less than or equal to 10,000 meters from a facility releasing chemicals undergoing risk evaluation to the ambient air. This distance of 10,000 meters was selected to capture receptors nearer to releasing facilities than may otherwise be evaluated under other EPA administered laws. Additionally, professional knowledge and experience regarding exposures associated with the ambient air pathway found that typical risks frequently occur out to approximately 1,000 meters from a releasing facility and quickly decrease farther out. Although 10,000 meters is an order of magnitude farther out than where risks are expected to decrease, it provides an opportunity to verify expectations and also characterize how quickly risks decrease. For evaluated aquatic exposure routes, proximity is limited to the extent of the identified waterbody receiving a facility discharge and therefore does not have a specific distance associated with the human receptor. Therefore, for purposes of this report, EPA is defining "fenceline communities" as follows:

> *Members of the general population that are in proximity to air emitting facilities or a receiving waterbody, and who therefore may be disproportionately exposed to a chemical undergoing risk evaluation under TSCA section (6). For the air pathway, proximity goes out to 10,000 meters from an air emitting source. For the water pathway, proximity does*

[3] TSCA section 3(12) states that "*the term 'potentially exposed or susceptible subpopulation' 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.*" (15 U.S.C. §2602).

not refer to a specific distance measured form a receiving waterbody, but rather to those members of the general population that may interact with the receiving waterbody and thus may be exposed.

The Agency believes the screening level methodology presented in this work can be used to ensure potential risks to fenceline communities will not go unidentified and unaddressed for the first chemicals that underwent risk evaluations under TSCA. The Agency also believes, given the extensive unreasonable risks already identified for all of these first substances, that it is imperative the Agency address these risks via protective and expeditiously promulgated risk management rules. It is for these reasons that the Agency quickly moved to develop and release this proposed screening level methodology for public comment and peer review—the Agency believes that the law requires, and the public is entitled to, protections from the identified risks as quickly as those protections can be finalized and implemented.

The proposed screening level methodology, as presented in this work, will go through public and peer review (including review by the SACC) for comments on the proposed methodology as well as recommended revisions or improvements to the methodology. Following public and peer review, EPA will review comments, recommendations, and improvements; modify the proposed screening level methodology, as appropriate, and finalize the screening level methodology as a framework to conduct screening level analyses. The final screening level analysis methodology framework will be used to conduct screening level analyses for seven of the first 10 chemicals for which EPA published risk evaluations between 2020 and 2021, as listed in Table 1-1, to help determine if there are potential exposures and associated potential risks to fenceline communities from the air and water pathways that were previously not assessed. The final screening level analysis methodology framework can also be used for future chemicals undergoing risk evaluation under TSCA section 6.

Table 1-1. Seven of the First 10 Chemicals Undergoing Risk Evaluation and Associated Pathways for Which Supplemental Screening Level Analysis for Fenceline Communities Will Be Conducted

Chemical	Air Pathway	Water Pathway
1-Bromopropane (1-BP)	Yes	No
Methylene chloride (MC)	Yes	Yes
n-Methyl-2-pyrrolidone (NMP)	Yes	Yes
Carbon tetrachloride (CTC)	Yes	Yes
Trichloroethylene (TCE)	Yes	Yes
Tetrachloroethylene (PCE)	Yes	Yes
1,4-Dioxane (1,4D)	[Yes][a]	[Yes][a]

[a] EPA is currently pursuing a full supplemental risk evaluation for 1,4-dioxane and the components of the screening level analysis for fenceline communities may be considered for part of that full supplemental risk evaluation.

Other components of published risk evaluations including, but not limited to, hazard identification, development of hazard endpoints, and assessment of occupational exposure, ecological exposure, and consumer exposure will not be revisited as part of screening level analyses for fenceline communities. A screening level analysis for fenceline communities via the water pathway will not be conducted for 1-BP since analysis conducted during Problem Formulation indicated that exposures via drinking water and surface water are unlikely to cause human or ecological risk. This was based on a combination of 1-BP's physical-chemical and fate properties (relatively high volatility and biodegradability), minimal releases to water or wastewater treatment plants according to Toxics Release Inventory data, and a lack of reported detections in drinking water (U.S. EPA, 2020b). Lastly, this work does not include proposed methodology for other pathways previously not assessed in published risk evaluations (*e.g.*, disposal, land use, groundwater derived drinking water sources like wells, or fish consumption), aggregate/cumulative exposures, or potential environmental justice concerns to inform future environmental justice analyses that assess racial and economic disparities in exposure and associated risks. However, EPA believes the design of the proposed methodology presented in this work is flexible enough to allow addition of expanded capacities to evaluate all three of these concepts and invites suggestions as part of the charge for the SACC on what such expanded capacities could look like for future risk evaluations.

In this report, EPA proposes a screening level methodology for assessing chemical exposures to fenceline communities via the ambient air and water pathways. These methodologies are described in Section 2 and include developing release assessments, exposure assessments, risk calculations, and risk characterizations. EPA then presents three case study chemicals as illustrative examples of applying the screening level methodology. These are presented in Section 3. EPA presents two case study chemicals for the air pathway (1-BP and MC) and two case study chemicals for the water pathway (MC and NMP). While all three case study chemicals are chemicals for which EPA published risk evaluations between 2020 and 2021, the results as presented in this work are not final agency actions and will not be used as presented to support risk management actions or associated rulemaking activities resulting from the published risk evaluations at this time. The purpose of these case study chemicals is to show the application and efficacy of the proposed screening level methodology and not to support risk management actions or rulemaking.

Looking Ahead

In this sub-section, EPA provides a brief description of how results from the screening level analysis may be used to further inform or support the Agency's risk management actions and associated rulemaking outcomes under TSCA resulting from published risk evaluations for chemicals undergoing risk evaluation. The descriptions are presented as simplified hypothetical examples only to provide insight into the next steps following completion of a screening level analysis. Although these examples describe potential risk management actions/rulemaking outcomes, neither the outcomes described in these examples nor the results from screening level analysis are final agency actions as presented in this work. All proposed risk management actions/rulemaking activities and supporting documentation for such actions, including any screening level analyses conducted, will go through public comment prior to finalization.

Setting *Up* the Example: EPA finalizes the screening level methodology and uses the framework to conduct a screening level analysis for chemical XYZ, which is a chemical undergoing risk evaluation under TSCA. The published risk evaluation for Chemical XYZ includes four conditions of use (COU1, COU2, COU3, and COU4) but as published did not include the ambient air pathway or ambient water pathways in the evaluation. Preliminary risk findings indicate there is unreasonable risk for COU1 (worker exposure) and COU3 (worker and consumer exposure), but not for COU2 or COU4. Risk management actions are considering an existing chemical exposure limit for COU1 and a ban on use of chemical XYZ for COU3. Since no unreasonable risk was identified for COU2 or COU4, there is no risk management action proposed for COU2 or COU4.

Actions *Taken*: Since the published risk evaluation for Chemical XYZ did not include the ambient air or ambient water pathways, EPA conducts a screening level analysis for fenceline communities using the final screening level methodology framework and preliminary risk findings indicate there is additional unreasonable risk to fenceline communities for three of the four COUs. Unreasonable risk for COU1 occurs via the ambient air pathway only (primarily fugitive releases), unreasonable risk for COU2 occurs via the ambient water pathway only with some additional uncertainties requiring consideration, unreasonable risk for COU3 occurs via the air and water pathways based on the screening level analysis results. COU4 still has no unreasonable risk identified.

How the *Screening Level Analysis Results May Be Used* to *Further Inform Risk Management Actions*: Combining the risk findings from the published risk evaluation and screening level analysis findings the Agency has identified unreasonable risks for three of the four COUs, the Agency now has a statutory obligation to craft risk management rules to address those identified risks. Considering the risks identified for the three COUs, and the information supporting such risk findings, EPA may develop and pursue one or more of the following outcomes:

- ***OUTCOME ONE:*** No unreasonable risk was identified for COU4 in the published risk evaluation and the additional screening level analysis did not identify any unreasonable risk to fenceline communities for COU4. The Agency expeditiously proposes no restrictions on the chemical being used for COU4 as no unreasonable risk is identified or expected. The published risk evaluation and associated screening level analysis results and documentation demonstrating the findings are placed in the docket and the Agency publishes a proposed rule which will undergo public comment prior to finalization.
- ***OUTCOME TWO:*** Unreasonable risk was identified for COU3 in the published risk evaluation and the additional screening level analysis for COU3. The Agency considers the additional unreasonable risks found to fenceline communities through the screening level analysis and determines the initial thought to ban use of chemical XYZ for COU3 is further substantiated by these additional risks to fenceline communities. The Agency expeditiously proposes a ban on the chemical from use with COU3 since the proposed prohibition(s) would be expected to address all identified risks. The published risk evaluation and associated screening level analysis results and documentation demonstrating the findings are placed in the docket and the Agency publishes a proposed rule which will undergo public comment prior to finalization.
- ***OUTCOME THREE:*** Unreasonable risk was identified for COU1 (worker exposure) in the published risk evaluation and the additional screening level analysis for COU1 (fenceline communities primarily as a result of uncontrolled fugitive emissions within a workplace which may enter the ambient air through uncontrolled roof vents, open windows, or similar exit points). The Agency considers the additional unreasonable risks found through the screening level analysis as well as the fugitive nature of those releases and determines the initial thought to propose an existing chemical exposure limit within the workplace to protect the workers from the unreasonable risk may also reduce the amount of fugitive emissions available for escaping into the ambient air. The Agency expeditiously proposes a risk management rule which establishes an existing chemical exposure limit which can be met by utilizing local controls to capture releases and direct them away from the worker. This risk management rule is also expected to reduce fugitive releases to levels below which an unreasonable risk is expected. The published risk evaluation and associated screening level analysis results and documentation demonstrating the findings are placed in the docket and the Agency publishes a proposed rule which will undergo public comment prior to finalization.

- ***OUTCOME FOUR:*** As an alternative to outcome three, if the Agency concludes that the unreasonable risks identified for COU1 would be more effectively addressed by another EPA administered Federal law (the Clean Air Act [CAA] in this case), the Agency may comply with the requirements of section 9 of TSCA, which sets forth a process for referring such risk findings to be managed under another EPA administered Federal law. In the example described for outcome three, this may be a more effective outcome to pursue if COU1 tends to involve area sources (non-major sources) where the CAA has expertise with area source regulations which requires specific localized controls on certain emission sources within a source category as best management practices to minimize emissions released to the ambient air. Although such standards are not set up to address worker exposures directly, requirements like total enclosures or high capture and control efficiency requirements can reduce both worker exposures as well as total fugitive emissions released to the ambient air and therefore directly reduce both worker exposures and fenceline community exposures to levels below which unreasonable risk is expected.
- ***OUTCOME FIVE:*** Unreasonable risk was not identified for COU2 in the published risk evaluation, however, the additional screening level analysis for fenceline communities for COU2 did identify unreasonable risk to fenceline communities. The Agency recognizes the additional screening level analysis has some COU2-specific uncertainties which should be considered prior to proposing a risk management rule. The Agency determines that rather than expeditiously propose and risk management rule, additional analysis beyond the screening level analysis for fenceline communities is warranted to further substantiate the unreasonable risk finding for COU2. The Agency then undertakes additional analysis beyond the screening level analysis for fenceline communities, supplements the published risk evaluation and, depending on the outcome of the additional analysis, either retains the no unreasonable risk determination or revises the determination to unreasonable risk and then proposes a risk management rule appropriate for the final risk determination that will undergo public comment prior to finalization.

2 SCREENING METHODOLOGIES

2.1 Ambient Air Pathway

Figure 2-1 provides an overview of EPA's screening level methodology for the ambient air pathway. Where reasonably available, fugitive and stack air release data from the 2019 Toxic Release Inventory (TRI) are used to quantify environmental releases. The 2019 TRI dataset is used for the proposed screening level analysis because it is not limited to criteria pollutants or chemicals listed as Hazardous Air Pollutants like the National Emissions Inventory (NEI) and is a more recent dataset than the latest NEI (2017). While the 2019 TRI dataset is used for the proposed screening level analysis, there are uncertainties associated with the 2019 TRI dataset which may warrant use of other, or additional, datasets for more detailed analyses under TSCA or other statutory programs administered by EPA. These are discussed in the assumptions and uncertainties section for environmental releases (Section 2.4.1) and include not capturing smaller releasing facilities, location coordinates of source specific release points, or source specific stack parameters/plume characteristics. Lastly, although the 2019 TRI dataset is used for the proposed screening level analysis in this work, the proposed methodology can use one or more datasets, like TRI and NEI, or multiple years of one or more datasets, if there is added benefit to the intended outcome of the screening level analysis.

AERMOD (EPA's regulatory model for air dispersion modeling) is used to estimate ambient air concentrations and exposures to receptors at various distances from the emission source. Distances of up to 10,000 meters are evaluated to capture potential exposures and associated risks to fenceline communities. A distance of 10,000 meters is used for this screening level analysis methodology to capture receptors nearer to releasing facilities than may otherwise be evaluated under other EPA administered laws. Additionally, professional knowledge and experience regarding exposures associated with the ambient air pathway find risks frequently occur out to approximately 1,000 meters from a releasing facility and quickly decrease farther out. Although 10,000 meters is an order of magnitude farther out than where risks are expected to occur, 10,000 meters provides an opportunity to capture other factors related to potential exposure and associated potential risks via the ambient air pathway (like multiple facilities impacting a single receptor) providing flexibility for screening level analyses for future risk evaluations. Although 10,000 meters is used for the outer distance in the screening level analysis, the methodology is not limited to 10,000 meters. If risks are identified out to 10,000 meters, then additional analysis using the screening level methodology can be extended to farther distances for purposes of identifying where risks may fall below levels of concern.

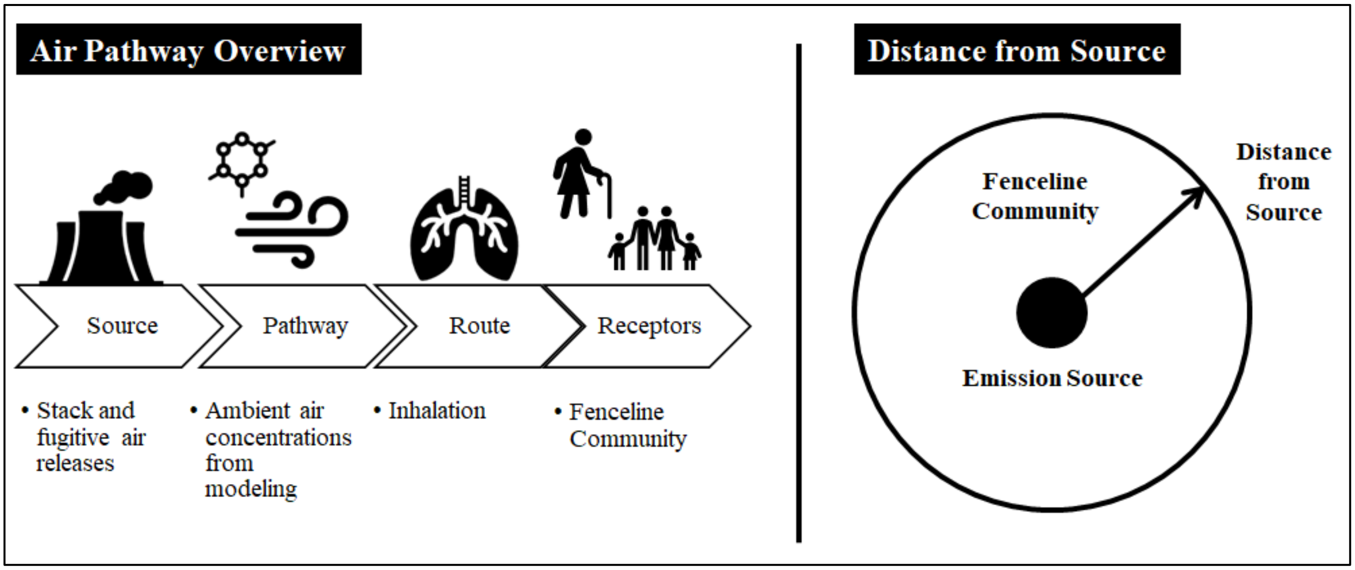

Figure 2-1. Overview of EPA's Screening Level Ambient Air Pathway Methodology

2.1.1 Environmental Air Releases

This section describes the general methodology (Figure 2-2) that was used to develop estimates of air emissions from facilities as part of EPA's screening level ambient air pathway methodology. The results of applying this methodology to 1-BP and MC are presented in Section 3 (Case Study Results).

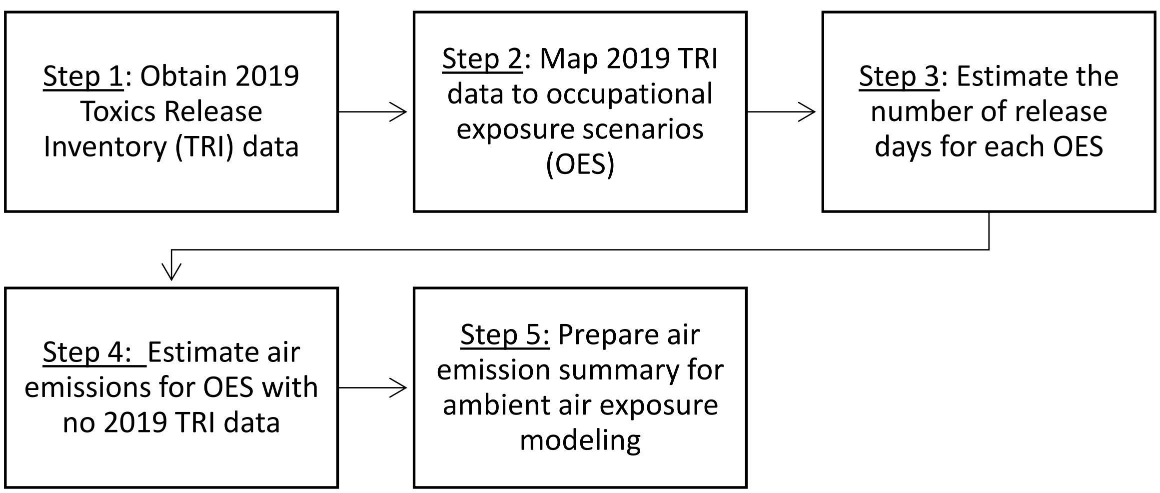

Figure 2-2. General Methodology for Estimating Air Emissions

2.1.1.1 Step 1: Obtain 2019 TRI Data

The first step in the methodology for estimating air emissions was to obtain 2019 TRI data for the chemical from EPA's Basic Plus Data Files (U.S. EPA, 2021). EPA included both TRI reporting Form R and TRI reporting Form A submissions in the fenceline analysis. Facilities may submit a Form A instead of a Form R if the amount of chemical manufactured, processed, or otherwise used does not exceed 1,000,000 pounds per year (lb/year) and the total annual reportable releases do not exceed 500 lb/year. Facilities do not need to report release quantities or uses/sub-uses on Form A. For Form A, the methodology to estimate emissions differs slightly from what is described below. Specifically, in Step 2, EPA does not have use/sub-use information for Form A submissions, so instead relies on North American Industry Classification System (NAICS) codes and facility information from internet searches to map these facilities to an OES. Additionally, for Step 5, EPA used the Form A threshold of 500 lb/year for total releases for sites that reported using a Form A. These differences are highlighted in the sections below.

2.1.1.2 Step 2: Map 2019 TRI to Occupational Exposure Scenarios

In the next step of fenceline analysis development, EPA mapped the chemical's 2019 TRI data to the OES that were in the published risk evaluation for the chemical. EPA used the following procedure to map 2019 TRI data to OES:

1. Compile TRI uses/sub-uses: EPA first compiled all the reported TRI uses/sub-uses for each facility into one column.
2. Map TRI uses/sub-uses to *Chemical Data Reporting (*CDR*)* IFC codes: EPA then mapped the TRI uses/sub-uses for each facility to one or more 2016 CDR Industrial Function Category (IFC) codes using the TRI-to-CDR Use Mapping crosswalk (see Appendix C).
3. Map OES to CDR IFC codes: EPA then mapped each Condition of Use (COU)/OES combination from the published risk evaluation to a 2016 CDR IFC code and description. The basis for this mapping was generally the COU category and subcategory from the published risk evaluation.
4. Map TRI facilities to an OES: Using the CDR IFC codes from Step 2 and the COU-CDR Mapping from Step 3, EPA mapped each TRI facility to an OES. EPA's rationale for the OES determination is generally described below.
    - In some cases, the facility mapped to only one OES and the mapping appeared to be correct given the facility name and NAICS code. For these, the OES as mapped from Steps 2 and 3 was used without adjustment.
    - In many cases, the facility mapped to multiple OES, and EPA decided which was the primary OES. To make this determination, EPA considered
        - Industry and NAICS codes;
        - Internet research of the types of products made at the facility;
        - Which OES was most likely to result in releases (*e.g.*, for a facility that reported both importation and formulation, EPA assigned the formulation COU because, in such cases, importation itself is likely to have lower releases; and
        - Grouping of like OES (*e.g.*, for facilities that reported the sub-use of cleaner or degreaser, EPA may assign the facility a grouped OES that covers both cleaning and degreasing because the specific cleaning/degreasing operation cannot be determined from the TRI data).
    - In some cases, EPA determined that the OES mapping from the TRI use/sub-use – CDR IFC code was incorrect. This incorrect mapping is a result of limitations of the TRI-to-CDR Use Mapping crosswalk. For example, the crosswalk maps the TRI use/sub-use of "Otherwise Use as Manufacturing Aid (Other)" to only CDR IFC codes U013 (closed-system functional fluids) and U023 (plating agents and surface treating agents); however, this TRI use/sub-use may encompass multiple other uses that are not captured in these CDR IFC codes. In these cases, EPA reviewed the reported NAICS codes and researched the facility to determine the likely OES.
    - Additionally, EPA reviewed 2016 CDR (U.S. EPA, 2016b) for sites that reported manufacturing (including importing) of the chemical. If the sites that reported to 2016 CDR also reported in 2019 TRI, EPA assigned the OES according to 2016 CDR.
5. Form A's: For Form A submissions, there were no reported TRI uses/sub-uses. To determine the COU for these facilities, EPA used 2016 CDR as described above, the NAICS codes, and internet searches to determine the type of products and operations at the facility.

The specific rationale for the OES mapping for each facility is broadly described in the supplemental fenceline analysis spreadsheets, *SF_FLA_Environmental Releases to Ambient Air for 1-BP* and *SF_FLA_Environmental Releases to Ambient Air for MC* (See Appendix B).

2.1.1.3 Step 3: Estimate Number of Release Days for Each OES

TRI air emissions data are provided on an annual basis, in pounds of chemical released per year via fugitive or stack emissions. However, for the exposure modeling described in Section 2.1.2, releases are needed on a daily basis. To estimate daily releases, EPA needs the number of release days for each facility. Because the number of release days is not reported in TRI, EPA used the general approach from the number of operating days in the published risk evaluations for the first 10 chemicals that were based on the following logic:

- Manufacture of solvents: 350 days/year (assumes the plant runs 7 days/week and 50 weeks/year, with two weeks down for turnaround, and assumes that the plant is always producing the chemical).
- Processing as reactant: 350 days/year (assumes chemical plant setting like manufacture of solvents and that the chemical of interest is used consistently throughout the year).
- Other Chemical Plant Scenarios: 300 days/year (based on a European Solvents Industry Group Specific Environmental Release Category factsheet that uses a default of 300 days/year for release frequency for the chemical industry, since it is unreasonable to assume the chemical of interest is always in use at the facility) (European Solvents Industry Group, 2012).
- All Other Scenarios: 250 days/year or the value cited in any relevant generic scenarios (GS) or emission scenario documents (ESD) (*e.g.*, a risk evaluation may use 260 days/year for degreasing operations per the Vapor Degreasing ESD (Organization for Economic and Development, 2017)).

This approach assumes the number of release days for a facility is equal to the estimated number of operating days for its assigned OES.

2.1.1.4 Step 4: Estimate Air Emissions for OES with No 2019 TRI Data

2019 TRI data were not available for every OES for 1-BP or MC. The hierarchy that was followed to estimate air emissions for facilities with no 2019 TRI data is presented in the decision tree diagram in Figure 2-3. As shown in the hierarchy, the first alternative approach considered was using TRI data from prior reporting years that map to the OES (only prior reporting years 2016 through 2018 were considered for this Version 1.0 screening-level approach). If no past years' TRI data were available, the next approach considered was modeling, including using any modeling already completed in the published risk evaluation or performing modeling with existing models. No new models were developed or researched for this screening-level fenceline analysis. After modeling, existing literature sources used in the published risk evaluation were considered. For example, the 1-BP fenceline analysis uses a Trinity Consultants report containing air emissions data for dry cleaning and spray adhesives, which is referenced in the systematic review supplemental file for releases and occupational exposures (Trinity Consultants, 2015).

If the published risk evaluation did not contain any literature sources with air release data, the use of 2019 TRI data for a different OES was considered as surrogate for the OES being assessed. For example, the MC fenceline analysis uses 2019 TRI data for Miscellaneous Non-aerosol Industrial and Commercial Uses as surrogate for the Adhesives and Sealants OES because these OES are expected to be similar and potentially overlap (see Section 3.2.3). Where none of the above approaches were sufficient to develop an air release assessment for an OES, additional approaches or refinements were considered, such as the use of Generic Scenarios and Emission Scenario Documents. The specific approaches used to estimate releases for each chemical's OES are discussed in the chemical-specific case studies in Section 3.

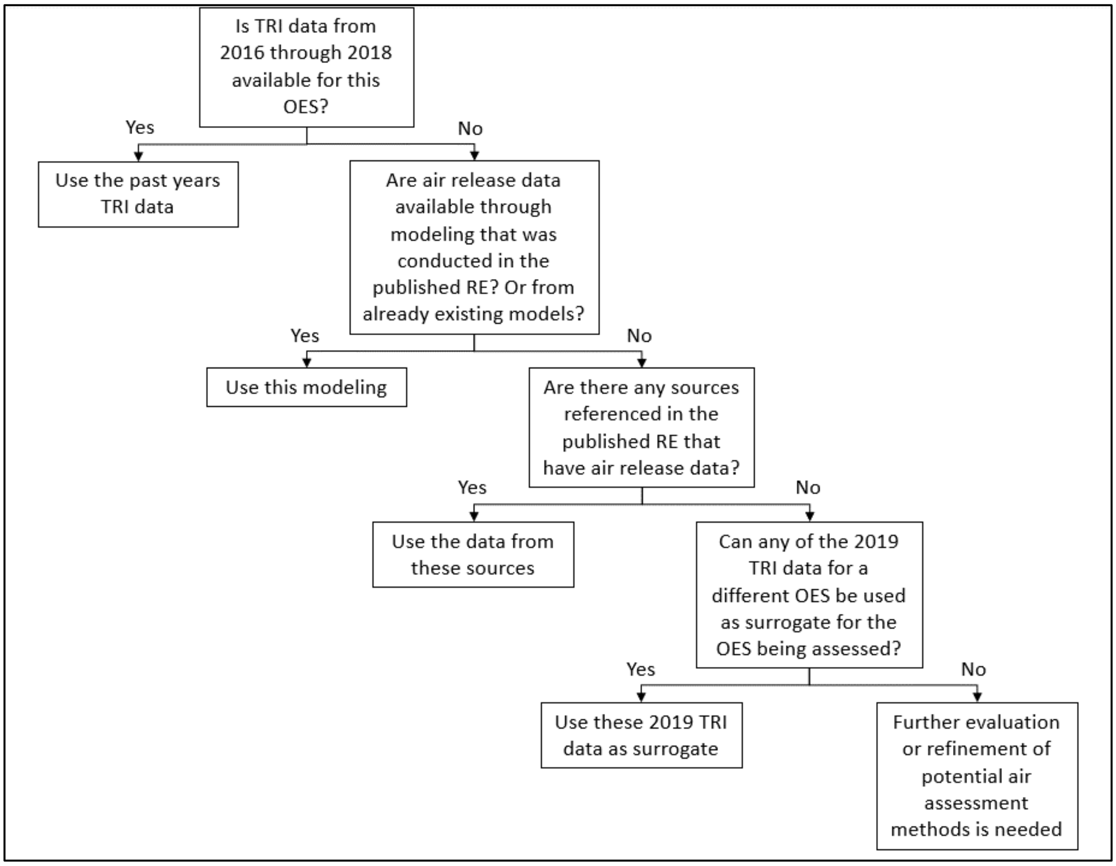

Figure 2-3. Decision Tree for Estimating Air Releases

2.1.1.5 Step 5: Prepare Air Emission Summary for Ambient Air Exposure Modeling

The final step was to prepare a summary of the fugitive and stack releases. See the supplemental files SF_FLA_*Environmental Releases to Ambient Air for 1-BP* and SF_FLA_*Environmental Releases to Ambient Air for MC* (See Appendix B) for the summaries developed for 1-BP and MC. The content of the summaries was developed to connect with the next stage of the analysis, which was the exposure modeling described in Section 2.1.2. The parameters included were selected with this next step in mind. Key parameters and their description and purpose for the exposure modeling are provided below and summarized in Table 2-1.

For each OES, EPA summarized air releases in a table containing the data elements shown in Table 2-1, with one row per site. EPA summarized site information, including site identity, city, state, zip code, TRI facility ID, and Facility Registry Service (FRS) ID because the exposure modeling is site and location specific. The summary includes the NAICS code and description and comparison to the assigned OES for the site. Next, the summary includes annual releases to stack and fugitive air. These annual releases are from 2019 TRI or from the alternative approaches discussed in Section 2.1.1.4. For these alternative approaches, where sufficient data (modeled or otherwise) were available, EPA presented the 50th and 95th percentile air emissions. Additionally, where sites reported to 2019 TRI with a Form A, EPA used the Form A threshold for total releases of 500 lb/year. EPA used the entire 500 lb/year for both the fugitive and stack air release estimates; however, since this threshold is for total site releases, these 500 lb/year are attributed either to fugitive air or stack air for this analysis, not both (since that would double count the releases and exceed the total release threshold for Form A).

As discussed in Section 2.1.1.3, the exposure modeling requires daily releases. Therefore, the summary for each site includes the estimated number of release days according to the methodology in Section 2.1.1.3 and the calculated daily fugitive and stack air releases. These daily releases were calculated by dividing the annual releases by the number of release days.

To accompany the summary table for each OES, EPA also provided any reasonably available information on the release duration and pattern, which are needed for the exposure modeling. Release duration is the expected amount of time per day during which the air releases may occur. Release pattern is the temporal variation of the air release, such as over consecutive days throughout the year, over cycles that occur intermittently throughout the year, or in a puff/instantaneous release that occurs over a short duration. The TRI dataset does not include release pattern or duration, so EPA used information from models or literature. For example, EPA presented the mean release duration from the Open-Top Vapor Degreasing Near-Field/Far-Field Inhalation Exposure Model for the cleaning/degreasing OES for both 1-BP (U.S. EPA, 2020b) and MC (U.S. EPA, 2020c). For release pattern, EPA provided the number of release days with the associated basis as described in Step 3. However, for most OES, no information was found on release duration and pattern and EPA listed these as “unknown.”

Table 2-1. Summary of Air Release Data Elements

Data Element	Data Element Description
Site Identity	Name of the facility where release occurred
City	Name of the city where the facility is located
State	State abbreviation for the state where the facility is located
Zip	Zip code for the location of the facility
TRIFID	TRI facility identification number
NAICS/SIC	Primary NAICS code for the facility
NAICS/SIC Description	Description of the industry associated with the reported primary NAICS code
Annual Fugitive Air Release (kg/site-year)	Reported or estimated annual fugitive air release from the facility
Annual Stack Air Release (kg/site-year)	Reported or estimated annual stack air release from the facility
Annual Release Days (day/year)	Estimated number of days per year the fugitive and/or stack air release occurs.
Daily Fugitive Air Release (kg/site-day)	Estimated average daily fugitive air release from the facility
Daily Stack Air Release (kg/site-day)	Estimated average daily stack air release from the facility
FRS	Facility Registry Service identification number for the facility
Sources & Notes	Identifies source of air release estimates and other key notes related to the estimates

2.1.2 Ambient Air Concentrations and Exposures

This section describes the tiered methodologies utilized to estimate ambient air concentrations and exposures for members of the general population that are in proximity (between 5 to 10,000 meters) to emissions sources emitting the chemicals being evaluated to the ambient air. All exposures were assessed for the inhalation route only. These methodologies are briefly described in Figure 2-4.

Ambient Air Pre-screening Methodology

- Methodology is independent of facility and use classifications. It is used to broadly estimate ambient air concentrations and associated exposures/risks based on maximum and mean releases to inform whether application of the full-screening methodology is warranted.

Ambient Air Full-Screening Methodology

- Methodology evaluates ambient air concentrations and associated exposures/risks resulting from facility-specific releases across multiple distances from the source.

Ambient Air Co-resident Screening Methodology

- Methodology is applied to exposure scenarios where receptors live above or adjacent to a releasing facility and is used to estimate indoor air exposures/risks associated with these facility releases. This methodology is not related to consumer or bystander exposure from use of consumer products.

Figure 2-4. Brief Description of Methodologies Used to Estimate Ambient Air Concentrations and Exposures

2.1.2.1 Ambient Air Pre-screening Methodology

The pre-screening analysis methodology was developed to identify, at a high level, if there are inhalation exposures to select receptors from a chemical undergoing risk evaluation which indicates a potential risk. Findings from the pre-screening analysis are intended to inform the need for a full-screening level analysis. If findings from the pre-screening analysis suggest there is any indication of risk (acute non-cancer, chronic non-cancer, or cancer) for a given chemical, EPA conducts a full-screening level analysis of exposures and associated risks for that chemical. If findings from the pre-screening analysis suggest there is no indication of risk for a given chemical, EPA does not expect to identify risks from a full-screening level analysis and therefore does not conduct further analysis for that chemical.

Model

The pre-screening methodology utilizes EPA's Integrated Indoor/Outdoor Air Calculator (IIOAC) model[4] to estimate high-end and central tendency (mean) exposures to select receptors at three pre-defined distances from a facility releasing a chemical to the ambient air (100, 100 to 1,000, and 1,000 meters). IIOAC is an Excel-based tool that estimates indoor and outdoor air concentrations using pre-run results from a suite of dispersion scenarios run in a variety of meteorological and land-use settings within EPA's American Meteorological Society/Environmental Protection Agency Regulatory Model (AERMOD). As such, IIOAC is limited by the parameterizations utilized for the pre-run scenarios within AERMOD (meteorologic data, stack heights, distances, receptors, etc.) and any additional or new parameterization would require revisions to the model itself. Readers can learn more about the IIOAC model, equations within the model, detailed input and output parameters, pre-defined scenarios, default values used, and supporting documentation by reviewing the IIOAC users guide (U.S. EPA, 2019c).

[4] IIOAC page: https://www.epa.gov/tsca-screening-tools/iioac-integrated-indoor-outdoor-air-calculator.

Releases

EPA modeled exposures from two categorical release values for each chemical undergoing risk evaluation under TSCA section (6). These values were extracted from 2019 TRI[5] data as follows:

1. The maximum individual facility release value for the chemical of concern among all facilities reporting to TRI.
2. The average (mean) release value for the chemical of concern across all facilities reporting to TRI.

Exposure Scenarios

EPA developed and evaluated a series of exposure scenarios for each categorical release value (max and mean) designed to capture a variety of release types, topography, meteorological conditions, and release scenarios as presented in Figure 2-5. Figure 2-5 includes a total of 16 different exposure scenarios, each of which is applied to both the maximum and mean release data resulting in a total of 32 exposure scenarios modeled for each chemical.

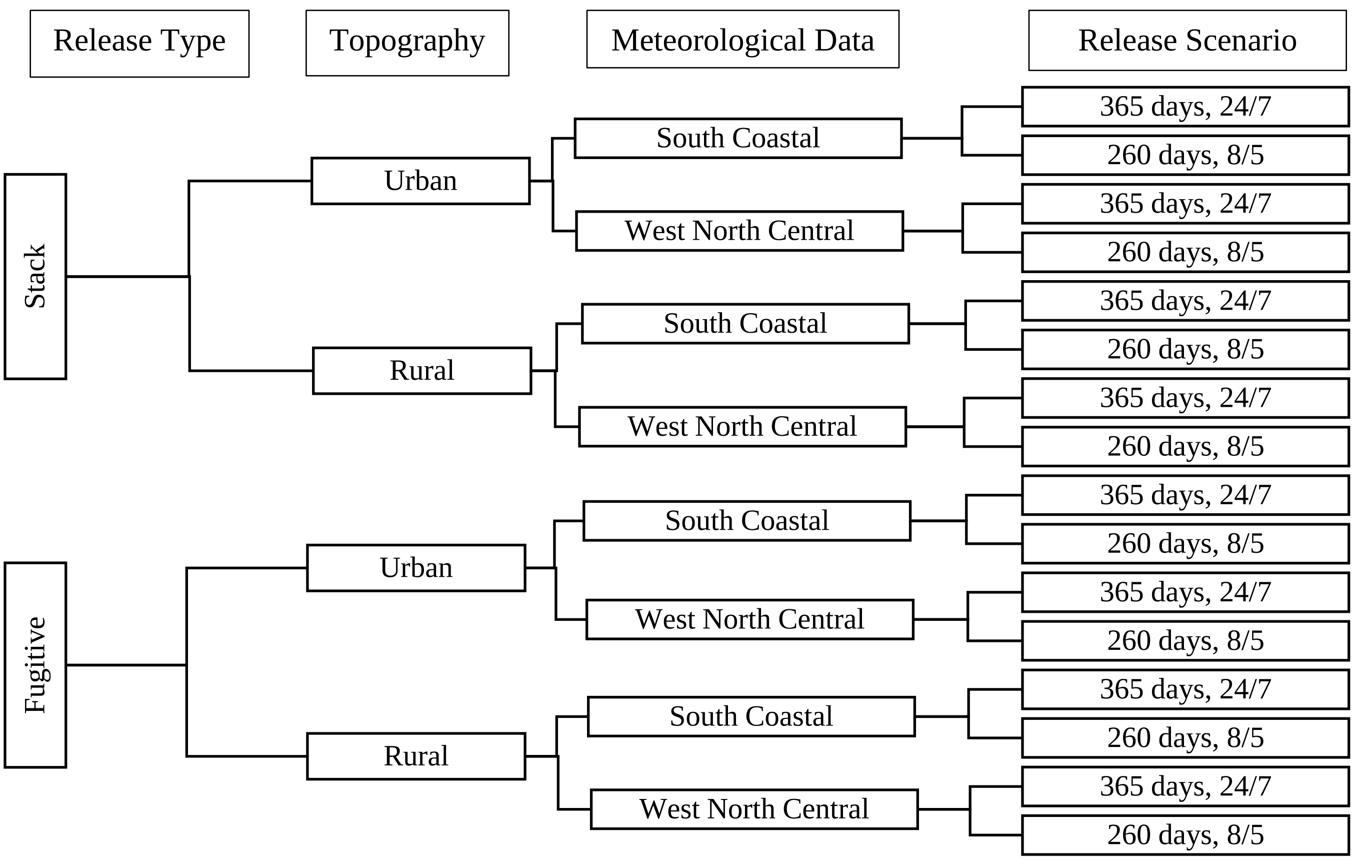

Figure 2-5. Pre-screen Exposure Scenarios Modeled for Max and Mean Release Using IIOAC Model

EPA modeled pre-screening exposure scenarios for two source types: stack (point source) and fugitive (area source) releases. These source types have different plume and dispersion characteristics accounted for differently within the IIOAC model. The topography represents an urban or rural population density and certain boundary layer effects (like heat islands in an urban setting) that can affect turbulence and resulting concentration estimates at certain times of the day.

[5] TRI page: https://www.epa.gov/toxics-releasE−inventory-tri-program.

IIOAC includes 14 pre-defined climate regions (each with a surface station and upper-air station). Since release data used for the pre-screening analysis was not facility location specific, EPA selected 2 of the 14 climate regions to represent a central tendency (West North Central) and high-end (South [Coastal]) climate region based on a sensitivity analysis of the average concentration and deposition predictions (further described in Appendix D). The meteorological stations associated with these two climate regions represent meteorological data sets that tended to provide high-end and central tendency concentration estimates relative to the other stations within IIOAC. Use of these two stations, therefore, provides high end and central tendency exposure concentrations utilized for risk calculation purposes to identify potential risks. The meteorological data within the IIOAC model are from years 2011 to 2015 as that is the meteorological data utilized in the suite of pre-run exposure scenarios during development of the IIOAC model (see IIOAC users guide (U.S. EPA, 2019c)). While this is older meteorological data, sensitivity analyses related to different years of meteorological data found that although the data does vary, the variation is minimal across years so the impacts to the model outcomes remain relatively unaffected.

The release scenarios consider two potential facility operating conditions. The first represents a facility that operates year-round (365 days per year), 24/7. The second represents a facility that operates generally on a Monday through Friday schedule (260 days per year) for 8 hours per day, 5 days per week. The difference between the two release scenarios is the resulting total daily release, frequency of release, and duration of release. These conditions result in a different exposure pattern that is captured by modeling both release scenarios. As an example, if a facility has a total annual release of 10,000 lb/year, then the daily release from a facility operating 365 days/year, 7 days per week, and 24 hours per day would be 27.4 lb per day for every day of the year over a 24-hour period. If the facility operates 260 days per year, 5 days per week, for 8 hours per day, the daily release would be 38.5 lb per day, but only Monday through Friday and over an 8-hour period.

Exposure Results and Risks

Modeled exposure concentration results from the pre-screening modeling effort were reviewed and summarized for each scenario modeled. To ensure potential risks were not missed, EPA maintained a conservative approach for the pre-screening analysis by selecting the highest estimated exposure concentrations from the 32 scenarios modeled for each chemical. These values were used for the risk calculations to estimate the Margin of Exposure (MOE) and excess cancer risk for comparison to the equivalent human health endpoints and benchmark values within the respective published final risk evaluations. The calculated risks were then compared to the benchmark values for the respective chemical to identify if there was an indication of potential added risk for either or both acute and chronic non-cancer effects (calculated MOE below the benchmark MOE for the specific chemical) or if there was an indication of potential excess risk for cancer (calculated values greater than the benchmark of 1×10^{6} for general population).

Chemical specific details and associated results of the pre-screening effort are provided in Appendix D.

2.1.2.2 Ambient Air Full-Screening Methodology

The full-screening methodology was developed to allow EPA to conduct a full-screening level analysis of releases, exposures, and associated risks to fenceline communities for chemicals undergoing risk evaluation when the pre-screening analysis identifies potential exposure and associated risk(s) to the select receptors. The full-screening methodology can be performed independent of the pre-screening analysis, provides a more thorough analysis, and allows EPA to fully characterize identified risks for chemicals undergoing risk evaluation.

Model

The full-screening methodology utilizes AERMOD[6] to estimate exposures to fenceline communities at user defined distances from a facility releasing a chemical undergoing risk evaluation. AERMOD is a steady-state Gaussian plume dispersion model that incorporates air dispersion based on planetary boundary layer turbulence structure and scaling concepts, including treatment of both surface and elevated sources and both simple and complex terrain. AERMOD can incorporate a variety of emission source characteristics, chemical deposition properties, complex terrain, and site-specific hourly meteorology to estimate air concentrations and deposition amounts at user-specified receptor distances and at a variety of averaging times. Readers can learn more about AERMOD, equations within the model, detailed input and output parameters, and supporting documentation by reviewing the AERMOD users guide (U.S. EPA, 2018).

Releases

EPA modeled exposures using the release data developed as described in Section 2.1.1 and summarized below. Release data was provided (and modeled) on a facility-by-facility basis:

1. Facility specific chemical releases (fugitive and stack releases) as reported to the 2019 TRI, where available.
2. Alternative release estimates as described in the decision tree for estimating air releases (Figure 2-3) where facility specific 2019 TRI data were not available. Alternative release estimates may include facility specific releases reported in previous TRI reporting years (2016 to 2018) or modeled release estimates using existing EPA models or other surrogate data.

Exposure Scenarios

EPA modeled exposure concentrations on a facility-by-facility basis, building out a series of facility specific exposure scenarios based on the release data provided as described in Section 2.1.1. EPA modeled exposure concentrations at 8 finite distances from a releasing facility (5, 10, 30, 60, 100, 2,500, 5,000 and 10,000 meters) and one area distance from a releasing facility (100-1,000 meters) in a series of concentric rings around the facility. Since these are radial distances from a releasing facility, the resulting diameter of distances evaluated is two times the distances evaluated.

For TRI reporting facilities, EPA used facility specific information extracted from TRI or provided as part of the release assessment to inform the exposure scenario(s) for a given facility including, but not limited to: facility names, locations, identifier codes, annual air releases (stratified by fugitive and stack), and descriptions of intraday and inter-day air-release patterns. Where surrogate data or estimated releases were provided, EPA followed a similar scenario development scheme as used for the pre-screen work described in Section 2.1.2.1. One difference, however, is EPA modeled a single facility specific operating condition, based on assumptions used in the release assessment, to estimate exposures in the full-screening level analysis rather than the two operating conditions presented in Section 2.1.2.1 (24/7 and 8/5).

Facility coordinates, in the form of latitude/longitude coordinates, were used to match the facility to the closest available meteorological station. For facilities reporting to the 2019 TRI, latitude/longitude coordinates were provided as part of the release assessment as extracted from TRI. For a limited number of facilities where earlier TRI reporting years were used to estimate releases, the TRI system[7] was queried to obtain latitude/longitude coordinates for the surrogate data. Where data were not in the TRI, but EPA estimated releases from a surrogate facility with a city location, the latitude/longitude coordinates were set near the center of the city in which the facility was located. Where data were not in

[6] See AERMOD for further information.
[7] Toxics Release Inventory search page: https://www.epa.gov/enviro/tri-search.

TRI or based on a city location, EPA was unable to identify and apply latitude/longitude coordinates and instead used the meteorological data applied for the pre-screen work (West North Central and South (Coastal) regional meteorologic stations from IIOAC) and described in Section 2.1.2.1.

Meteorological data for TRI reporting facilities was obtained using the same AERMOD-ready meteorological data that EPA's Risk and Technology Review (RTR) program uses for multimedia, multipathway-risk modeling in review of National Emission Standards for Hazardous Air Pollutants (NESHAP).[8] These data cover 824 hourly stations in the 50 states, District of Columbia, and Puerto Rico. The data are for year 2016. While this is older meteorologic data, sensitivity analyses related to different years of meteorological data found that although the data does vary, the variation is minimal across years so the impacts to the model outcomes remain relatively unaffected.

All meteorologic data was processed with version 16216 of AERMOD's meteorological preprocessor (AERMET).[9] [10] Following EPA guidance,[11] all processing utilized sub-hourly wind measurements (to calculate hourly-averaged wind speed and wind direction; see Section 8.4.2 of that guidance). The processing for the 2016 data also used the "ADJ_U*" option for mitigating modeling issues during light-wind, stable conditions. All processing also used automatic substitutions for small gaps in data for cloud cover and temperature.

Meteorological data for EPA estimated releases (where TRI or city data were not available) were modeled with the two meteorological stations utilized in the pre-screen methodology (Sioux Falls, SD, and Lake Charles, LA). These two meteorological stations represent meteorological data sets that tended to provide high-end and central tendency concentration estimates relative to the other stations within IIOAC based on a sensitivity analysis of the average concentration and deposition predictions (further described in Appendix D) conducted in support of IIOAC development. Use of these two stations, therefore, provides high end and central tendency exposure concentrations utilized for risk calculation purposes to identify potential risks. The "ADJ_U*" option was not used for the 2011 to 2015 data, which could lead to model overpredictions of ambient concentrations during those particular conditions.

Urban/rural designations of the area around a facility are relevant when considering possible boundary layer effects on concentrations. Air emissions taking place in an urbanized area are subject to the effects of urban heat islands, particularly at night. When sources are set as urban in AERMOD, the model will modify the boundary layer to enhance nighttime turbulence, often leading to higher nighttime air concentrations. AERMOD uses urban-area population as a proxy for the intensity of this effect.

EPA utilized a population density analysis to identify facilities warranting an urban designation for the AERMOD runs. Specifically, EPA considered a facility to be in an urban area if it had a population density greater than 750 people per square kilometer (km^2) within a 3-km radius of the facility (see Section 7.2.1.1 of the guidance referenced in footnote 11) and set the relevant inputs to urban within AERMOD. However, as noted in the EPA guidance referenced in footnote 11, the population-density analysis can be misleading for facilities in an industrial park within a city, facilities that border a water body or some other unpopulated area, etc. Recognizing this limitation can result in situations where the

[8] RTR page: https://www.epa.gov/stationary-sources-air-pollution/risk-and-technology-review-national-emissions-standards-hazardous.

[9] See AERMET for further information.

[10] Note: The RTR program's inhalation-risk modeling now uses data mostly from year 2019 and a more updated version of AERMET (see the HEM4 User's Guide). However, EPA does not anticipate the modeling used here to be sensitive to these differences.

[11] See EPA Guideline on Air Quality Models.

facility site likely is influenced by urban heat island effects but the population density within 3 km is below 750 people per km^2, EPA conducted a brief visual examination of the region around the facility, using aerial imagery, to identify any facility within or on the edge of an urban domain but where a substantial portion of the 3-km radius around the facility had low population counts. Facilities meeting these visual conditions were also given an urban designation for modeling purposes.

For facilities set for urban modeling, AERMOD requires an estimate of the urban population count. EPA estimated the urban-area population by identifying a proxy for the area of urbanization. The urban-area proxy was the largest radius around the facility (out to a limit of 15 km) having a population density greater than 750 people per km^2 and identified the population within that radius and applied it for modeling purposes. EPA used U.S. Census data at the level of block groups for these analyses (with geographies from the 2019 census TIGER/Line shapefiles[12] and population counts from the American Community Survey[13] 2015 to 2019 5-year estimates-detailed tables (table B01003)).

Where TRI or city data were not available for a facility requiring modeling, there was no way for EPA to determine an appropriate urban or rural designation. Instead, EPA modeled each such facility once as urban and once as not urban.[14] There is no recommended default urban population for AERMOD modeling, so for these facilities EPA assumed an urban population of 1 million people, which is consistent with the estimated populations used with IIOAC. Although slightly higher, the assumed urban population is close to the average of all the urban populations used for the TRI reporting facilities (which was 847,906 people).

Source-specific physical characteristics like actual release location, stack height, exit gas temperature, etc. are generally not reported as part of the TRI dataset but can affect the plume characteristics and associated dispersion of the plume. For the release location, EPA used a local-coordinate system. EPA centered a facility's emissions on one location which was assigned the local coordinate of (0,0) and concentrations were estimated at modeled distances in concentric rings from that one location.

EPA used physical stack parameters and plume characteristics consistent with those used in IIOAC, including, but not limited to: stack emissions released from a point source at 10 meters above ground from a 2-m inside diameter stack, with an exit gas temperature of 300 °Kelvin and an exit gas velocity of 5 m per second (see Table 6 of the IIOAC User Guide). EPA acknowledges these stack parameters represent conservative plume characteristics which resemble a slow-moving, low-to-the-ground plume with limited dispersion but believe are appropriate for screening level purposes.

Fugitive emissions were modeled using a release height of 3.05 m above ground from a square area source 10 m on a side (see Table 7 of the IIOAC User Guide). These parameters are also conservative in that they represent fugitive sources relatively low to the ground with no buoyancy or momentum to the emissions. Additionally, because we modeled fugitive sources centered at (0,0) and 10 m on a side (*i.e.*, extending out 5 m to the north, south, east, and west from the facility center point, and extending out about 7.1 m to the northeast, southeast, southwest, and northwest), all of the modeled exposure concentrations at the 5-m ring distance will be either directly on the edge of the fugitive source or "on

[12] 2019 census TIGER/Line shapefiles page: https://www.census.gov/geographies/mapping-files/timE−series/geo/tiger-linE−file.2019.html.
[13] American Community Survey page: https://www.census.gov/programs-surveys/acs.
[14] While this may be viewed as a potential double counting of these releases, EPA only utilized the highest estimated releases from a single exposure scenario from the suite of exposure scenarios modeled for surrogate/estimated facility releases as exposure estimates and for associated risk calculations.

top of" the fugitive source. All other modeled concentrations for fugitive sources will be well outside the fugitive source.

Temporal emission patterns are another factor that can affect the overall modeled concentration estimates. The release assessments for this work included information on temporal emission patterns—release duration (across the hours of a day, or intraday) and release pattern (across the days of a year, or inter-day)—stratified by OES. When release duration was "unknown," EPA assumed releases occurred each hour of the day. When release duration or release pattern was described as a distribution, EPA used the stated mean of that distribution, and when they were fractional values EPA rounded to the nearest integer.

EPA's assumptions for intraday release duration are provided in Table 2-2. The hours shown conform to AERMOD's notation scheme of using hours 1 to 24, where hour 1 is the hour ending at 1 a.m. and hour 24 is the final hour of the same day ending at midnight.

Table 2-2. Assumptions for Intraday Emission-Release Duration

Hours per Day of Emissions	Assumed Hours of the Day Emitting (Inclusive)
Unknown	All (hours 1–24)
1	Hour 13 (hour ending at 1 p.m.; *i.e.*, 12 to 1 p.m.)
3	Hours 13–15 (hour ending at 1 p.m. through hour ending at 3 p.m.; *i.e.*, 12 to 3 p.m.)
4	Hours 13–16 (hour ending at 1 p.m. through hour ending at 4 p.m.; *i.e.*, 12 to 4 p.m.)
8	Hours 9–16 (hour ending at 9 a.m. through hour ending at 4 p.m.; *i.e.*, 8 a.m.to 4 p.m.)
12	Hours 9–20 (hour ending at 9 a.m. through hour ending at 8 p.m.; *i.e.*, 8 a.m.to 8 p.m.)
14	Hours 7–20 (hour ending at 7 a.m. through hour ending at 8 p.m.; *i.e.*, 6 a.m.to 8 p.m.)

EPA's assumptions for inter-day release pattern are provided in Table 2-3. EPA started with the assumption that emissions took place every day of the year. Next, EPA turned emissions off for certain days of the year as needed to achieve the desired number of emission days: assumptions such as no emissions on Saturday and Sunday, no emissions on the days around New Year's Day, no emissions at regular patterns like the first Monday of every month, and so on. EPA developed these patterns for the TRI reporting facilities, and then adjusted the patterns as needed for facilities where no TRI or city data were available (years 2011 to 2015), since the number of Mondays, Saturdays, etc., in the year varies year-by-year.

Table 2-3. Assumptions for Inter-day Emission-Release Pattern

Provided Language for Release Pattern	Implemented Release Pattern: Days When Emissions Are on (Format of Month Number/Day Number)	
	Real Facilities (Year 2016)	**Generic Facilities (Years 2011–2015)**
Release pattern: unknown; **350 days/yr** is based on the assumption of operations over **7 days/wk and 50 wk/yr**.	All days except 1/1–1/5 and 12/21–12/31	Not applicable
Release pattern: unknown; **300 days/yr** is based on the assumption of operations over **7 days/wk over some portion of the year** since the chemical may not be processed throughout the entire year.	All days except 12/26–12/31 and the first 5 days of each month	Not applicable
Release pattern: unknown; The Brake Servicing Model estimates 260 to 364 days/yr with a mean of **291 days/yr**; Use of aerosol degreasers is expected to be intermittent throughout the year; Aerosol degreasing is expected to be **intermittent throughout the day, week, and year**.	Not applicable	All Mon.–Sat. except 1/1–1/5, 12/21–12/31, the first Mon. of Feb.–Sep. (and Oct. but only for 2012 and 2014)
Release pattern: unknown; The Dry Cleaning Model calculates a mean of **287 days/yr** using a triangular distribution of low-end 250 days/yr (5 day/wk and 50 wk/yr), high-end 312 days/yr (6 day/wk and 52 wk/yr), and mode 300 days/yr (6 day/wk and 50 wk/yr)	All Mon.–Sat. except 1/1–1/5, 12/21–12/31, the first Mon. of Feb.–Dec., and the first Tue. of Feb.–Mar.	All Mon.–Sat. except 1/1–1/5, 12/21–12/31, the first Mon. of Feb.–Dec., and the first Tue. of Feb. (and Mar. but only for 2012 and 2014)
Release pattern: unknown; The Spot Cleaning Model calculates a mean of **287 days/yr** using a triangular distribution of low-end 250 days/yr (5 day/wk and 50 wk/yr), high-end 312 days/yr (6 day/wk and 52 wk/yr), and mode 300 days/yr (6 day/wk and 50 wk/yr); Spot cleaning is expected to be **intermittent throughout the day, week, and year**	Not applicable	All Mon.–Sat. except 1/1–1/5, 12/21–12/31, the first Mon. of Feb.–Dec., and the first Tue. of Feb. (and Mar. but only for 2012 and 2014)
Release pattern: unknown; **260 days/yr** is from the Vapor Degreasing ESD, which is based on 2011 NEI data, and is the median for OTVDs	All Mon.–Fri. except 1/1	Not applicable
Release pattern: unknown; **260 days/yr** based on **5 days/wk and 52 wk/yr**	All Mon.–Fri. except 1/1	Not applicable
Release pattern: unknown; **250 days/yr** is based on the assumption of operations over **5 days/wk and 50 wk/yr**.	All Mon.–Fri. except 1/1–1/5 and 12/21–12/31	Not applicable

Note: Some of the “Provided Language for Release Pattern” is specific to an OES.
yr = year; wk = week; Mon. = Monday; Sat. = Saturday; Feb. = February; Sep. = September; Oct. = October; Dec. = December; Tue. = Tuesday; Mar. = March.

The release assessments included emission rates for each facility in kilograms per site per year, for fugitive and stack sources as appropriate. In most cases, one emission rate was included per source type per facility (*i.e.*, one rate for fugitive emissions, one rate for stack emissions), though in some cases, where releases were estimated, releases were provided as a range of values. The ranges of values typically were a central tendency and a 95th percentile or higher-end value. In some cases, both a mean and a 50th percentile value was provided (mean being an arithmetic mean value and the 50th percentile being a median value). Typically, the mean and 50th percentile releases were similar, so EPA used the 50th-percentile value and excluded the mean value for modeling purposes. Central tendency and high-end emission scenarios were modeled separately.

Some TRI reporting facilities had emissions lower than the required reporting thresholds for TRI and reported emissions using TRI's "Form A." These forms have a reporting threshold of 500 lb/year of total facility releases and were included in the release assessments as the release rate for both fugitive and stack sources. Since fugitive and stack releases are modeled differently within AERMOD (point source vs area source), and there was no way to parse out the total release across fugitive and stack releases, Form A reported releases were modeled as two different scenarios, one where the 500 lb of total releases were all fugitive releases (with no stack emissions) and another where the 500 lb of the total releases were all stack releases (with no fugitive emissions).[15]

Emission rates included in the release assessments were converted to units needed by AERMOD (grams per second for stack sources; grams per second per square meter (m^2) for fugitive sources). The conversion from per-hour to per-second utilized the number of emitting hours per year based on the assumed temporal release patterns. The area of fugitive sources was 100 m^2.

All modeling scenarios utilized a region of gridded receptors placed around a ring/radial at varying distances from the facility being modeled. Receptors were placed every 22.5 degrees (starting due north of the facility) around each ring resulting in 16 receptors around each ring as shown in Figure 2-6.

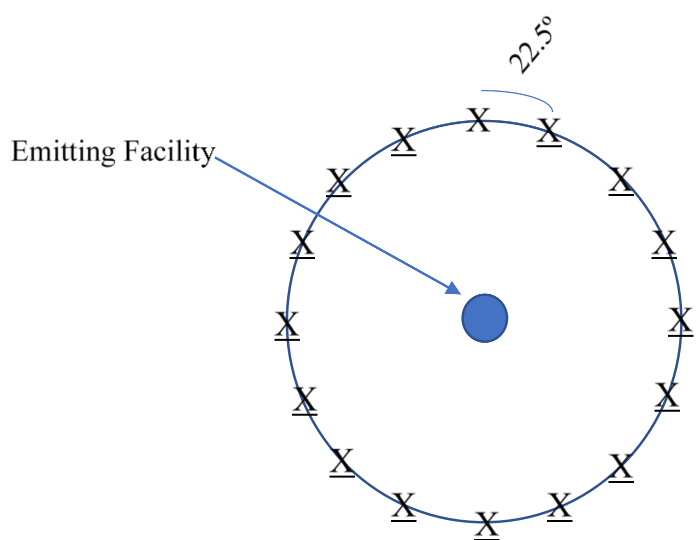

Figure 2-6. Receptor Locations around Each Distance Ring

[15] Although this may be viewed as a potential double counting of these releases, EPA utilized only the highest estimated releases from a single exposure scenario from the suite of exposure scenarios modeled for surrogate/estimated facility releases as exposure estimates and for associated risk calculations.

Rings were placed at eight finite distances from a facility (5, 10, 30, 60, 100, 2,500, 5,000, and 10,000 meters) forming concentric circles around a modeled facility. One additional distance was modeled to cover an “area” of receptors between 100 and 1,000 meters from a facility. These can be seen in **Figure** 2-7**.**

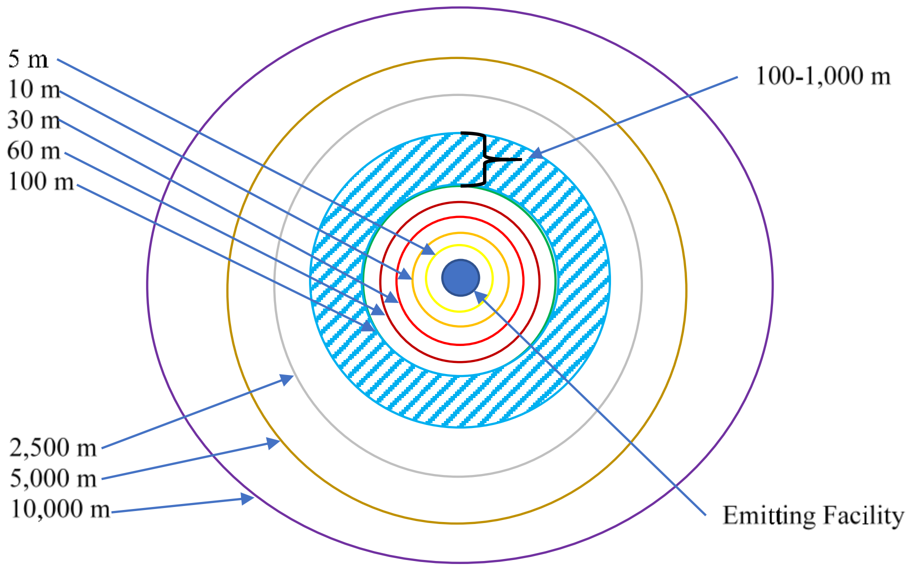

Figure 2-7. Modeled Distances from Facility

For the “area” of receptors, receptors were regularly spaced at 100-m intervals every 22.5 degrees in all directions within the area between 100 m and 1,000 m from the facility, which is necessary to average the modeled concentrations across the area. This can be seen in Figure 2-8.

All receptors were set at 1.8 m above ground, as a proxy for breathing height of an average receptor. EPA assumed flat terrain for all modeling scenarios and used a local-coordinate system centered at (0, 0) for the source of the release. Although AERMOD is capable of modeling elevations for source locations and receptor locations, a flat terrain was modeled for simplicity and the absence of reasonably available information on elevation data for sources and receptors modeled for purposes the screening level analysis.

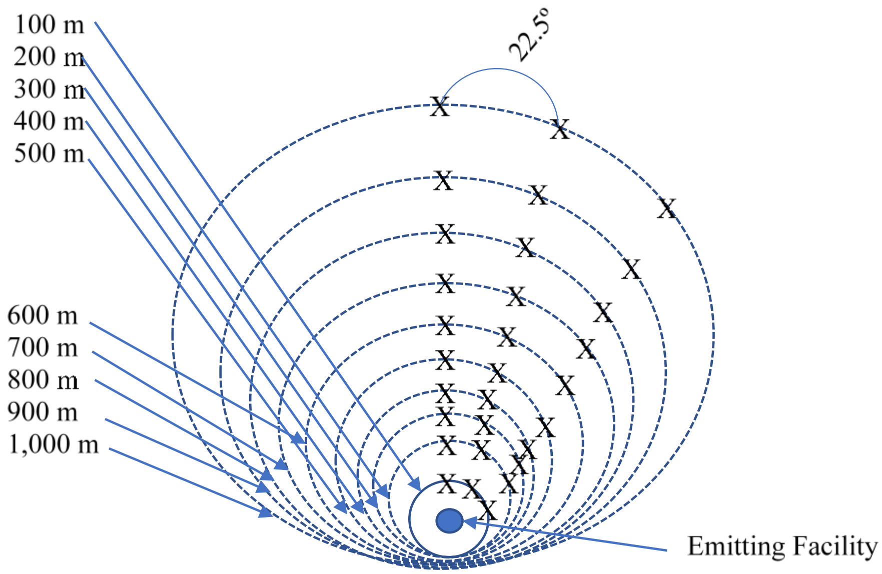

Figure 2-8. Receptor Locations between 100 and 1,000 m

Exposure Concentration Outputs

Daily- and period-average outputs were provided for every run for each receptor around the ring (each of 16 receptors around a ring or within the 100 to 1,000 meters area distance scenario). Period averages were 1 year for TRI reporting facilities and 5 years for facilities where releases were estimated. Outputs were stratified by different source scenarios, such as urban/not urban setting or emission-strengths where needed. Outputs from AERMOD are provided in units of micrograms per cubic meter ($\mu g/m^3$) requiring conversion to parts per million (ppm) for purposes of risk calculations and comparison to applicable health endpoints for this work. The following formula was used for this conversion:

$$C_{ppm} = (24.45*(C_{AERMOD})/1,000)/MW$$

Where:

C_{ppm} = Concentration (ppm),
24.45 = molar volume of a gas at 25 °C and 1 atmosphere pressure,
C_{AERMOD} = Concentration from AERMOD ($\mu g/m^3$), and
MW = Molecular weight of the chemical of interest (g/mole).

Post-processing scripts were used to extract and summarize the output concentrations at each facility and for each meteorological or source scenario. The following statistics for daily- and period-average concentrations at each of the receptor groups (*i.e.*, each ring and grid of receptors) were extracted or calculated from the results (also see Table 2-4):

- Minimum
- Maximum
- Average
- Standard deviation
- 10th, 25th, 50th, 75th, and 95th percentiles

AERMOD provides daily-average concentrations for each day of the modeled year for each receptor around a ring at each distance modeled. For TRI reporting facilities (which used 2016 calendar year meteorological data), this results in one daily average concentration for each of 366 days for a total of

366 values at each receptor. For EPA estimated releases (which used 2011 to 2015 meteorological data), this results in 5 daily average concentrations (for each year of meteorological data) for each of 365 (or 366) days for a total of 1,826 values at each receptor. AERMOD also provides a period-average concentration at each of the 16 receptors placed around the ring of a given modeled distance. This results in a total of 16 values for each ring derived from either averaging the daily averages across the single year of meteorological data used (2016) for TRI reporting facilities or across the multi-year meteorological data used (2011 to 2015) for EPA estimated releases.

Table 2-4. Description of Daily or Period Average and Air Concentration Statistics

Statistic	Description
Minimum	The minimum daily or period average concentration estimated at any receptor location on any day at the modeled distance.
Maximum	The maximum daily or period average concentration estimated at any receptor location on any day at the modeled distance.
Average	Arithmetic mean of all daily or period average concentrations estimated at all receptor locations on all days at the modeled distance. This incorporates lower values (from days when the receptor location largely was upwind from the facility) and higher values (from days when the receptor location largely was downwind from the facility).
Percentiles	The daily or period average concentration estimate representing the numerical percentile value across the entire distribution of all concentrations at all receptor locations on any day at the modeled distance. The 50th percentile represents the median of the daily or period average concentration across all concentration values for all receptor locations on any day at the modeled distance.

Exposure Results and Risks

Modeled exposure concentration results from the full-screening level analysis were reviewed and summarized on a facility-by-facility basis (and each alternative release estimate) for each scenario modeled. EPA used the 10th, 50th, and 95th percentile estimated concentrations for each facility (and each alternative release estimate) at each distance evaluated for risk calculation purposes. Risk calculations were used to estimate the MOE and excess cancer risk for comparison to the equivalent human health endpoints and benchmark values presented within the respective published final risk evaluations.

Land Use Considerations

EPA conducted a review of land use patterns around facilities where there was an indication of risk. This review was limited to those facilities with real Global Information System (GIS) locations that showed risk and did not include alternative release estimates showing risk. The purpose of this review was to determine if EPA can reasonably expect an exposure to fenceline communities to occur within the modeled distances where there was an indication of risk. This detailed review consisted of visual analysis using aerial imagery and interpreting land use/zoning practices around the facility. More specifically, EPA used ESRI ArcGIS (Version 10.8) and Google maps to characterize land use patterns within the radial distances evaluated in this work where there was an indication of risk. For locations where residential or industrial/commercial businesses or other public spaces are present within those radial distances indicating risk, EPA includes those receptors within the fenceline communities category and reasonably expects an exposure and therefore an associated potential risk. Where the radial distances showing an indication of risk occur within the boundaries of the facility or is limited to uninhabited areas, EPA does not reasonably expect an exposure to fenceline communities to occur and therefore does not expect an associated risk.

Case Studies

Chemical specific details and associated results of EPA's application of this full screening methodology for 1-BP and MC are provided in Sections 3.1.4 and 3.2.4. Risk calculations and associated risk findings for 1-BP and MC are provided in Sections 3.1.5 and 3.2.5.

2.1.2.3 Ambient Air Co-resident Screening Methodology

The co-resident screening methodology was developed to allow EPA to evaluate exposures and associated risks to a specific subset of receptors falling under the fenceline community category living above or directly adjacent to a facility releasing a chemical undergoing risk evaluation under case-specific exposure scenarios and are referred to as co-resident receptors. Although this methodology can be applied for any chemical falling under an appropriate case-specific exposure scenario, in this report it is only applied to 1-BP. The exposure scenarios addressed in this report are chemical-specific releases from dry-cleaning facilities and effects on co-resident receptors. For purposes of this report, co-resident receptors are defined as a person who lives above or directly adjacent to a dry-cleaning facility utilizing the chemical undergoing risk evaluation.

The objectives of this co-resident screening methodology are to (1) develop an approach to estimate air concentrations and exposures to co-resident receptors for the dry-cleaning condition of use; (2) estimate the interzonal air flow—a key parameter for contaminant transport from the source zone to the living spaces—by using the value calibrated against field monitoring data from the literature and other methods applicable to the co-resident exposure scenarios; and (3) develop high-end and central tendency estimates of air concentrations and exposures to co-resident receptors for acute and chronic scenarios.

A deterministic indoor air quality model was used to predict chemical transport from the dry-cleaning facilities to the co-resident spaces followed by calculation of the 8-hr, 24-hr, 7-day, and annual time-weighted average (TWA) concentrations in the living space. The unadjusted and adjusted TWA concentrations were then used to calculate potential acute, chronic, and lifetime doses, and potential risks.

Model

The co-resident screening methodology uses EPA's Indoor Environment Concentration in Buildings with Conditioned and Unconditioned Zones (IECCU) model. IECCU is a deterministic model which can be used as (1) a general-purpose indoor exposure model in buildings with multiple zones, multiple chemicals and multiple sources and sinks or (2) as a special-purpose concentration model for simulating the effects of sources in unconditioned zones on the indoor environmental concentrations in conditioned zones. Readers can learn more about the IECCU model, equations within the model, detailed input and output parameters, and supporting documentation by reviewing the IIOAC users guide (U.S. EPA, 2019a).

Releases

The emission rates for dry-cleaning operations were generated using EPA's dry-cleaning model (sections 2.3.1.16 and 4.3.1.6 of the *Risk Evaluation for 1-Bromopropane*). The data set contains nine emission scenarios, representing a variety of operational scales and conditions. The co-resident screening methodology for this work considered both dry-cleaning and spot cleaning operations, as applicable for the chemical undergoing risk evaluation.

Exposure Scenarios

IECCU was used to predict the concentrations in the co-resident space, as illustrated in Figure 2-9. The model assumes the dry-cleaning shop and the co-resident space are two air zones, the air is well mixed within each zone, and the contaminated indoor air in the dry-cleaning facility can be transported to the co-resident space by the interzonal air flow Q_{12}.

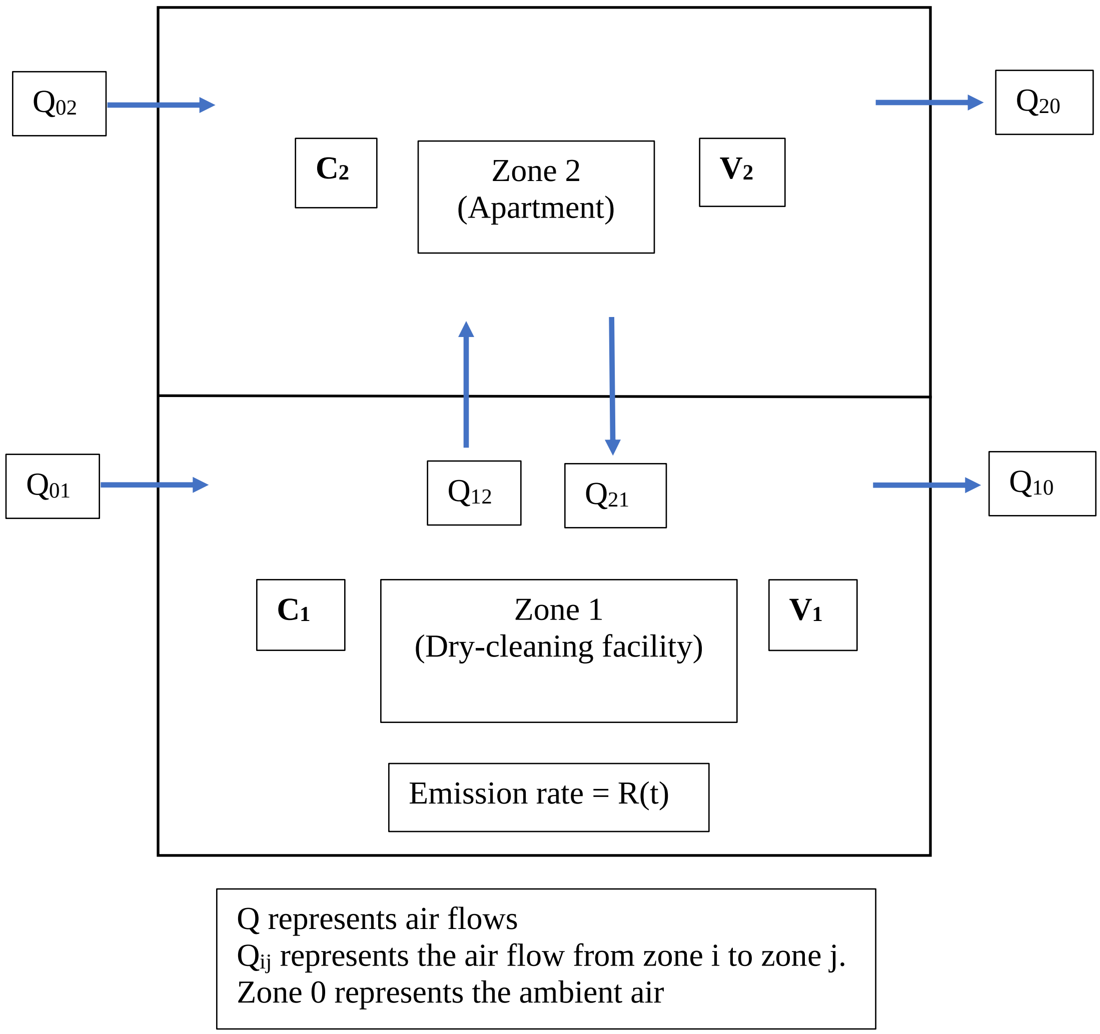

Figure 2-9. Schematic Representation of the Two-Zone Model for Co-resident Exposure

The mass balance equations for the chemical of concern are given by Equations 1 and 2.

$$V_1 \frac{dC_1}{dt} = R(t) + Q_{01}\,C_0 - Q_{10}\,C_1 - Q_{12}\,C_1 + Q_{21}\,C_2 \qquad (1)$$

$$V_2 \frac{dC_2}{dt} = Q_{02}\,C_0 - Q_{20}\,C_2 + Q_{12}\,C_1 - Q_{21}\,C_2 \qquad (2)$$

Where:
V_1 and V_2 are volumes of zone 1 and zone 2 (m^3),

C_1 and C_2 are the concentrations of the chemical of concern in zone 1 and zone 2 (μg/m^3),
t is the elapsed time (h),
R(t) is the time−varying emission rate (μg/h),
C_0 is the concentration of the chemical being evaluated in ambient air (μg/m^3), and
Q_{ij} is the air flow rate from zone i to zone j.

In this model, the interzonal air flow Q_{12} is considered a major contaminant transport route and, thus, assume $C_0 = 0$. Given a set of initial conditions (typically $C_1 = 0$ and $C_2 = 0$ at $t = 0$), Equations 1 and 2 can be solved numerically to give chemical concentrations in the two zones (C_1 and C_2) as a function of time.

This model requires six input parameters, listed below. IECCU does not provide default values for input parameters at this time, therefore, model inputs are derived from empirical data or modeled estimates.

- Zone volumes, V_1 and V_2
- Ventilation air flow rates, Q_{10} and Q_{20}
- Chemical emission rate, R(t)
- Interzonal air flows, Q_{12}/Q_{21}

The zone volume and ventilation rate (N_1 and N_2) for the dry-cleaning facility are those utilized in the dry-cleaning model. The zone volume and ventilation rate for the co-resident apartment are based on values from EPA's Exposure Factors Handbook (U.S. EPA, 2011a). The ventilation air flow rate is the product of the zone volume and ventilation rate of the respective zone (*e.g.*, $Q_{10} = V_1 \times N_1$).

Chemical emission rates are from the results of the dry-cleaning model runs. Emission rates were provided as 10-minute averages and converted to 1-hour averages for use as an input for IECCU.

The interzonal air flow (Q_{12}) plays a key role in determining the rate of contaminant transfer from the dry-cleaning shop to the co-resident space. To estimate this parameter, the co-resident exposure scenarios considered two building configurations (B1 and B2) and four methods to estimate the interzonal flow rate as described in Table 2-5.

Table 2-5. Summary of Two Building Configurations and Methods to Estimate Interzonal Flow Rate

Building Configuration	Description of Configuration	Method for Estimating Interzonal Flow Rate	Description of Method
B1	The two zones are architecturally separated as two building units. Such co-resident spaces can be commonly found in mixed-use buildings where the dry-cleaning shop is located on the first floor and the co-resident apartment is above the shop on the second floor. Air convection can occur between the two zones through the cracks and crevices along the	Method 1	Uses a literature value in which the Q_{12} was calibrated against field monitoring data for perchloroethylene from dry-cleaning shops based on a study from McDermott et al. (McDermott et al., 2005).
		Method 2	Estimates Q_{12} based on the stack effect. (Khoukhi and Al-Maqbali, 2011) In general, this concept assumes when the air in the dry-

Building Configuration	Description of Configuration	Method for Estimating Interzonal Flow Rate	Description of Method
	wall joints due to the pressure difference.		cleaning shop is warmer than in the second-floor apartment, the rising air draft serves as a driving force for air flow Q_{12}. For purposes of the co-resident effort, EPA assumes a 2° C temperature difference between the dry-cleaning shop and co-resident apartment, although this is a rough estimate due to the potential influence of ambient temperature in different locations across the country.
B2	The two zones are architecturally interconnected. This is a more uncommon case, where the owner uses part of a building unit (*e.g.*, the first floor of a two-story condominium) as a small dry-cleaning shop and the rest space (*e.g.*, second floor) as living quarters. In such cases, the opening along the stairways allows the air to move between the two zones.	Method 3	Calculates the Q_{12} based on a recommended interzonal air exchange rate of 0.7 hr^{-1} from a study by Jayjock and Havics (Jayjock and Havics, 2018).
		Method 4	Assumes the two zones share the same HVAC system and calculates the Q_{12} based on an assumed residential HVAC system re-circulation rate of 5 per hour or hr^{-1}.

Exposure Results and Risks

Modeled exposure concentration results from the co-resident screening effort were reviewed and summarized for each scenario modeled. EPA used the unadjusted 24-hour TWA and adjusted annual TWA exposure concentrations for risk calculations to estimate the MOE and excess cancer risk for comparison to the equivalent human health endpoints and benchmark values within the respective published final risk evaluations. The calculated risks were then compared to the benchmark values for the respective chemical of interest to determine if there was an indication of potential added risk for either or both acute and chronic non-cancer effects (calculated MOE below the benchmark MOE for the specific chemical) or if there was an indication of potential excess risk for cancer (calculated values greater than the benchmark of 1×10^6 for fenceline communities).

Chemical specific details and associated exposure results of the co-resident effort are provided in Section 3.1.4. Risk calculations and associated risk findings are provided in Section 3.1.5.2.

2.2 Ambient Water Pathway

Figure 2-10 provides an overview of EPA's screening level methodology for the ambient water pathway. EPA modeled water releases from facilities and POTWs in its final risk evaluations to estimate waterbody concentrations for environmental exposure assessment. As part of this screening level ambient water analysis, EPA used the same release scenarios along with results of previous E-FAST modeling runs to estimate drinking water and incidental oral/dermal exposures to fenceline communities to the receiving water body. Explication of what constitutes these fenceline communities is given in the EXECUTIVE SUMMARY and INTRODUCTION.

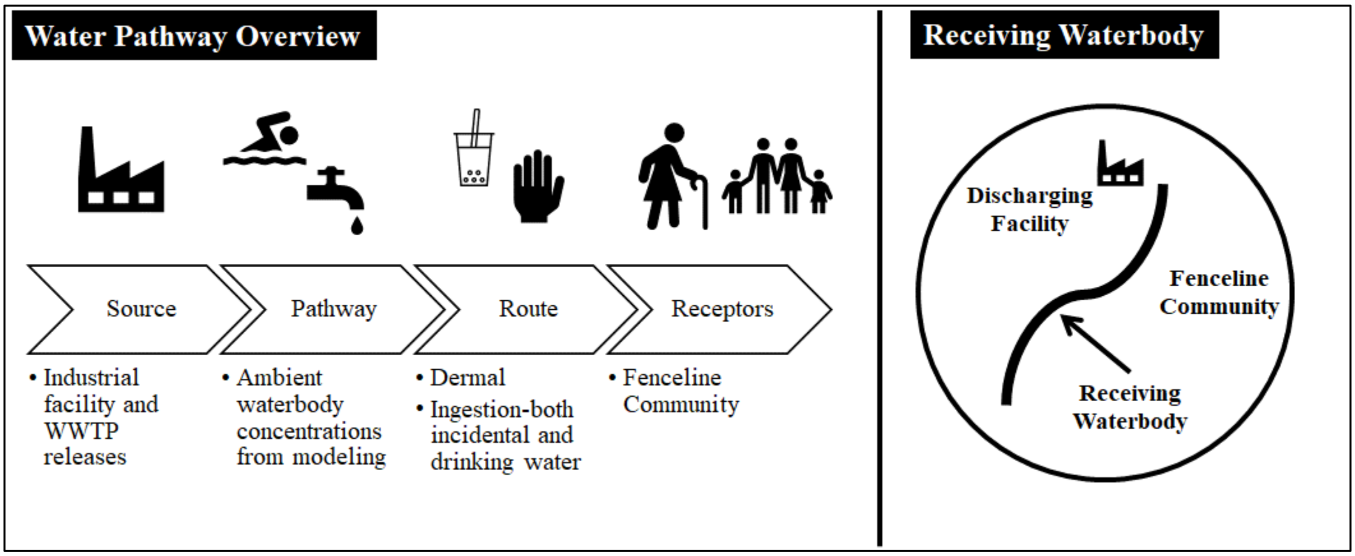

Figure 2-10. Overview of EPA's Screening Level Ambient Water Pathway Methodology

2.2.1 Environmental Water Releases

This section describes the general methodology (Figure 2-11) that was used to develop estimates of water releases from facilities as part of EPA's screening level ambient water pathway methodology. The results of applying this methodology to NMP and MC are presented in Section 3 (Case Study Results).

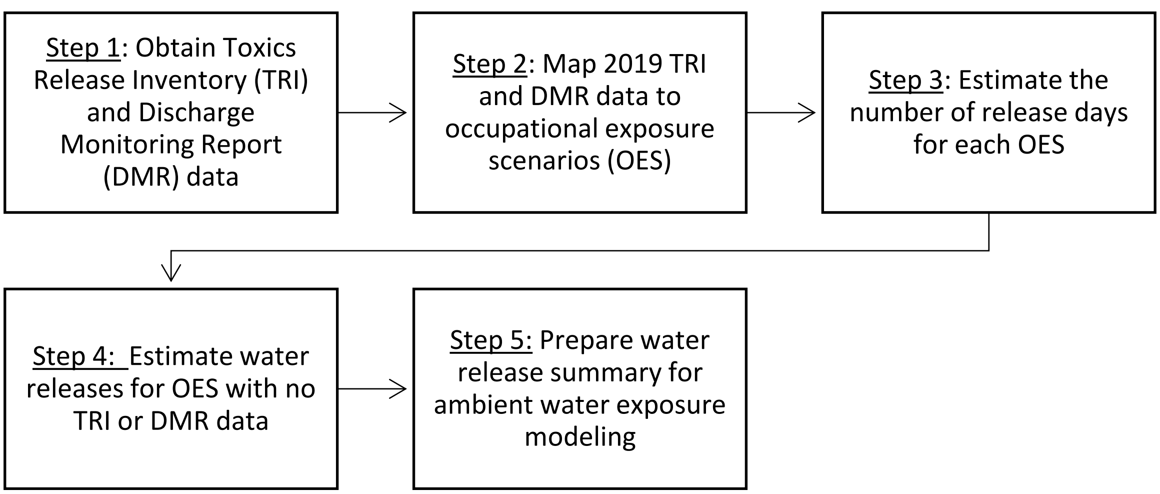

Figure 2-11. General Methodology for Estimating Water Releases

2.2.1.1 Step 1: Obtain TRI and DMR Data

The first step in the methodology for estimating water releases was to obtain TRI data for the chemical from EPA's Basic Plus Data Files (U.S. EPA, 2021) and DMR data from EPA's Water Pollutant Loading Tool within EPA's Enforcement and Compliance History Online (ECHO) (U.S. EPA, 2016a) to query all point source water discharges for the chemical of interest. Where water releases were assessed in the final risk evaluation report, EPA used the same TRI and DMR data as used in the risk evaluation report. TRI data included both Form R and Form A submissions in the fenceline analysis. Facilities may submit a Form A instead of a Form R if the amount of chemical manufactured, processed, or otherwise used do not exceed 1,000,000 lb/year and the total annual reportable releases do not exceed 500 lb/year. Facilities do not need to report release quantities or uses/sub-uses on Form A. For Form A submissions, the methodology to estimate emissions differs slightly from what is described below. Specifically, in Step 2, EPA does not have use/sub-use information for Form A submissions, so instead relies on North American Industry Classification System (NAICS) codes and facility information from internet searches to map these facilities to an OES. For DMR data, the only use information reported is the facility's Standard Industrial Classification (SIC) code. Therefore, EPA relied solely on these codes to map DMR facilities to an OES. These differences are highlighted in the sections below.

2.2.1.2 Step 2: Map TRI and DMR to Occupational Exposure Scenarios

In the next step of fenceline analysis development, EPA mapped the chemical's TRI and DMR data to the OES that were in the published risk evaluation for the chemical. Where water releases were assessed in the risk evaluation, the OES mapping did not change. During risk evaluation, EPA used the following procedure to map TRI and DMR data to OES:

1. Review TRI uses and NAICS code: EPA reviewed TRI uses (note: sub-use data not available in TRI until 2018) and NAICS codes for each facility and assigned an OES based on this information
2. Form A's: For Form A submissions, there were no reported TRI uses. To determine the OES for these facilities, EPA used the NAICS codes, market data, public comments, industry meetings and internet searches to determine the type of products and operations at the facility.
3. DMR: For DMR data, there are no reported use information. To determine the OES for these facilities, EPA first cross walked the facilities to TRI facilities and applied the same OES as TRI if the facility reported in both. If the facility did not report in TRI, EPA used the SIC codes, market data, public comments, industry meetings and internet searches to make a reasonable determination regarding the type of products and operations at the facility.

If water releases were not assessed in the final risk evaluation, EPA followed the same methodology as described for air releases in Section 2.1.1.2 but with the added step of mapping DMR data as described in Step #3 above.

2.2.1.3 Step 3: Estimate Number of Release Days for Each OES

TRI and DMR water release data are provided on an annual basis, in pounds of chemical released per year. However, for the exposure modeling described in Section 2.2.2, releases are needed on a daily basis. To estimate daily releases, EPA needs the number of release days for each facility. Because number of release days is not reported in TRI or DMR, EPA used general guidance to estimate the number of operating days for each OES. In general, the number of operating days in the published risk evaluations for the first round of chemicals were based on the same logic as described in Section 2.1.1.3 for air emissions. This approach assumes the number of release days for a facility is equal to the estimated number of operating days for its assigned OES.

2.2.1.4 Step 4: Estimate Water Releases for OES with No TRI or DMR Data

TRI and DMR data were not available for every OES. In such cases, the risk evaluations assessed releases using data from literature, relevant Emission Scenario Documents (ESDs) or Generic Scenarios (GSs), existing EPA models (*e.g.*, EPA Water Saturation Loss Model), and/or relevant Effluent Limitation Guidelines (ELG). ELG are national regulatory standards set forth by EPA for wastewater discharges to surface water and municipal sewage treatment plants. In some cases, there were insufficient information to estimate water releases from an OES. For these instances, EPA did a qualitative assessment.

2.2.1.5 Step 5: Prepare Water Release Summary for Ambient Water Exposure Modeling

The final step was to prepare a summary of the water releases. Water releases assessed in the risk evaluations were summarized and used in the fenceline analysis.

2.2.2 Ambient Water Concentrations and Exposures

This section describes the methodologies utilized to assess exposures for members of the fenceline communities to waterbodies receiving MC or NMP discharges. These exposures were evaluated by first reviewing available monitored drinking water information for both MC and NMP, and then by using modeling to estimate drinking water exposure and incidental oral and dermal exposures from swimming (see Figure 2-12). Ambient surface water data was evaluated for both MC and NMP as part of their original REs (U.S. EPA, 2020c; U.S. EPA, 2020d) with no ambient surface water information found for NMP and data for MC described in Section 3.2.4.2.1.

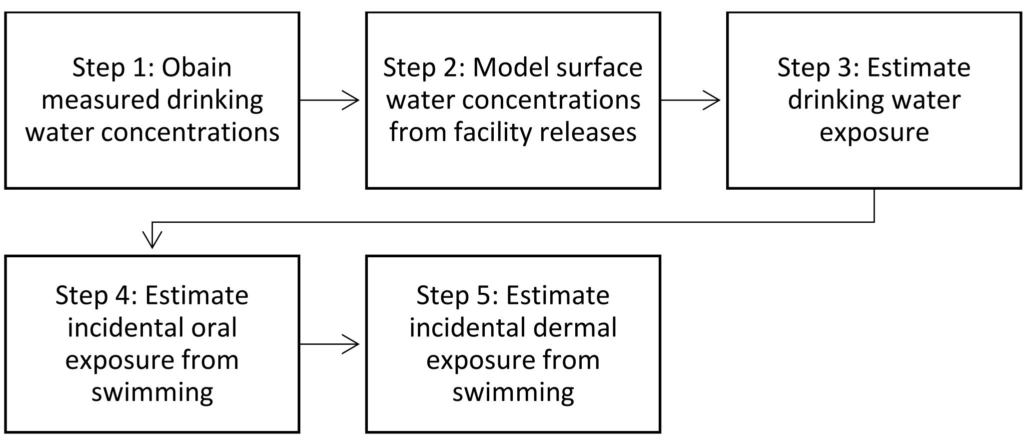

Figure 2-12. General Methodology for Estimating Ambient Water Exposures

2.2.2.1 Step 1: Obtain Measured Drinking Water Concentrations

Where possible, reasonably available data for monitored drinking water concentrations for both MC and NMP were evaluated. No monitoring data for NMP were found, but MC data were found via EPA's six-year review process of drinking water standards as required under the Safe Drinking Water Act (SDWA). As part of this process, EPA analyzes compliance monitoring data from public water supplies for regulated drinking water contaminants. A full description and purpose of the six-year review process can be found at the Six-Year Review of Drinking Water Standards.

Methylene chloride was evaluated under this program during the third six-year review cycle covering January 2006 through December 2011. During this time period, public water systems (PWSs) compliance monitoring data were provided by states and primacy agencies to EPA via their voluntary Information Collection Request (ICR). This dataset is referred to as the National Compliance

Monitoring ICR Dataset for the third six-year review (or "SYR3 ICR Dataset"). The SYR3 data and User Guide for Downloading the data can be found at Six-Year Review 3 Compliance Monitoring Data (2006-2011) | US EPA.

Data for MC was obtained to characterize potential exposures found in drinking water. The SYR3 data for MC was located under the Organic and Inorganic Chemicals category Phase 3 chemical set and downloaded as a zip file on September 8, 2021. The zip file (SYR3_PhaseChem_3.zip) contained a tab delimited text file specific for MC. The text file was imported into Microsoft Excel using the procedure outlined in the User Guide. Once in the spreadsheet, the dataset was filtered to identify non-detect (ND) samples and their reported detection limits. For all ND samples, one-half the reported detection limit was used for summary calculation purposes. If a detection limit was not provided, calculations were performed using one-half the average of the reported detection limits in all samples (calculated as 0.28 µg/L). Reported detection limits without units were assumed to be µg/L. When applying the one-half detection limits or one-half the average detection limits as needed, this can create a range, average, and standard deviation based only on detection limit data rather than sampled data when detected sample concentrations fall inside the range of one-half detection limits. Similar discrepancies may appear in the data when considering the concentrations in all samples against the concentrations only in the samples above the detection limit. As an example, when considering the 2011 ground water data set, there were 52,124 samples total and of those samples there were 207 samples with detected values which were used for the statistical analysis. For these samples, the detection limits were between 0.5 to 2 µg/L with detected concentrations ranged from 0.1 to 88 µg/L. For the non-detect samples, the detection limits were between $5.0\times10^{-}04$ to 1,000 µg/L. Since samples that did not have a detection were provided with a value of one-half of its detection limit, the values applied to these samples for the purpose of the statistical analysis ranged between $2.5\times10^{-}04$ to 500 µg/L.

2.2.2.2 Step 2: Model Surface Water Concentrations from Facility Releases

Exposure via drinking water, incidental oral ingestion and incidental dermal contact were evaluated based off modeled stream and water body concentrations using E-FAST 2014 (U.S. EPA, 2014) as described and documented in the risk evaluations for both chemicals (MC and NMP, (U.S. EPA, 2020c; 2020d)). These E-FAST 2014 outputs were based on model runs for the release activities identified for the chemical(s) of interest and acted as the input surface water concentrations. No additional modeling using E-FAST 2014 for instream surface water concentrations was conducted For complete description on the approach and methodology behind initial surface water modeling and results of those efforts, see the MC and NMP risk evaluations (U.S. EPA, 2020c; 2020d).

Data for both MC and NMP from the previous E-FAST 2014 model results were extracted and organized using the following data elements:

- Release activity names
- Chemical IDs
- Facility names and locations
- NPDES and SIC codes
- Occupational exposure scenarios (OES)
- Total release amounts
- Per site release amounts
- Release days per year
- Harmonic mean flows and concentrations
- 30Q5 flows and concentrations
- Concentrations in still water or large water bodies (such as lakes, bays, or oceans)

- Drinking water exposure metrics such as lifetime average daily dose (LADD), lifetime average daily concentration (LADC), and acute dose rate (ADR)

2.2.2.3 Step 3: Estimate Drinking Water Exposure

Once the above information was extracted and compiled into tables, the E-FAST 2014 drinking water exposure calculations were recreated in Excel to verify the inputs and equations used. This validation was done for the adult age group (21+) only, as that is the only age group assessed in E-FAST 2014. After validating that the E-FAST 2014 calculations for LADD, LADC, and ADR could be replicated using equations in Excel, the chemical spreadsheets were expanded to include additional age groups and possible inputs. Calculations were also added for chronic average daily dose (ADD) using the same equation as that for LADD in E-FAST 2014 but modified with inputs to represent a chronic scenario for a specified time frame rather than for the lifetime. The equations utilized for drinking water exposure calculations are

$$ADR_{POT} = \frac{SWC \times \left(1 - \frac{DWT}{100}\right) \times IR_{dw} \times RD \times CF1}{BW \times AT}$$

$$ADD_{POT} = \frac{SWC \times \left(1 - \frac{DWT}{100}\right) \times IR_{dw} \times ED \times RD \times CF1}{BW \times AT \times CF2}$$

$$LADD_{POT} = \frac{SWC \times \left(1 - \frac{DWT}{100}\right) \times IR_{dw} \times ED \times RD \times CF1}{BW \times AT \times CF2}$$

$$LADC_{POT} = \frac{SWC \times \left(1 - \frac{DWT}{100}\right) \times ED \times RD \times CF1}{AT \times CF2}$$

Where:
SWC = Surface water concentration (ppb or µg/L)
DWT = Removal during drinking water treatment (%)
IRdw = Drinking water intake rate (L/day)
RD = Release days (days/year for ADD, LADD and LADC; 1 day for ADR)
ED = Exposure duration (years for ADD, LADD and LADC; 1 day for ADR)
BW = Body weight (kg)
AT = Exposure duration (years for ADD, LADD and LADC; 1 day for ADR)
CF1 = Conversion factor (1.0×10−03 mg/µg)
CF2 = Conversion factor (365 days/year)

For drinking water estimates, concentrations in estuaries or bays are not considered as they are unlikely to be potable waters. Drinking water exposures are also not considered for large lakes due to high uncertainty in the applicable dilution factors. This is in alignment with the methodology used in E-FAST 2014 (U.S. EPA, 2014). ADR or acute exposure concentrations used the modeled 30Q5 stream concentrations while the ADD, LADD, and LADC or chronic calculations used the modeled harmonic mean stream concentrations. Drinking water treatment removal (DWT) was set to 0% to represent a conservative estimate of possible drinking water exposures.

Inputs for body weight, averaging time (AT), and exposure duration were applied the same across the evaluation of drinking water, incidental oral exposure, and incidental dermal exposure, but are described here. For all calculations, mean body weight data were used from Chapter 8, Table 8-1 in the U.S. *Exposure Factors Handbook* (EFH) (U.S. EPA, 2011a). To align with the age groups of interest, weight averages were calculated for the infant age group (birth to <1 year) and toddlers (1 to 5 years). The ranges given in the EFH were weighted by their fraction of the age group of interest. For example, the EFH provides body weight for 0 to 1 month, 1 to 3 months, 3 to 6 months, and 6 to 12 months. Each of those body weights were weighted by their number of months out of 12 to determine the weighted average for an infant 0 to 1 year old. For all ADR calculations, the AT is 1 day, and the days of release are assumed to be 1 according to the methodology used in E-FAST 2014 (U.S. EPA, 2014). For all ADD calculations, the AT and the ED are both equal to the number of years in the relevant age group up to the 95th percentile of the expected duration at a single residence, 33 years (U.S. EPA, 2011a). For example, estimates for a child between 6 and 10 years old would be based on an AT and ED of 5 years. For all LADD and LADC calculations, the AT is the lifetime of 78 years, and the ED is the number of years in the relevant age group, up to 33 years.

Drinking water exposure was estimated for the following age groups: Adult (21+ years), Youth (16-20 years), Youth (10 to 15 years), Child (6 to 10 years), Toddler (1 to 5 years), and infant (birth to <1 year). For NMP, exposure was also estimated for pregnant females as a susceptible population. Drinking water intake rates are provided in the 2019 update of Chapter 3 of the EFH (U.S. EPA, 2019e). Weighted averages were calculated for acute and chronic drinking water intakes for adults 21+ and toddlers 1 to 5 years. From Table 3-17, 95th percentile consumer data were used for acute drinking water intake rates. From Table 3-9, mean per capita data were used for chronic drinking water intake rates. The intake rates from Table 3-3 were used for pregnant females in NMP exposure estimates.

Supplemental Files *SF_FLA_Water Pathway Exposure Data for MC* and *SF_FLA_Water Pathway Exposure Data for NMP* (Appendix B) provide additional details on inputs and assumptions for MC and NMP respectively as well as complete results for each chemical as described Section 3.2.4.2.3 (MC) and Section 3.3.4.1 (NMP).

2.2.2.4 Step 4: Estimate Incidental Oral Exposures from Swimming

Estimated surface water concentrations from the initial risk evaluations of MC (U.S. EPA, 2020c) and NMP (U.S. EPA, 2020d) were used to estimate acute and chronic incidental oral exposure from swimming following methodologies originally published in the 1,4-dioxane RE (U.S. EPA, 2020e) and NMP RE (U.S. EPA, 2020d). Those methodologies presented in the previous risk evaluations have been updated here to include more updated input parameters (*e.g.*, incidental ingestion rates) and consistency amongst evaluated age groups. This screening-level analysis focuses on health endpoints relevant to the most sensitive human population for each evaluated chemical, but also provides the adult population (if different from most sensitive) as a point of comparison across chemicals. For MC, the most sensitive health endpoint is youths aged 11 to 15 years due to greatest exposure when considering age-specific ingestion rate, body weight and duration of exposure. For NMP, the most sensitive groups are pregnant women (due to pregnancy-specific hazards) and youths aged 11 to 15 years (due to greater exposure).

The equations used to estimate the acute daily dose rate (ADR) and average daily dose (ADD) for incidental oral ingestion are shown below (U.S. EPA, 2014):

$$ADR = \frac{SWC * IR * CF1}{BW}$$

$$ADD = \frac{SWC * IR * ED * RD * CF1}{BW * AT * CF2}$$

Where:
SWC = Surface water concentration (ppb or µg/L)
IR = Daily ingestion rate (L/day)
RD = Release days (days/yr)
ED = Exposure duration (years)
BW = Body weight (kg)
AT = Averaging time (years)
CF1 = Conversion factor (0.001 mg/µg)
CF2 = Conversion factor (365 days/year)

All receiving water bodies were considered for evaluation of incidental oral ingestion using modeled 30Q5 and harmonic surface water concentrations. Predicted 30Q5 surface water concentrations are used in the calculation of ADRs and ranged from 2.82×10^{-07} to 61.9 µg/L for MC and 4.52×10^{-04} to 812 µg/L for NMP, while predicted harmonic mean surface water concentrations used in the calculation of ADDs ranged from 1.26×10^{-07} to 14.3 µg/L for MC and 3.01×10^{-04} to 812 µg/L for NMP (*SF_FLA_Water Pathway Exposure Data for MC* and *SF_FLA_Water Pathway Exposure Data for NMP*; Appendix B). Key inputs/exposure factors used to estimate these oral exposures are included in Table 2-6.

Supplemental Files *SF_FLA_Water Pathway Exposure Data for MC* and *SF_FLA_Water Pathway Exposure Data for NMP* (Appendix B) provide additional details on inputs and assumptions for MC and NMP respectively as well as complete results for each chemical as described Section 3.2.4.2.4 (MC) and Section 3.3.4.2 (NMP).

Table 2-6. Incidental Oral Exposure Factors for MC and NMP

Input	Description (units)	Age Group			Notes
		Adult (21+ years)	Youth (11–15 years)	Pregnant Female (NMP only)	
IR_{inc}	Incidental ingestion rate (L/hr)	0.092	0.152	0.092	Upper percentile hourly ingestion rate for respective age groups from *Exposure Factors Handbook*, Table 3-7 (U.S. EPA, 2019e)
BW	Body weight (kg)	80	56.8	65.9	Recommended mean body weight for each population from the *Exposure Factors Handbook*, Table 8-1 (U.S. EPA, 2011a). Values for NMP for pregnant woman age class are taken from the young women/ female adolescent age class (aged 16–21 years)

Input	Description (units)	Age Group			Notes
		Adult (21+ years)	Youth (11–15 years)	Pregnant Female (NMP only)	
ET	Exposure time (hr/day)	3	2	3	High-end default short-term duration from EPA Swimmer Exposure Assessment Model (SWIMODEL); based on competitive swimmers in the respective age class (U.S. EPA, 2015)
$IR_{inc\text{-}daily}$	Incidental daily ingestion rate (L/day)	0.276	0.304	0.276	Ingestion rate × exposure time
IR/BW	Weighted incidental daily ingestion rate (L/kg-day)	0.0035	0.0054	0.0042	
ED	Exposure duration (year for ADD)	33	5	33	
AT	Averaging time (years for ADD)	33	5	33	
CF1	Conversion factor (mg/µg)	1.00E−03	1.00E−03	1.00E−03	
CF2	Conversion factor (days/yr)	365	365	365	

2.2.2.5 Step 5: Estimate Incidental Dermal Exposure from Swimming

All receiving water bodies were considered for evaluation of incidental dermal contact using modeled 30Q5 and harmonic surface water concentrations. Predicted 30Q5 surface water concentrations are used in the calculation of ADRs and ranged from 2.82×10−07 to 61.9 µg/L for MC and 4.52×10−04 to 812 µg/L for NMP, while predicted harmonic mean surface water concentrations used in the calculation of ADDs ranged from 1.26×10^{-07} to 14.3 µg/L for MC and 3.01×10^{-04} to 812 µg/L for NMP (*SF_FLA_Water Pathway Exposure Data for MC* and *SF_FLA_Water Pathway Exposure Data for NMP*; Appendix B). This screening-level analysis focused on the adult (MC) and pregnant female (NMP) age classes, as they represent the worst-case exposure conditions when considering the age-specific surface area to body weight ratio and duration of exposure (Table 2-7).

The equations used to estimate the acute daily dose rate (ADR) and average daily dose (ADD) for incidental dermal exposure are shown below (U.S. EPA, 2015):

$$ADR = \frac{SWC * Kp * SA * ET * CF1 * CF2}{BW}$$

$$ADD = \frac{SWC * Kp * SA * ET * RD * ED * CF1 * CF2}{BW * AT * CF3}$$

Where:
ADR = Acute Dose Rate (mg/kg/day)
ADD =Average Daily Dose (mg/kg/day)
SWC = Chemical concentration in water (µg/L)
Kp = Permeability coefficient (cm/hr)
SA = Skin surface area exposed (cm^2)
ET = Exposure time (hr/day)
RD = Release days (days/yr)
ED = Exposure duration (years)
BW = Body weight (kg)
AT = Averaging time (years)
CF1 = Conversion factor ($1.0{\times}10{-}03$ mg/µg)
CF2 = Conversion factor ($1.0{\times}10{-}03$ L/cm^3)
CF3 = Conversion factor (365 days/year)

Key inputs/exposure factors used to estimate these dermal exposures are included in Table 2-7.

Supplemental Files *SF_FLA_Water Pathway Exposure Data for MC* and *SF_FLA_Water Pathway Exposure Data for NMP* (Appendix B) provide additional details on inputs and assumptions for MC and NMP respectively as well as complete results for each chemical as described Section 3.2.4.2.5 (MC) and Section 3.3.4.3 (NMP).

Table 2-7. Incidental Dermal Exposure Factors for MC and NMP

Input	Description (units)	MC Adult (≥21 years)	NMP (Pregnant Female)	Notes
BW	Body weight (kg)	80	65.9	Recommended mean body weight for each population from the *Exposure Factors Handbook*, Table 8-1 (U.S. EPA, 2011a). Values for NMP for pregnant woman age class are taken from the young women/ female adolescent age class (aged 16 – 21 years)
SA	Skin surface area exposed (cm^2)	19,500	18,500	MC: Default dermal contact surface area for the adult age class in SWIMODEL (U.S. EPA, 2015) NMP: Mean total surface area of adult females from the *Exposure Factors Handbook*, Table 7-13 (U.S. EPA, 2011a)
ET	Exposure time (hours/day)	3	3	High-end default short-term duration from EPA Swimmer Exposure Assessment Model (SWIMODEL); based on competitive swimmers in the respective age class (U.S. EPA, 2015)
Kp	Permeability coefficient (cm/hr)	7.17E−03	4.78E−04	MC: Estimated from Consumer Exposure Model (U.S. EPA, 2017) NMP: Recalibrated from data in Poet et al. (2010)
ED	Exposure duration (years for ADD)	33	33	Number of years in age group, up to the 95th percentile residential occupancy period. U.S. EPA *Exposure Factors Handbook*, Chapter 16, Table 16-5 (U.S. EPA, 2011a)
AT	Averaging time (years for ADD)	33	33	Number of years in age group, up to the 95th percentile residential occupancy period. U.S. EPA *Exposure Factors Handbook*, Chapter 16, Table 16-5 (U.S. EPA, 2011a)
CF1	Conversion factor (mg/µg)	1.00E−03	1.00E−03	
CF2	Conversion factor (L/cm^3)	1.00E−03	1.00E−03	
CF3	Conversion factor (days/year)	365	365	

2.3 Risk Estimation Approach

To calculate risks from fenceline exposures through air and water, EPA used the same methods used in previously published risk evaluations.

2.3.1 Characterization of Non-cancer Risks

EPA used a Margin of Exposure (MOE) approach to identify potential non-cancer risks. The MOE is the ratio of the non-cancer POD divided by a human exposure dose. Acute and chronic MOEs for non-cancer inhalation and dermal risk were calculated using the following equation:

$$\text{MOE}_{\text{acute or chronic}} = \frac{\text{Non} - \text{cancer Hazard value (POD)}}{\text{Human Exposure}}$$

Where:
MOE = Margin of exposure (unitless)
Hazard value (POD)= HEC (ppm) or HED (mg/kg-d)
Human Exposure = Exposure estimate (in ppm or mg/kg-d)

MOEs allow for the presentation of a range of risk estimates. EPA interpreted the MOE risk estimates for each use scenario in reference to benchmark MOEs. Benchmark MOEs are the total UF for each non-cancer POD. The MOE estimate was interpreted as a human health risk if the MOE estimate was less than the benchmark MOE (*i.e.*, the total UF). On the other hand, the MOE estimate indicated negligible concerns for adverse human health effects if the MOE estimate was equal to or exceeded the benchmark MOE. Typically, the larger MOE, the more unlikely it is that a non-cancer adverse effect would occur.

2.3.2 Characterization of Cancer Risks

Extra cancer risks for repeated exposures to a chemical were estimated using the following equations:

$$\text{Inhalation Cancer Risk} = \text{Human Exposure} \times \text{IUR}$$

or

$$\text{Dermal/Oral Cancer Risk} = \text{Human Exposure} \times \text{CSF}$$

Where:
Risk = Extra cancer risk (unitless)
Human exposure = Exposure estimate (LADC in ppm)
IUR = Inhalation unit risk (1×10^{-6} per ppm)
CSF = Cancer slope factor (1.2×10^{-1} per mg/kg-d)

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 used 1×10^{-6} as the benchmark for cancer risk in fenceline communities. This is consistent with the cancer benchmark used for general population cancer risk in several other EPA programs and in previous risk evaluations . It is important to note that exposure related considerations (duration, magnitude, specific population exposed) can affect EPA's estimates of the excess lifetime cancer risk (ELCR).

In order to address increased exposure and sensitivity of younger lifestages, total lifetime cancer risk across lifestages was calculated by integrating partial risk for each lifestage based on differential exposure. For chemicals with a mutagenic mode of action, EPA applied age-dependent adjustment factors (ADAFs) using methods consistent with EPA's supplemental guidance for assessing susceptibility for early-life exposure to carcinogens, (U.S. EPA, 2005). Specifically, for chemical with a mutagenic mode of action, EPA applied a 10-fold adjustment for exposure before 2 years of age, a 3-fold adjustment for exposures between 2 and <16 years of age and no additional adjustment for exposures at 16 years of age and above.

2.4 Key Assumptions and Uncertainties

2.4.1 Assumptions and Uncertainties in Release Estimation

EPA estimated releases using reported data from TRI and DMR. TRI and DMR data were determined to have a "medium" confidence rating through EPA's systematic review process. However, when using TRI data to analyze chemical releases, it is important to acknowledge that TRI reporting does not include all releases of the chemical and therefore, the number of sites for a given OES may be underestimated. Due to limiting the scope of this screening-level analysis to facilities that report releases to TRI and DMR, it is uncertain, the extent to which, sites not captured in these databases have air emissions or water releases of a chemical and whether any air emissions would be stack or fugitive and whether water releases would be to surface water, POTW, or non-POTW WWT. TRI data do not include

- Releases from any facility that used the chemical in quantities below the applicable annual chemical activity threshold (*e.g.*, 25,000 lb manufactured or processed, or 10,000 lb otherwise used, for most chemicals);
- Releases from any facility that is not in a TRI covered sector; and
- Releases from any facility that does not meet the TRI employment threshold of greater than 10 full-time employee equivalents (20,000 labor hours) for the year.

EPCRA section 313 states that facilities may estimate their release quantities using "readily available data," including monitoring data, collected for other purposes. When data are not readily available, EPCRA section 313 states that "reasonable estimates" may be used. The facility is not required to monitor or measure the quantities, concentration, or frequency of any toxic chemical release for TRI reporting. TRI guidance states that not using readily available information, such as relevant monitoring data collected for compliance with other regulations, could result in enforcement and penalties.

For each release quantity reported, TRI facilities select a "Basis of estimate" code indicating the principal method used to determine the amount of the release. TRI provides six basis of estimate codes to choose from: continuous monitoring, periodic monitoring, mass balance, published emissions factors, site-specific emissions factors, or engineering calculations/best engineering judgment. In facilities where a chemical is used in multiple operations, the facility may use a combination of methods to calculate the release reported. In such cases, TRI instructs the facility to enter the basis of estimate code of the method that applies to the largest portion of the release quantity. Additional details on the basis of estimate, such as any calculations and underlying assumptions, are not reported.

For any release quantity that is less than 1,000 lb, facilities may report either the estimated quantity or a range code. The 1,000-pound limit for range code reporting applies to each type of release reported to TRI - fugitive air emissions, stack air emissions, water discharges, each type of land disposal, and each type of off-site transfer. There are three TRI range codes: 1–10; 11–499; and 500–999 lb. TRI data tools display the approximate midpoint of the range (*i.e.*, 5, 250, or 750 lb). Although analyses using data that was reported as a range code may add uncertainty, it is not clear that the uncertainty associated with a range code is greater than that associated with any other estimated release value. Range code reporting is not permitted for chemicals of special concern.

TRI facilities enter the facility's primary six-digit North American Industry Classification System (NAICS) code indicating the primary economic activity at the facility. Facilities can also enter secondary NAICS codes. NAICS codes are reported for the facility as a whole and are not chemical specific. When using TRI chemical release data for a facility that also reported secondary NAICS codes, there may be uncertainty as to which NAICS is associated with the use of the chemical.

TRI guidance states that release estimates need not be reported to more than two significant figures. However, the guidance also states that facilities should report release quantities at a level of precision supported by the accuracy of the underlying data and the estimation techniques on which the estimate was based. If a facility's release calculations support reporting an amount that is more precise than two significant digits, then the facility should report that more precise amount. The facility makes the determination of the accuracy of their estimate and the appropriate significant digits to use.

For chemicals that meet certain criteria, facilities have the option of submitting a TRI Form A Certification Statement instead of a TRI Form R. The Form A does not include any details on the chemical release or waste management quantities. The criteria for a Form A are that during the reporting year, the chemical (1) did not exceed 500 lb for the total annual reportable amount (including the sum of on- and off-site quantities released, treated, recycled, and used for energy recovery); (2) amounts manufactured, processed, or otherwise used do not exceed 1 million lb; and (3) the chemical is not a chemical of special concern. When conducting analyses of chemical releases and a facility has submitted a Form A for the chemical, there is no way to discern the quantity released to each medium or even if there were any releases. For air emissions, where facilities reported to TRI with a Form A, EPA used the Form A threshold for total releases of 500 lb/year. EPA used the entire 500 lb/year for both the fugitive and stack air release estimates; however, since this threshold is for total site releases, these 500 lb/year are either to fugitive air or stack air for this analysis, not both (since that would double count the releases and exceed the total release threshold for Form A). Furthermore, the threshold represents an upper limit on total releases to all environmental media from the facility; therefore, assessing the air emissions at the threshold value likely overestimates actual air emissions from the facility.

In addition, information on the use of the chemical at facilities in TRI and DMR is limited; therefore, there is some uncertainty as to whether the mapping of each facility to an OES does in fact represent that specific OES. If facilities were categorized under a different OES, the annual air emissions or water releases for each site would remain unchanged; however, average daily releases may change depending on the release days expected for the different OES.

Facilities reporting to TRI and DMR only report annual releases; to assess daily releases, EPA estimated the release days and averaged the annual releases over these days. There is some uncertainty that all facilities for a given OES operate for the assumed duration; therefore, the average daily release may be higher if sites have fewer release days or lower if they have greater release days. Furthermore, chemical concentrations in air emissions and wastewater streams at each facility may vary from day-to-day such that on any given day the actual daily releases may be higher or lower than the estimated average daily discharge.

In some cases, the number of facilities for a given OES was estimated using data from the U.S. Census. In such cases, the average daily release calculated from sites reporting to TRI or DMR was applied to the total number of sites reported in (U.S. Census Bureau, 2015). It is uncertain how accurate this average release is to actual releases at these sites; therefore, releases may be higher or lower than the calculated amount.

For air emissions, where facilities reported to TRI with a Form A, EPA used the Form A threshold for total releases of 500 lb/yr. EPA used the entire 500 lb/year for both the fugitive and stack air release estimates; however, since this threshold is for total site releases, these 500 lb/year are either to fugitive air or stack air for this analysis, not both (since that would double count the releases and exceed the total release threshold for Form A). EPA used the entire 500 lb/year for both the fugitive and stack air release estimates; however, since this threshold is for total site releases, these 500 lb/year are either to fugitive air or stack air for this analysis, not both (since that would double count the releases and exceed the total release threshold for Form A). Furthermore, the threshold represents an upper limit on total releases to all environmental media from the facility; therefore, assessing the air emissions at the threshold value likely overestimates actual air emissions from the facility.

For release estimates developed for an OES when 2019 TRI data were not available, there are uncertainties related to the use of prior year TRI data or, in their absence, the use of modeling. Use of the past years' TRI data may introduce uncertainties related to whether those releases are currently ongoing or the extent to which past years' data reflects current releases. Although no new models were developed for this screening level fenceline analysis, the adaptations made to and uses of these models as part of the screening-level fenceline analysis may result in release estimates higher or lower than the actual amount. Additionally, the approach used for scenario development for estimated releases based on modeling or other data sources differs from the facility-specific approach used for OES for which TRI data were available (as described in section 2.1.2.2). This may introduce uncertainties that differ from those of the scenarios using TRI data, described above. TRI guidance states that release estimates need not be reported to more than two significant figures. However, the guidance also states that facilities should report release quantities at a level of precision supported by the accuracy of the underlying data and the estimation techniques on which the estimate was based. If a facility's release calculations support reporting an amount that is more precise than two significant digits, then the facility should report that more precise amount. The facility makes the determination of the accuracy of their estimate and the appropriate significant digits to use.

For chemicals that meet certain criteria, facilities have the option of submitting a TRI Form A Certification Statement instead of a TRI Form R. The Form A does not include any details on the chemical release or waste management quantities. The criteria for a Form A are that during the reporting year, the chemical (1) did not exceed 500 lb for the total annual reportable amount (including the sum of on- and off-site quantities released, treated, recycled, and used for energy recovery); (2) amounts manufactured, processed, or otherwise used do not exceed 1 million lb; and (3) the chemical is not a chemical of special concern. When conducting analyses of chemical releases and a facility has submitted a Form A for the chemical, there is no way to discern the quantity released to each medium or even if there were any releases. For air emissions, where facilities reported to TRI with a Form A, EPA used the Form A threshold for total releases of 500 lb/year. EPA used the entire 500 lb/year for both the fugitive and stack air release estimates; however, since this threshold is for total site releases, these 500 lb/year are either to fugitive air or stack air for this analysis, not both (since that would double count the releases and exceed the total release threshold for Form A). Furthermore, the threshold represents an upper limit on total releases to all environmental media from the facility; therefore, assessing the air emissions at the threshold value may overestimate actual air emissions from the facility.

2.4.2 Assumptions and Uncertainties in Air Pathway Exposure Modeling

Pre-screening Analysis

IIOAC provides exposure concentrations at three pre-defined distances (100 meters, 100 to 1,000 meters, and 1,000 meters) which is a limitation to the model itself (it does not estimate exposure concentrations closer or farther out than these distances). Based on this current fenceline work, exposures from fugitive releases were found to peak around 10 meters from a facility and rapidly decay at farther distances and stack releases were found to peak around 100 meters. Therefore, where a facility's releases are primarily fugitive in nature, the inherent distance limitations of the model prohibit it from estimating exposures to receptors closer to a facility (less than 100 meters from the facility). This could result in the pre-screening modeling methodology not identifying or capturing exposures and associated potential risk from such fugitive releases for receptors closer than 100 meters. Taking the IIOAC pre-screening results alone, without considering release type (stack/fugitive) and other factors, could then lead to a decision to screen out a pathway due to no risk at 100 meters, when there is exposure and associated risk at distances closer than 100 meters. This issue could be avoided by taking a closer look at exposure concentrations and associated risks at 100 meters to see how close to (or far off) the estimated risks are from the relevant benchmarks. Even if risk is not explicitly indicated at 100 meters, if it is close to indicating a risk (*e.g.*, close to a benchmark), it may warrant a full screening level analysis to be conducted.

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Meteorological data can have a significant impact on exposure concentrations upwind and downwind of a releasing facility. The use of 14 pre-defined meteorological stations representing regions of the United States generalizes the meteorological data across a wide area where competing conditions can significantly influence the exposure concentrations modeled. However, when using IIOAC for pre-screening work, EPA used the meteorological stations within IIOAC which provided high end and central tendency exposure concentration estimates, based on a sensitivity analysis, therefore maintaining a conservative estimate of the exposure concentrations used to calculate risk. This approach adds confidence to the findings by ensuring under a high-end exposure scenario potential risks would be captured.

Screening Analysis

AERMOD is EPA's regulatory model and has been thoroughly peer reviewed therefore the general confidence in results from the model is high but reliant on the integrity and quality of the inputs used and interpretation of the results. For the full-screening level analysis, EPA used 2019 TRI data for release information. There is uncertainty around the use of only 2019 TRI data for the full-screening level analysis.

The 2019 TRI dataset used for the full-screening level analysis does not have actual release point locations which can affect the estimated concentrations at varying distances modeled. For the release location, EPA used a local-coordinate system. EPA centered a facility's emissions on one location which was assigned the local coordinate of (0,0) and concentrations were estimated at modeled distances in concentric rings from that location. However, the (0,0) coordinate was placed at a location which represents the latitude/longitude (lat/long) information reported to TRI. That lat/long may represent the mailing address location of the office building associated with a very large facility rather than the actual release location (*e.g.*, a specific process stack). This discrepancy between the (0,0) coordinate from which an exposure concentration is modeled for the full-screening level analysis and the actual release point could result in an exposure concentration that does not represent the actual distance where fenceline communities may be exposed. This is particularly relevant for larger facilities where the actual release point may be several hundred meters to the northeast of the office building. In this situation, the exposure concentrations estimated at several hundred meters from the (0,0) coordinate (office building) may be located within the facility property-line; however, the exposure concentration should be applied from the actual release point. This could shift the actual modeled exposure concentration from within the facility property-line to well outside of the facility property-line where fenceline communities may be exposed (e.g., the actual release point may be directly next to a residential community or school yard just outside the facility property-line).

The 2019 dataset used for full-screening level analysis does not include source specific physical characteristics like stack height, exit gas temperature, etc. which can affect plume characteristics and associated dispersion of the plume. For the source specific characteristics, EPA used physical stack parameters and plume characteristics consistent with those used in IIOAC, including, but not limited to: stack emissions released from a point source at 10 meters above ground from a 2-m inside diameter stack, with an exit gas temperature of 300 °Kelvin and an exit gas velocity of 5 m per second (see Table 6 of the IIOAC User Guide). EPA acknowledges these stack parameters represent conservative plume characteristics which resemble a slow-moving, low-to-the-ground plume with limited dispersion but believe are appropriate for screening level purposes. None-the-less, use of these conservative parameters may overestimate emissions for certain facilities modeled. Additionally, while these default values are based on national averages and some research into typical stack parameters and conditions, they may not be applicable or representative of all sources evaluated in this fenceline work.

As discussed in the release section, some facilities modeled relied on release data from the TRI Form A (which has a reporting threshold of 500 lb). Since there is no source attribution associated with a Form A reporting value, EPA modeled each facility associated with a Form A submittal twice, once assuming all 500 lb of the reporting threshold was fugitive and once assuming all 500 lb of the reporting threshold was stack. This maintains a conservative estimate, in terms of total release, but may overestimate exposure concentrations associated with these releases if a facility did not actually release all 500 lb. At the same time, although it maintains a conservative estimate the resulting modeled concentrations for Form A facilities tended to be low in comparison to the majority of TRI reporting facilities reporting an actual stack and/or fugitive release across a given OES. Additionally, in each case Form A modeled facilities tended to have higher exposure concentrations resulting from the fugitive release scenario compared to the stack release scenario. Although this approach could lead to a potential concern over double counting a facility release, when presenting potential exposures EPA relies on the highest (more conservative) exposure concentration between the two release types for purposes of evaluating potential risks to fenceline communities. As discussed above, this tended to result in EPA considering the scenario where 500 lb of release occurred under the fugitive release scenario for purposes of presenting potential exposures and associated potential risks.

Co-resident Screening Analysis

IECCU does not include default values for select input parameters and relies on user derived input parameters. In many cases, the availability of reference data for the input parameters is limited or non-existent and therefore inputs rely on other models to estimate an input parameter. This places a higher reliance on the efficacy of the models used to estimate input parameters which may or may not be appropriate or thoroughly reviewed. EPA minimized this uncertainty by using reference data, where reasonably available and by relying on other EPA reviewed and/or approved models to derive input parameters.

As described in the model documentation, the Q_{12} flow is a significant factor when estimating transport of the chemical of concern into the adjacent living space and therefore should be well established to ensure confidence in the results. EPA minimized uncertainty by estimating the Q_{12} two different ways for each of the two buildings configuration. Not only does this approach provide a variation in the Q_{12}, but it also provides results which can be compared for consistency. Comparison of the two approaches for the Q_{12} values showed consistency across both methods within a building configuration and therefore helps provide added confidence that the results are reliable.

2.4.3 Assumption and Uncertainties in Drinking Water Monitoring Results

Drinking water monitoring data were identified only for MC and only through the discussed data found in the Six-Year Review of Drinking Water Standards. It is noted that the date range of this dataset is between 2006 and 2011 and those monitored values may not represent current conditions, nevertheless they represented the most recent available monitored information on drinking water concentrations and provide relevant information to possible drinking water exposures. Additionally, these measurements are taken at the point of drinking water distribution meaning the sampled location may be temporally or spatially separate from the initial point of chemical release. Finally, due to the different years between modeled and monitored information available for MC, the monitored results were not linked to physical locations or compared to modeled estimates of instream and drinking water concentrations from facility releases.

2.4.4 Assumptions and Uncertainties in Water Pathway Exposure Modeling

Estimation of all water pathway exposures is dependent on modeling done through E-FAST 2014 (U.S. EPA, 2014) which is subject to a number of assumptions and uncertainties. Since modeling was not redone for this evaluation the original risk evaluations for both MC (U.S. EPA, 2020c) and NMP (U.S. EPA, 2020d) go into greater depth on these uncertainties and assumptions, but they are briefly discussed here .

The modeled scenarios used and estimated high and low days of release frequency for all direct releasers and a high days of release frequency for all indirect releasers. The greater the number of release days, the more a per-day release will be diluted assuming the same overall annual loading estimate. The selection of both a high and low number of release days is intended to bracket and provide the range of possible releases to stream waterbodies, but release days may vary across and between industries and may not be accurately represented by these assumed values.

The applied stream flow distribution is another key parameter determining output results. The modeled 30Q5 and harmonic mean surface water concentrations are used to calculate the estimated water pathway exposures for drinking water, incidental oral, and incidental dermal exposures. The flow distributions are applied by selecting a facility-specific NPDES code in E-FAST 2014. When site-specific or surrogate site-specific stream flow data were not available, flow data based on a representative industry sector were used in the assessment. This includes cases where a receiving facility for an indirect release could not be determined. In such cases, it is likely that the stream concentration estimates are higher than they would be if a facility-specific NPDES code was able to be applied, except in certain cases (*e.g.*, NPDES associated with low-flow or intermittent streams or bays). Additionally, the stream flow data currently available in E-FAST 2014 are 15 to 30 years old and may not represent current conditions at a particular location. Due to the age and spatial resolution of this dataset, the input waterbody flow values may represent either an overestimate or underestimate of actual flow conditions depending on location. Nevertheless, the used datasets represent the most comprehensive and accurate nationwide datasets available for modeling evaluation and analysis.

The use of E-FAST 2014 also estimates waterbody surface water concentrations at the point of release, without considering post-release environmental fate or degradation processes such as volatilization, biodegradation, photolysis, hydrolysis, or partitioning. Additionally, E-FAST 2014 does not estimate stream concentrations based on the potential for downstream transport and dilution. These considerations tend to lead to higher predicted surface water concentrations. Dilution is incorporated, but it is based on the stream flow applied.

Estimated drinking water exposures were based on the assumption that an individual is exposed to potential waterbody concentrations as the point of release without any potential for transport, dilution, or treatment. Estimation of waterbody concentrations at the point of actual drinking water intakes or the distances to these locations was beyond the scope of this evaluation, but in most cases, it would be expected that waterbody concentrations at these locations would be lower even without treatment. Therefore, our analysis represents a higher-end estimate of possible drinking water exposures.

Estimation of incidental dermal and oral exposures used default inputs for exposure time from EPA's SWIMODEL. These exposure time defaults are based on swimming pool use patterns rather than freshwater bodies assumed here and thus represents an uncertainty about the application of swimming pool duration data to this analysis. Additionally, these evaluations are based on estimated waterbody concentrations at the point of release with the assumption that an individual would be incidentally exposed at that location. This assumption represents a higher-end estimate of possible exposure, as activities occurring farther downstream would be expected to have lower waterbody concentrations.

2.4.5 Assumptions and Uncertainties in Risk Characterization

Exposure Duration

This analysis provides exposure and hazard values based on a 24-hour exposure. This assessment assumes that an individual living nearby a facility will be exposed to a chemical at a similar concentration for all hours of the day—either they are present at home all day or remain close-by. This uncertainty may result in an overestimation of exposure and risk, especially for chronic durations, for exposed individuals who may regularly travel farther away from exposure sources and would not be chronically exposed at the same concentration continuously. Similarly, chronic and lifetime exposure and risk estimates are only relevant to individuals who reside at the same location for years or decades. These longer-term exposures would vary for individuals who did not remain within the same range of a particular facility.

Distance Where Risk Identified

IIOAC and AERMOD provided exposure concentrations at discrete distances. EPA calculated risk at modeled discrete distances. Therefore, there is uncertainty of risk between the two distances modeled. For example, if we found risk at 100 meters and we did not find risk at 1000 meters, EPA is uncertain if there is risk at 101 to 999 meters. To not underestimate risk beyond the risk showing distance (*e.g.*, at 101 meters), or overestimate risk closer to the distance where risk was not found (*e.g.*, at 999 meters), remodeling may be required to determine exposure concentrations, and thus calculating risk between the two discrete distances previously modeled.

As discussed in Section 2.1.2.2, EPA review of land use patterns was limited to those facilities with GIS locations that showed risk. Because estimated releases do not have a physical location associated with a facility, EPA was unable to visually examine land use patterns around the theoretical facility. Therefore, EPA was unable to conduct such analysis for alternative release estimates showing risk. Additionally, reported TRI facility's location data (latitude/longitude) may not represent the actual location of the releasing source (e.g., a processes stack).

Potentially Exposed or Susceptible Subpopulations

Human health toxicity values for this analysis incorporate the same considerations for PESS as were described in the respective risk evaluations for each chemical. For oral and dermal exposures, risks were additionally estimated for multiple relevant lifestages and subpopulations, with the most sensitive results (based on elevated exposure) presented in this analysis alongside adult estimates. Inhalation risk estimates are based on air concentrations and were not adjusted for potential lifestage-specific differences, consistent with current EPA guidance which assumes that lifestage-specific differences in inhalation dosimetry are covered by the 10× intraspecies uncertainty factor (UF_H) (U.S. EPA, 2012a).

3 CASE STUDY RESULTS

EPA presents three case study chemicals in this section: two case study chemicals for the air pathway (1-BP and MC) and two case study chemicals for the water pathway (MC and NMP). The purpose of these case study chemicals is to show the application and efficacy of the proposed screening level methodology to estimate releases, potential exposures and capture potential risks to fenceline communities for select pathways not previously evaluated in published risk evaluations. While these case study chemicals are among the seven chemicals for which EPA published risk evaluations between 2020 and 2021 and intends to conduct a screening level analysis following finalization of the screening level methodology and framework development, the results presented here are for illustrative purposes only and not final agency action. Any results, risks, or risk conclusions, as presented here, are not intended to be used to support risk management actions or rulemaking.

3.1 1-Bromopropane (Air Pathway)

3.1.1 Background for 1-BP

1-Bromopropane (1-BP) is a highly volatile, liquid organic compound. It degrades slowly in the atmosphere and can be transported over long distances. Its volatility and biodegradability are such that intermittent releases to surface water are not expected to accumulate. However, continuous releases can lead to persistent concentrations. It has low affinity for organic surfaces and is therefore expected to be mobile in groundwater (U.S. EPA, 2020b). The physical-chemical properties of 1-BP are summarized in Table_Apx A-1.

3.1.2 Human Health Hazard Endpoints for 1-BP

All hazard values used to calculated risk for 1-BP in this report are derived from the previously peer-reviewed PODs published in the Final Risk Evaluation for 1-Bromopropane (U.S. EPA, 2020b). In the Final Risk Evaluation, EPA utilized the endpoints shown in Table 3-1 for risk determination. For 1-BP, distinct human equivalent concentrations (HECs) for non-cancer endpoints were derived for occupational and consumer scenarios. Additionally, an inhalation unit risk (IUR) for lifetime cancer risk was applied for both occupational and consumer scenarios for COUs where it was applicable.

Table 3-1. Hazard Values Used for Risk Estimation in the 1-BP Risk Evaluation

Scenario	Endpoint	Occupational POD	Consumer POD	Benchmark	Reference
Acute	Developmental: Post-implantation loss	17 ppm	6 ppm	100	(W.I.L. Research, 2001)
Chronic	Developmental: Post-implantation loss	17 ppm	6 ppm	100	(W.I.L. Research, 2001)
Cancer	Respiratory adenomas/carcinoma	4E−03 per ppm	6E−03 per ppm	1E-4 (occup.); 1E-6 (cons.)	(NTP, 2011)

For the analyses in this report, EPA derived POD values for fenceline communities based on a continuous exposure scenario. The noncancer HECs were derived from the original benchmark concentration levels (BMCLs) from the animal studies as presented in Table 3-8 of (U.S. EPA, 2020b). The acute and chronic HECs are for the developmental endpoint of post-implantation loss, with a $BMCL_1$ of 23 ppm following 6 hr/day daily inhalation exposure of pregnant rats from pre-mating through gestational day 20. In adjusting for continuous 24 hr/day exposure, the resulting HEC matches the value used for consumers in the Final Risk Evaluation. For cancer, the IUR value used for consumers was already adjusted to continuous exposure and did not require any further extrapolation for evaluation of risks to fenceline communities. The adjusted POD values for fenceline communities are presented below in Table 3-2.

Table 3-2. Hazard Values for 1-BP Used in this Fenceline Analysis

Scenario	Endpoint	Fenceline HEC/IUR	Benchmark	Reference
Acute	Developmental: Post-implantation loss	6 ppm	100	(W.I.L. Research, 2001)
Chronic	Developmental: Post-implantation loss	6 ppm	100	(W.I.L. Research, 2001)
Cancer	Respiratory adenomas/carcinoma	6E−03 per ppm	1E−6	(NTP, 2011)

3.1.2.1 Assumptions and Uncertainties for 1-BP Human Health Hazard

The PODs used for the fenceline analysis match those used in the risk evaluation, so there is no uncertainty associated with any additional extrapolation for fenceline communities. Any other assumptions or uncertainties inherent to the human health hazard assessment in the Final Risk Evaluation for 1-Bromopropane (U.S. EPA, 2020b) are still applicable for this analysis.

3.1.3 Environmental Releases for 1-BP

This case study provides information specific to the 1-BP fenceline environmental release analysis that is not captured in the general methodology described in Section 2.1.1.

3.1.3.1 Step 1: Obtain 2019 TRI Data

For 1-BP, the 2019 TRI dataset used for this fenceline analysis includes a total of 59 sites that reported stack and fugitive air releases (U.S. EPA, 2021). These data include nine Form A submissions and 50 Form R submissions.

3.1.3.2 Step 2: Map 2019 TRI to OES

EPA followed the methodology described in Section 2.1.1.2 to map the facilities in 2019 TRI to the OES in the published 1-BP Risk Evaluation (U.S. EPA, 2020b) (see Appendix E). However, there were a few deviations from this general methodology that EPA encountered during the mapping of 1-BP 2019 TRI sites to OES, which are described below.

- The 1-BP Risk Evaluation is unique in that it makes a distinction between the "Import" and "Repackaging" OES, even though the "Import" OES is expected to also include repackaging operations (U.S. EPA, 2020b). The mapping of the 2019 TRI data to the "Import" and "Repackaging" OES was based largely on the mapping of 2018 TRI (U.S. EPA, 2019b), 2016 TRI (U.S. EPA, 2017), and preliminary 2017 TRI (U.S. EPA, 2020a) data to OES. The assignment of these OES was also informed in part by 2016 CDR (U.S. EPA, 2016b).
- The 2019 TRI data for 1-BP includes many sites that report the TRI uses/sub-uses for "Ancillary or Other use – Cleaner" and "Ancillary or Other use – Degreaser" (U.S. EPA, 2021). EPA was unable to determine the specific types of cleaning or degreasing from the TRI uses/sub-uses, NAICS codes, or internet searches of the facilities. Therefore, for these facilities, EPA assigned the OES as "Degreasing (Batch Vapor Degreaser (Open-Top); Batch Vapor Degreaser (Closed-

Loop); In-Line Vapor Degreaser (Conveyorized); Cold Cleaner." This OES designation is a grouping of the following COUs from the 1-BP Risk Evaluation: Batch Vapor Degreaser (Open-Top), Batch Vapor Degreaser (Closed-Loop), In-Line Vapor Degreaser (Conveyorized), and Cold Cleaner. EPA did not include the OES for Aerosol Spray Degreaser/Cleaner, Dry Cleaning, or Spot Cleaner/Stain Remover in this grouping because facilities conducting these types of cleaning and degreasing are not expected to be captured in TRI because they likely use 1-BP at quantities below the reporting threshold or do not use a NAICS code that is included in a TRI-covered industry sector.

- There were multiple sites in the 1-BP 2019 TRI data set that initially mapped to the COU for "Functional fluids (closed systems) – refrigerant" (U.S. EPA, 2021). However, upon review of NAICS codes and research into these facilities, EPA determined that the COU for "Functional fluids (open system) – cutting oils" was more appropriate because these facilities produce fabricated metal products. The use of 1-BP in metalworking fluids at quantities that would trigger TRI reporting is much more likely than the use of 1-BP in refrigerant flushes at these types of sites.
- One facility reported the TRI use/sub-use for "Processing: Repackaging"; however, this facility reported the NAICS code 562211, Hazardous Waste Treatment and Disposal (U.S. EPA, 2021). Based on the NAICS code, EPA assigned the "Disposal and Recycling" OES. An additional site reported the TRI use/sub-use of "Ancillary or other use as a fuel" and the NAICS code 327310, Cement Manufacturing. Because 1-BP is not typically used in cement manufacturing, EPA interpreted this as the combustion of 1-BP in an incineration process with energy recovery, which is covered in the "Disposal and Recycling" OES (U.S. EPA, 2021).

The 1-BP fenceline analysis spreadsheet, *SF_FLA_Environmental Releases to Ambient Air for 1-BP* (Appendix B), contains the rationale for the mapping of each facility in 2019 TRI to an OES. Refer to this spreadsheet for details of the mapping at the facility-level.

3.1.3.3 Step 3: Estimate Number of Release Days for Each OES

EPA estimated the number of release days for each 1-BP OES according to the methodology in Section 2.1.1.3. Specifically, the number of release days was assumed to be equal to the number of operating days, which were estimated for each OES as shown in Table 3-3.

Table 3-3. Number of Release Days for Each 1-BP OES

OES	Number of Release Days (days/year)	Basis for Number of Release Days
Manufacture	350	Number of release days for "Manufacture of Solvents" discussed in Section 2.1.1.3
Import	250	Number of release days for "All Other Scenarios"
Processing as a Reactant	350	Number of release days for "Processing as a Reactant"
Processing – Incorporation into Formulation, Mixture, or Reaction Product	300	Number of release days for "Other Chemical Plant Scenarios"
Processing – Incorporation into Articles	250	Number of release days for "All Other Scenarios"
Repackaging	250	Number of release days for "All Other Scenarios"

OES	Number of Release Days (days/year)	Basis for Number of Release Days
Degreasing, which includes the following OES: Batch Vapor Degreasing (Open-Top) Batch Vapor Degreasing (Closed-Loop) In-line Vapor Degreasing (Conveyorized) Cold Cleaning	260	Vapor Degreasing ESD (Organization for Economic and Develop.m.ent, 2017)
Aerosol Spray Degreaser/Cleaner	260 (low-end) and 364 (high-end)	Brake Servicing Near-Field/Far-Field Inhalation Exposure Model
Dry Cleaning	250 (low-end) and 312 (high-end)	Dry Cleaning Multi-Zone Inhalation Exposure Model
Spot Cleaner/Stain Remover	289 (50th percentile) and 307 (95th percentile)	Spot Cleaning Near-Field/Far-Field Inhalation Exposure Model
Spray Adhesives	260	Based on 5 days/week and 52 weeks/year per literature (Trinity Consultants, 2015)
THERMAX Installation	N/A	Ambient air release estimates are not provided for this OES because it is specific to occupational and consumer exposures resulting from off-gassing of 1-BP from the installed product and not expected to result in exposure to fenceline communities.
Other Uses – Cutting Oils	250	Number of release days for "All Other Scenarios"
Other Uses – Asphalt Extraction	250	Number of release days for "All Other Scenarios"
Disposal and Recycling	250	Number of release days for "All Other Scenarios"

3.1.3.4 Step 4: Estimate Air Emissions for OES with No TRI Data

A summary of the air release assessment approaches for each 1-BP OES is included in Table 3-4. Of the 15 OES listed in in Table 3-4, 7 have directly applicable 2019 TRI data that were used. For the remaining eight OES without 2019 TRI data, EPA used the hierarchy of alternate air assessment approaches described in Section 2.1.1.4. Specifically, EPA estimated air releases with past years' TRI data for three OES, modeling for two OES, literature values for one OES, and a combination of modeling and literature values for one OES. Air estimates are not required for the remaining one OES.

Table 3-4. Summary of Air Release Estimation Approaches for Each 1-BP OES

OES	Range of Annual Fugitive Air Release (kg/site-yr)	Range of Annual Stack Air Release (kg/site-yr)	Air Release Estimation Approach	Notes
Manufacture	227 to 3,045[f g]	227 to 2,307[f g]	2019 TRI (U.S. EPA, 2021)	2019 TRI data are available for two sites (one Form A).
Import	227 (same for all sites)[g]	227 (same for all sites)[g]	2019 TRI (U.S. EPA, 2021)	2019 TRI data are available for four sites (all Form As).
Processing as a Reactant	635 (same for all years)[f]	1.36 to 2.72[f]	Past years' TRI data (U.S. EPA, 2020a, 2019b, 2017)	2019 TRI data are not available for this OES. However, one site reported use of 1-BP as a reactant in 2016 through 2018 TRI (this site did not report for 1-BP in 2019 TRI). Because only three data points are available, EPA presented the central tendency (50th percentile) and maximum of these three years' data for fugitive and stack air releases for this site.
Processing – Incorporation into Formulation, Mixture, or Reaction Product	0 to 1,105[c d e f g]	0 to 340[c d e f g]	2019 TRI (U.S. EPA, 2021)	2019 TRI data are available for 11 sites (three Form As).
Processing – Incorporation into Articles	508 to 520[e]	943 to 974[e]	Past years' TRI data (U.S. EPA, 2020a, 2019b, 2017)	2019 TRI data are not available for this OES. However, one site reported use of 1-BP for articles in 2016 through 2018 TRI (this site did not report for 1-BP in 2019 TRI). Because only three data points are available, EPA presented the central tendency (50th percentile) and maximum of these three years' data for fugitive and stack air releases for this site.
Repackaging	88 (1 site)[c]	0 (1 site)	2019 TRI (U.S. EPA, 2021)	2019 TRI data are available for one site (not a Form A).
Degreasing, which includes the following OES: Batch Vapor Degreasing (Open-Top), Batch Vapor	0 to 53,319[a c d e f g]	0 to 50,615[a c e f g]	2019 TRI (U.S. EPA, 2021)	2019 TRI data are available for 34 sites (one Form A).

OES	Range of Annual Fugitive Air Release (kg/site-yr)	Range of Annual Stack Air Release (kg/site-yr)	Air Release Estimation Approach	Notes
Degreasing (Closed-Loop), In-line Vapor Degreasing (conveyorized), Cold Cleaning				
Aerosol Spray Degreaser/ Cleaner	277 (CT) to 377 (HE)	0 (all fugitive)	Modeling	2019 TRI data and past years' TRI data are not available for this OES. EPA modeled air releases from this OES using the *Brake Servicing Near-Field/Far-Field Inhalation Exposure Model*.
Dry Cleaning	57 to 1,294	0 (all fugitive)	Literature (Trinity Consultants, 2015) and modeling (pending discussion with exposure assessors)	2019 TRI data and past years' TRI data are not available for this OES. 1-BP emission data are available in a Trinity report (Trinity Consultants, 2015) for two companies (data are from 2014). The Trinity report is cited in the published 1-BP Risk Evaluation. EPA presented these emission data for each company, assuming the releases were entirely to fugitive air. The data available from the Trinity report were insufficient to calculate a 50th and 95th percentile, so the low-end and high-end values were presented. In addition to air releases for air modeling for fenceline communities, EPA required air release modeling for co-residence communities (people who live in a building with a dry cleaner on the ground floor) using the model for 3rd generation dry cleaning machines (U.S. EPA, 2020b).
Spot Cleaner/ Stain Remover	75.3 (CT) to 80 (HE)	0 (all fugitive)	Modeling	2019 TRI data and past years' TRI data are not available for this OES. EPA adapted the Spot Cleaning Model and ran it to estimate daily air emissions for this OES.
Spray Adhesives	0 (1 site, all stack)	614 (1 site)	Literature (Trinity	2019 TRI data and past years' TRI data are not available for this OES. Additionally, there are no current

OES	Range of Annual Fugitive Air Release (kg/site-yr)	Range of Annual Stack Air Release (kg/site-yr)	Air Release Estimation Approach	Notes
			Consultants, 2015)	applicable modeling approaches for this OES. 1-BP emission data are available in the Trinity report (Trinity Consultants, 2015) for one company (data are from 2013). The Trinity report is cited in the published 1-BP Risk Evaluation. EPA presented these emission data, which the report indicates are entirely to stack air.
THERMAX Installation	N/A	N/A	N/A	Ambient air release estimates are not provided for this OES because it is specific to occupational and consumer exposures resulting from off-gassing of 1-BP from the installed product and not expected to result in exposure to fenceline communities.
Other Uses – Cutting Oils	0 to 663[b c f]	0 to 207[b f]	2019 TRI (U.S. EPA, 2021)	2019 TRI data are available for five sites for use of 1-BP in functional fluids (open system) - cutting oils (no Form As).
Other Uses – Asphalt Extraction	7,235 (1 site)[b]	9,862 (1 site)[d]	Past years' TRI data (U.S. EPA, 2020a, 2019b, 2017)	2019 TRI data are not available for this OES. However, data are available for the asphalt extraction OES for one site in 2016 and 2017 TRI (this site did not report for 1-BP to 2018 or 2019 TRI). EPA presented these 2016 and 2017 TRI data for this one site. Note that for year 2016, these air releases were reported entirely to fugitive air, and for year 2017, these air releases were reported entirely to stack air.
Disposal and Recycling	18.1 to 29.3[f]	5.22 to 5.31[f]	2019 TRI (U.S. EPA, 2021)	2019 TRI data are available for two sites (no Form A's).

[a] This range includes estimates based on continuous monitoring data or measurements.
[b] This range includes estimates based on periodic or random monitoring data or measurements .
[c] This range includes estimates based on mass balance calculations, such as calculation of the amount in streams entering and leaving process equipment.
[d] This range includes estimates based on published emissions factors, such as those relating release quantity to through-put or equipment type (*e.g.*, air emissions factors).
[e] This range includes estimates based on site-specific emissions factors, such as those relating release quantity to through-put or equipment type (*e.g.*, air emissions factors).
[f] This range includes estimates based on other approaches such as engineering calculations (*e.g.*, estimating volatilization using published mathematical formulas) or best engineering judgment.

OES	Range of Annual Fugitive Air Release (kg/site-yr)	Range of Annual Stack Air Release (kg/site-yr)	Air Release Estimation Approach	Notes
[g] This range includes Form A submissions, for which EPA used the entire 500 lb/year for both the fugitive and stack air release estimates; however, since this threshold is for total site releases, these 500 lb/year are either to fugitive air or stack air for this analysis, not both.				

3.1.3.5 Step 5: Prepare Air Emission Summary for Ambient Air Exposure Modeling

Using the work completed in Steps 1 through 4, EPA compiled a summary of air releases on a per-site basis for each 1-BP OES, in the format of Table 2-1. See the supplemental fenceline analysis spreadsheet *SF_FLA_Environmental Releases to Ambient Air for 1-BP* (Appendix B) for this summary. To model exposures resulting from these air emissions, EPA used the daily emissions, site identity and location information, and release duration and pattern information from this summary. Additional information on the modeled 1-BP exposures is provided in the next section.

3.1.4 Exposures for 1-BP

All three fenceline exposure methodologies (pre–screening, screening, and co-resident screening) were utilized to evaluate potential exposures to fenceline communities for 1-BP.

Pre-screening Analysis

Pre-screening work for 1-BP is included in Appendix D. Inputs for all IIOAC model runs for all exposure scenarios are included in Supplemental File *SF_FLA_Air Pathway Input Parameters for IIOAC for 1-BP and MC* (Appendix B). Based on the pre-screening analysis, there is an indication of potential exposures and associated risks to fenceline communities and therefore EPA conducted a full-screening level analysis for 1-BP.

Full-Screening Analysis

A total of 14 OES were evaluated for 1-BP as presented in Table 3-5. A total of 59 real facilities and 5 surrogate facilities were modeled. Exposure modeling was also performed for those OES where releases were estimated, although there is no real facility associated with those estimates and therefore a "number of facilities" is not available for those OES. Inputs for all AERMOD model runs for all exposure scenarios are included in Supplemental File SF_FLA_*Air Pathway Input Parameters for AERMOD for 1-BP and MC* (Appendix B).

Table 3-5. Fenceline Community Exposure Scenarios for 1-BP

OES	Release Data Source	Number of Facilities in OES[a]
Aerosol Spray Degreaser/Cleaner	Estimate	–
Asphalt Extraction	TRI (2016–2017)	1 surrogate
Degreasing	TRI (2019)	34
Dry-Cleaning	Estimate	– (2 surrogate)
Processing into Formulation	TRI	11
Import	TRI	4

OES	Release Data Source	Number of Facilities in OES[a]
Processing-Incorporation into Articles	TRI (2016–2018)	1 surrogate
Manufacturing	TRI	2
Other Uses – Cutting Oils	TRI	5
Processing as Reactant	TRI (2016–2018)	1 surrogate
Recycling and Disposal	TRI	2
Repackaging	TRI	1
Spot Cleaner/Stain Remover	Estimate	–
Spray Adhesives	Estimate	–
	Total	**59 (+5 surrogate)**

[a] When (–) is indicated for the number of facilities in OES, no facilities were identified via TRI reporting. The provided estimates are based on modeling of theoretical facilities.

Modeling results for inhalation exposure concentrations are categorized by OES and presented by facility. Daily and annual average concentrations are summarized for three percentile concentrations (10th, 50th, 95th) to cover the range of exposure concentrations across all nine distances modeled (5, 10, 30, 60, 100, 100 to 1,000, 2,500, 5,000, and 10,000 meters) and can be found in the Supplemental File SF_FLA_*Air Pathway Full-Screen Results for 1-BP* (Appendix B). Exposure concentrations are presented as a total concentration to inform the total exposure to a given receptor at each modeled distance from each releasing facility. EPA did not identify air monitoring data to which modeled concentrations could be compared at the distances modeled.

EPA conducted a source attribution analysis which provides exposure concentrations from each release type (fugitive and stack) at each modeled distance for each facility in anticipation of informing future risk management actions and the potential need for a more detailed analysis if risks are identified. For facilities reporting both fugitive and stack releases within TRI, adding the exposure concentrations for each release type at each modeled distance provides the total concentration used for risk calculation purposes in this report.

EPA further distilled exposure results for the 95th percentile values across all facilities within each OES, at all nine distances modeled, and is presenting them in Table 3-6. The purpose of this further distillation is to present a smaller subset of results within the body of this report. The further distilled results presented here are carried into the risk characterization section of the body of this report for risk calculation purposes.

The minimum and maximum concentrations in Table 3-6 represent the lowest and highest 95th percentile concentrations, respectively, among all facilities categorized into the respective OES at each distance modeled. The mean 95th percentile concentrations in Table 3-6 represent arithmetic averages across all facilities within the given OES at each distance modeled. Additionally, for certain OES, there are a variety of industry types and release points (stack, fugitive, stack, and fugitive) categorized within an OES which may not be directly comparable. This results in a wide range of modeled exposure concentrations which, in some cases, extends over many orders of magnitude. For example, in the degreaser OES, there are 34 facilities that may include open-top degreasers, batch degreasers, closed-loop degreasers, and others. Although releases within an industry type may be comparable, releases across industry types may have considerably different emission profiles and therefore may not be comparable. Further, looking at the release points, EPA found that fugitive releases do not have much lift or dispersion resulting in higher concentrations very near facilities (around 10 meters) and lower concentrations around 100 meters. In contrast, stack releases often have more lift and dispersion resulting in lower concentrations around 10 meters and higher concentrations around 100 meters. Even with these different concentration profiles, the modeled exposure concentrations from stacks are still several orders of magnitude lower than fugitive concentrations. This can skew the mean of the 95th percentile modeled concentrations across multiple facilities orders of magnitude lower, thus underestimating exposures and associated risks.

1 **Table 3-6. 95th Percentile Exposure Concentration Summary across Facilities within Each OES for 1-BP**

OES[a]	Number of TRI Facilities Evaluated [b]	Distance from Facility (meters)	Concentration (ppm)							
			Daily Average				Annual Average			
			Single Facility	Minimum	Arithmetic Mean	Maximum	Single Facility	Minimum	Arithmetic Mean	Maximum
Aerosol Spray Degreaser/ Cleaner		5		3.92E−03	6.70E−03	9.91E−03		8.11E−04	1.83E−03	3.08E−03
		10		6.91E−03	9.65E−03	1.27E−02		1.47E−03	2.57E−03	3.88E−03
		30		2.81E−03	3.39E−03	3.97E−03		5.83E−04	8.13E−04	1.08E−03
		60		9.54E−04	1.17E−03	1.40E−03		2.12E−04	2.78E−04	3.49E−04
		100		3.55E−04	4.42E−04	5.40E−04		8.30E−05	1.06E−04	1.30E−04
		100–1,000		9.22E−06	1.11E−05	1.31E−05		5.61E−06	6.93E−06	8.22E−06
		2,500		3.49E−07	4.24E−07	5.07E−07		8.65E−08	1.29E−07	2.10E−07
		5,000		9.58E−08	1.19E−07	1.41E−07		2.40E−08	3.97E−08	6.78E−08
		10,000		3.08E−08	4.44E−08	5.88E−08		1.04E−08	1.64E−08	2.69E−08
Asphalt Extraction	1	5	7.59E−02				2.88E−02			
		10	1.57E−01				6.77E−02			
		30	8.57E−02				3.73E−02			
		60	3.71E−02				1.62E−02			
		100	1.92E−02				8.46E−03			
		100–1,000	1.62E−03				8.43E−04			
		2,500	1.72E−04				6.39E−05			
		5,000	5.89E−05				2.13E−05			
		10,000	1.98E−05				7.04E−06			

OES[a]	Number of TRI Facilities Evaluated [b]	Distance from Facility (meters)	Concentration (ppm)							
			Daily Average				Annual Average			
			Single Facility	Minimum	Arithmetic Mean	Maximum	Single Facility	Minimum	Arithmetic Mean	Maximum
Degreasing	34	5		1.79E−12	1.96E−01	1.79E+00		3.19E−11	6.69E−02	6.53E−01
		10		3.29E−10	2.46E−01	2.13E+00		2.16E−09	8.50E−02	8.23E−01
		30		2.12E−06	8.27E−02	6.43E−01		5.21E−07	2.69E−02	2.42E−01
		60		1.48E−05	3.08E−02	2.28E−01		5.60E−06	9.74E−03	8.32E−02
		100		3.15E−05	1.37E−02	9.53E−02		1.26E−05	4.27E−03	3.48E−02
		100–1,000		7.13E−06	8.41E−04	5.30E−03		4.20E−06	4.52E−04	3.01E−03
		2,500		1.04E−06	7.27E−05	4.09E−04		3.25E−07	2.10E−05	1.42E−04
		5,000		5.01E−07	2.58E−05	1.62E−04		1.39E−07	7.37E−06	4.62E−05
		10,000		1.99E−07	9.20E−06	6.93E−05		6.25E−08	2.77E−06	1.82E−05
Dry Cleaning	–	5		7.10E−04	9.66E−03	3.73E−02		1.59E−04	2.99E−03	1.37E−02
		10		1.22E−03	1.32E−02	4.55E−02		2.91E−04	4.18E−03	1.71E−02
		30		5.89E−04	5.25E−03	1.64E−02		1.37E−04	1.54E−03	5.80E−03
		60		2.27E−04	2.07E−03	6.68E−03		5.15E−05	5.85E−04	2.26E−03
		100		9.85E−05	9.01E−04	2.97E−03		2.22E−05	2.60E−04	1.04E−03
		100–1,000		4.95E−06	4.40E−05	1.46E−04		2.40E−06	2.80E−05	1.05E−04
		2,500		2.54E−07	2.49E−06	7.81E−06		7.54E−08	1.30E−06	5.44E−06
		5,000		6.92E−08	7.08E−07	2.18E−06		2.50E−08	4.27E−07	1.90E−06
		10,000		2.29E−08	2.31E−07	7.20E−07		8.61E−09	1.44E−07	6.63E−07

OES[a]	Number of TRI Facilities Evaluated [b]	Distance from Facility (meters)	Concentration (ppm)							
			Daily Average				Annual Average			
			Single Facility	Minimum	Arithmetic Mean	Maximum	Single Facility	Minimum	Arithmetic Mean	Maximum
Processing into Formulation	11	5		2.41E−11	5.73E−03	2.55E−02		2.20E−11	2.29E−03	1.17E−02
		10		7.63E−10	7.28E−03	3.87E−02		8.07E−10	3.02E−03	1.62E−02
		30		4.22E−07	2.91E−03	1.83E−02		1.50E−07	1.22E−03	8.04E−03
		60		6.70E−06	1.19E−03	7.80E−03		2.47E−06	4.95E−04	3.41E−03
		100		1.72E−05	5.78E−04	3.84E−03		6.01E−06	2.38E−04	1.67E−03
		100–1,000		5.57E−06	4.67E−05	3.06E−04		2.70E−06	2.59E−05	1.72E−04
		2,500		6.54E−07	4.23E−06	2.49E−05		2.01E−07	1.46E−06	8.93E−06
		5,000		2.51E−07	1.54E−06	8.55E−06		7.63E−08	5.06E−07	2.89E−06
		10,000		8.70E−08	5.59E−07	2.95E−06		2.82E−08	1.78E−07	9.46E−07
Import	4	5		7.82E−16	2.92E−03	7.09E−03		3.06E−13	6.37E−04	1.56E−03
		10		9.90E−12	4.41E−03	1.03E−02		2.98E−10	8.76E−04	1.95E−03
		30		1.03E−06	1.46E−03	3.12E−03		3.52E−07	2.55E−04	5.72E−04
		60		2.64E−05	4.91E−04	9.90E−04		6.52E−06	8.81E−05	1.89E−04
		100		5.65E−05	2.02E−04	3.62E−04		1.28E−05	3.78E−05	6.86E−05
		100–1,000		5.59E−06	6.37E−06	7.38E−06		3.40E−06	4.12E−06	5.23E−06
		2,500		1.53E−07	1.94E−07	2.40E−07		5.54E−08	6.41E−08	7.61E−08
		5,000		1.69E−08	3.94E−08	6.55E−08		1.76E−08	2.17E−08	2.76E−08
		10,000		1.57E−09	1.04E−08	1.92E−08		7.86E−09	1.01E−08	1.32E−08

OES[a]	Number of TRI Facilities Evaluated [b]	Distance from Facility (meters)	Concentration (ppm)							
			Daily Average				Annual Average			
			Single Facility	Minimum	Arithmetic Mean	Maximum	Single Facility	Minimum	Arithmetic Mean	Maximum
Processing–Incorporation into Articles	1	5	1.86E−02				5.03E−03			
		10	1.99E−02				5.52E−03			
		30	6.36E−03				1.74E−03			
		60	2.48E−03				6.73E−04			
		100	1.18E−03				3.26E−04			
		100–1,000	1.12E−04				5.39E−05			
		2,500	1.26E−05				3.07E−06			
		5,000	4.44E−06				1.04E−06			
		10,000	1.51E−06				3.50E−07			
Manufacturing	2	5		2.86E−10	3.87E−02	1.08E−01		1.86E−10	1.45E−02	4.06E−02
		10		4.80E−09	5.19E−02	1.45E−01		1.70E−09	1.96E−02	5.48E−02
		30		9.30E−07	1.82E−02	5.08E−02		2.44E−07	7.48E−03	2.09E−02
		60		1.01E−05	7.45E−03	2.08E−02		3.95E−06	3.00E−03	8.39E−03
		100		2.30E−05	3.52E−03	9.83E−03		8.94E−06	1.41E−03	3.94E−03
		100–1,000		7.95E−06	2.89E−04	8.03E−04		3.83E−06	1.67E−04	4.65E−04
		2,500		2.02E−06	2.69E−05	7.45E−05		6.55E−07	8.86E−06	2.46E−05
		5,000		9.75E−07	1.05E−05	2.91E−05		2.94E−07	3.16E−06	8.75E−06
		10,000		4.41E−07	4.08E−06	1.13E−05		1.27E−07	1.15E−06	3.17E−06

OES[a]	Number of TRI Facilities Evaluated [b]	Distance from Facility (meters)	Concentration (ppm)							
			Daily Average				Annual Average			
			Single Facility	Minimum	Arithmetic Mean	Maximum	Single Facility	Minimum	Arithmetic Mean	Maximum
Other Uses – Cutting Oil	5	5		7.89E−10	8.32E−03	3.81E−02		4.38E−07	3.63E−03	1.69E−02
		10		1.47E−06	8.53E−03	3.66E−02		2.68E−06	4.16E−03	1.87E−02
		30		4.13E−05	2.75E−03	1.10E−02		1.12E−05	1.36E−03	5.91E−03
		60		1.76E−05	1.04E−03	4.04E−03		8.44E−06	5.12E−04	2.18E−03
		100		8.84E−06	4.76E−04	1.79E−03		4.20E−06	2.32E−04	9.73E−04
		100–1,000		7.59E−07	3.29E−05	1.19E−04		4.36E−07	2.04E−05	7.81E−05
		2,500		7.33E−08	2.68E−06	9.11E−06		2.78E−08	1.17E−06	4.51E−06
		5,000		2.99E−08	8.98E−07	3.04E−06		1.04E−08	3.79E−07	1.44E−06
		10,000		1.20E−08	3.05E−07	1.04E−06		3.95E−09	1.23E−07	4.65E−07
Processing as Reactant	1	5	9.90E−03				3.61E−03			
		10	1.43E−02				5.66E−03			
		30	6.10E−03				2.30E−03			
		60	2.49E−03				9.16E−04			
		100	1.16E−03				4.26E−04			
		100–1,000	8.19E−05				5.03E−05			
		2,500	6.45E−06				1.94E−06			
		5,000	2.13E−06				6.35E−07			
		10,000	7.07E−07				2.10E−07			

OES[a]	Number of TRI Facilities Evaluated [b]	Distance from Facility (meters)	Concentration (ppm)							
			Daily Average				Annual Average			
			Single Facility	Minimum	Arithmetic Mean	Maximum	Single Facility	Minimum	Arithmetic Mean	Maximum
Recycling and Disposal	2	5		2.68E−04	3.90E−04	5.11E−04		7.19E−05	1.05E−04	1.38E−04
		10		5.00E−04	7.00E−04	8.99E−04		1.48E−04	1.93E−04	2.37E−04
		30		2.64E−04	3.61E−04	4.57E−04		7.50E−05	9.65E−05	1.18E−04
		60		1.09E−04	1.52E−04	1.95E−04		3.02E−05	3.94E−05	4.86E−05
		100		5.43E−05	7.50E−05	9.57E−05		1.42E−05	1.91E−05	2.39E−05
		100–1,000		3.88E−06	5.53E−06	7.18E−06		1.82E−06	2.63E−06	3.44E−06
		2,500		3.53E−07	4.88E−07	6.22E−07		7.26E−08	1.05E−07	1.38E−07
		5,000		1.15E−07	1.63E−07	2.11E−07		2.42E−08	3.51E−08	4.60E−08
		10,000		3.88E−08	5.30E−08	6.72E−08		8.20E−09	1.19E−08	1.55E−08
Repackaging	1	5	2.69E−03				6.19E−04			
		10	3.84E−03				8.12E−04			
		30	1.24E−03				2.32E−04			
		60	3.96E−04				7.48E−05			
		100	1.42E−04				2.73E−05			
		100–1,000	2.79E−06				1.82E−06			
		2,500	6.84E−08				3.62E−08			
		5,000	1.04E−08				1.40E−08			
		10,000	1.22E−09				7.11E−09			

OES[a]	Number of TRI Facilities Evaluated [b]	Distance from Facility (meters)	Concentration (ppm)							
			Daily Average				Annual Average			
			Single Facility	Minimum	Arithmetic Mean	Maximum	Single Facility	Minimum	Arithmetic Mean	Maximum
Spot Cleaner/Stain Remover	–	5		1.03E−03	1.54E−03	2.03E−03		2.12E−04	4.41E−04	6.74E−04
		10		1.84E−03	2.25E−03	2.64E−03		3.94E−04	6.27E−04	8.66E−04
		30		7.58E−04	8.00E−04	8.40E−04		1.60E−04	2.01E−04	2.43E−04
		60		2.58E−04	2.77E−04	2.98E−04		5.89E−05	6.90E−05	7.89E−05
		100		9.61E−05	1.05E−04	1.14E−04		2.35E−05	2.66E−05	2.95E−05
		100–1,000		2.55E−06	2.74E−06	2.93E−06		1.67E−06	1.82E−06	2.08E−06
		2,500		9.40E−08	1.04E−07	1.17E−07		2.52E−08	3.37E−08	4.60E−08
		5,000		2.77E−08	2.92E−08	3.15E−08		6.85E−09	1.02E−08	1.48E−08
		10,000		9.60E−09	1.10E−08	1.22E−08		2.82E−09	4.02E−09	5.59E−09
Spray Adhesives	–	5	1.68E−11				5.01E−11			
		10	1.66E−08				6.42E−09			
		30	9.56E−06				2.48E−06			
		60	7.33E−05				2.35E−05			
		100	1.33E−04				4.34E−05			
		100–1,000	1.63E−05				1.03E−05			
		2,500	8.95E−07				2.90E−07			
		5,000	3.58E−07				1.11E−07			
		10,000	1.62E−07				5.08E−08			

OES[a]	Number of TRI Facilities Evaluated [b]	Distance from Facility (meters)	Concentration (ppm)							
			Daily Average				Annual Average			
			Single Facility	Minimum	Arithmetic Mean	Maximum	Single Facility	Minimum	Arithmetic Mean	Maximum

[a] Thermax Installation was not evaluated for general population exposure as it is an indoor installation activity and EPA does not expect general population exposure to occur from such activity. Thermax Installation was evaluated for occupational and consumer exposure as a condition of use in the 2020 published risk evaluation for 1-BP.

[b] When (–) is indicated for the total number of facilities, no facilities were identified via TRI reporting. The provided estimates are based on modeling of theoretical facilities.

Co-resident Analysis

EPA evaluated one OES (dry-cleaning) using the co-resident screening methodology. Site specific emission data was not identified for dry-cleaners using 1-BP so far-field indoor air concentrations within the dry-cleaner shop were modeled, and estimated emission rates were for third generation dry-cleaning machines. For this work, all emissions from dry cleaning activities are assumed to be fugitive emissions. EPA considered both dry-cleaning and spot-cleaning operations for 1-BP.

Estimated emission rates were provided for nine emission scenarios, representing a variety of operational scales, conditions, and source strengths. Exposure scenarios include two building configurations, each with two different methods for estimating Q12, resulting in a total of 36 exposure scenarios which were modeled with IECCU. Table 3-7 provides a summary of the 36 exposure scenarios evaluated for 1-BP co-resident analysis. Inputs for all IECCU model runs for all exposure scenarios are included in Supplemental File *SF_FLA_Air Pathway Information for Co-Resident Exposure Modeling for 1-BP* (Appendix B).

Table 3-7. Simulation Matrix for Evaluating Co-resident Exposures from Dry-Cleaning Operations (IECCU) for 1-BP

Serial No.	Building Type	Method for Estimating Q12	1-BP Emission Scenario	Model File Name
1	B1 –Two zones – architecturally separated	Method 1 – Literature (monitored)	1	01-B1-M1-S1.IEC
2			2	02-B1-M1-S2.IEC
3			3	03-B1-M1-S3.IEC
4			4	04-B1-M1-S4.IEC
5			5	05-B1-M1-S5.IEC
6			6	06-B1-M1-S6.IEC
7			7	07-B1-M1-S7.IEC
8			8	08-B1-M1-S8.IEC
9			9	09-B1-M1-S9.IEC
10		Method 2 – Stack effect	1	10-B1-M2-S1.IEC
11			2	11-B1-M2-S2.IEC
12			3	12-B1-M2-S3.IEC
13			4	13-B1-M2-S4.IEC
14			5	14-B1-M2-S5.IEC
15			6	15-B1-M2-S6.IEC
16			7	16-B1-M2-S7.IEC
17			8	17-B1-M2-S8.IEC
18			9	18-B1-M2-S9.IEC

Serial No.	Building Type	Method for Estimating Q12	1-BP Emission Scenario	Model File Name
19	B2 – Two zones – architecturally inter-connected	Method 3 –Literature (recommended)	1	19-B2-M3-S1.IEC
20			2	20-B2-M3-S2.IEC
21			3	21-B2-M3-S3.IEC
22			4	22-B2-M3-S4.IEC
23			5	23-B2-M3-S5.IEC
24			6	24-B2-M3-S6.IEC
25			7	25-B2-M3-S7.IEC
26			8	26-B2-M3-S8.IEC
27			9	27-B2-M3-S9.IEC
28		Method 4 – HVAC Recirculation Rate	1	28-B2-M4-S1.IEC
29			2	29-B2-M4-S2.IEC
30			3	30-B2-M4-S3.IEC
31			4	31-B2-M4-S4.IEC
32			5	32-B2-M4-S5.IEC
33			6	33-B2-M4-S6.IEC
34			7	34-B2-M4-S7.IEC
35			8	35-B2-M4-S8.IEC
36			9	36-B2-M4-S9.IEC

The maximum and central tendency unadjusted 24-hour TWA and adjusted annual TWA predicted 1-BP concentrations from IECCU are summarized in Table 3-8. All exposure concentrations and associated calculated TWA values for all IECCU model runs for all exposure scenarios are included in Supplemental File SF_FLA_*Air Pathway Information for Co-Resident Exposure Modeling for 1-BP* (Appendix B).

Table 3-8. Predicted 1-BP Concentrations for Co-resident Apartment

Building Configuration	Method for Estimating Q12	Predicted 1-BP Concentrations (ppm)			
		Unadjusted 24-hour TWA		Adjusted Annual TWA	
		High End	Central Tendency	High End	Central Tendency
B1	Method 1 (Q_{12} = 0.822 m^3/hr)	0.10	0.02	0.09	0.02
	Method 2 (Q_{12} = 3.39 m^3/hr)	0.42	0.07	0.36	0.06
B2	Method 3 (Q_{12} = 134 m^3/hr)	5.15	1.16	4.41	0.95
	Method 4 (Q_{12} = 1,960 m^3/hr)	5.16	1.35	4.41	1.11

3.1.5 Risk Characterization for 1-BP

3.1.5.1 Fenceline Inhalation Risk for 1-BP

EPA calculated risk estimates for each of the endpoints in Table 3-2 across all known TRI reporters and other modeled facilities under each OES. EPA calculated risk estimates for each facility using the 10th, 50th, and 95th percentile of modeled exposure concentrations around the releasing facility. The 95th percentile estimates were then further distilled across facilities within a given OES to present the range from minimum to maximum risk.

Based on the 95th percentile values, risks were indicated for at least one facility relative to benchmarks for 13 of 14 OES. Risks were not indicated for any OES beyond 1,000 m from a facility. These results are summarized below in Table 3-9. Results for 10th and 50th percentile measurements along with facility-specific results are provided in SF_FLA_*Air Pathway Full-Screen Results for 1-BP* (Appendix B).

Table 3-9. 1-BP Inhalation Risk across OES at Various Distances from Releasing Facility (Based on 95th Percentile Exposure Concentrations)

Occupational Exposure Scenario	Number of TRI Facilities		Distance from Facility (meters)	Estimated MOE								Estimated Cancer Risk			
				Non-cancer								Cancer (Benchmark 1E−06)			
				Acute (Benchmark 100)				Chronic (Benchmark 100)							
	Total [a]	w/ Risk		Single Facility	Min Risk [b]	Mean Risk [c]	Max Risk [d]	Single Facility	Min Risk	Mean Risk	Max Risk	Single Facility	Min Risk	Mean Risk	Max Risk
Aerosol Spray Degreaser/ Cleaner	–	–	5	N/A	1,531	895	605	N/A	7,398	3,271	1,948	N/A	**4.9E−06**	**1.1E−05**	**1.8E−05**
			10	N/A	868	622	472	N/A	4,082	2,337	1,546	N/A	**8.8E−06**	**1.5E−05**	**2.3E−05**
			30	N/A	2,135	1,771	1,511	N/A	1.0E+04	7,377	5,556	N/A	**3.5E−06**	**4.9E−06**	**6.5E−06**
			60	N/A	6,289	5,131	4,286	N/A	2.8E+04	2.2E+04	1.7E+04	N/A	**1.3E−06**	**1.7E−06**	**2.1E−06**
			100	N/A	1.7E+04	1.4E+04	1.1E+04	N/A	7.2E+04	5.7E+04	4.6E+04	N/A	5.0E−07	6.4E−07	7.8E−07
			100–1,000	N/A	6.5E+05	5.4E+05	4.6E+05	N/A	1.1E+06	8.7E+05	7.3E+05	N/A	3.4E−08	4.2E−08	4.9E−08
			2,500	N/A	1.7E+07	1.4E+07	1.2E+07	N/A	6.9E+07	4.7E+07	2.9E+07	N/A	5.2E−10	7.7E−10	1.3E−09
			5,000	N/A	6.3E+07	5.1E+07	4.3E+07	N/A	2.5E+08	1.5E+08	8.8E+07	N/A	1.4E−10	2.4E−10	4.1E−10
			10,000	N/A	1.9E+08	1.4E+08	1.0E+08	N/A	5.8E+08	3.7E+08	2.2E+08	N/A	6.2E−11	9.8E−11	1.6E−10
Asphalt Extraction	1	1	5	**79**	–	–	–	208	–	–	–	**1.7E−04**			
			10	**38**	–	–	–	**89**	–	–	–	**4.1E−04**			
			30	**70**	–	–	–	161	–	–	–	**2.2E−04**			
			60	162	–	–	–	370	–	–	–	**9.7E−05**			
			100	313	–	–	–	709	–	–	–	**5.1E−05**			
			100–1,000	3,704	–	–	–	7,117	–	–	–	**5.1E−06**			
			2,500	3.4E+3	–	–	–	9.4E+04	–	–	–	3.8E−07			
			5,000	1.0E+05	–	–	–	2.8E+05	–	–	–	1.3E−07			
			10,000	3.0E+05	–	–	–	8.5E+05	–	–	–	4.2E−08			
Degreasing	34	30	5	N/A	3.4E+12	**31**	**3**	N/A	1.9E+11	**90**	**9**	N/A	1.9E−13	**4.0E−04**	**3.9E−03**
			10	N/A	1.8E+10	**24**	**3**	N/A	2.8E+09	**71**	**7**	N/A	1.3E−11	**5.1E−04**	**4.9E−03**
			30	N/A	2.8E+06	**73**	**9**	N/A	1.2E+07	223	**25**	N/A	3.1E−09	**1.6E−04**	**1.5E−03**
			60	N/A	4.1E+05	195	**26**	N/A	1.1E+06	616	**72**	N/A	3.4E−08	**5.8E−05**	**5.0E−04**
			100	N/A	1.9E+05	438	**63**	N/A	4.8E+05	1,404	172	N/A	7.6E−08	**2.6E−05**	**2.1E−04**
			100–1,000	N/A	8.4E+05	7,134	1,132	N/A	1.4E+06	1.3E+04	1,993	N/A	2.5E−08	**2.7E−06**	**1.8E−05**
			2,500	N/A	5.8E+06	8.3E+04	1.5E+04	N/A	1.8E+07	2.9E+05	4.2E+04	N/A	2.0E−09	1.3E−07	8.5E−07
			5,000	N/A	1.2E+07	2.3E+05	3.7E+04	N/A	4.3E+07	8.1E+05	1.3E+05	N/A	8.3E−10	4.4E−08	2.8E−07

Occupational Exposure Scenario	**Number of TRI Facilities**		**Distance from Facility (meters)**	**Estimated MOE**								**Estimated Cancer Risk**			
				Non-cancer								**Cancer (Benchmark 1E−06)**			
				Acute (Benchmark 100)				**Chronic (Benchmark 100)**							
	Total [a]	**w/ Risk**		**Single Facility**	**Min Risk [b]**	**Mean Risk [c]**	**Max Risk [d]**	**Single Facility**	**Min Risk**	**Mean Risk**	**Max Risk**	**Single Facility**	**Min Risk**	**Mean Risk**	**Max Risk**
			10,000	N/A	3.0E+07	6.5E+05	8.7E+04	N/A	9.6E+07	2.2E+06	3.3E+05	N/A	3.8E−10	1.7E−08	1.1E−07
Dry Cleaning	–	–	5	N/A	8,451	621	161	N/A	3.8E+04	2,004	438	N/A	9.5E−07	**1.8E−05**	**8.2E−05**
			10	N/A	4,918	456	132	N/A	2.1E+04	1,434	351	N/A	**1.7E−06**	**2.5E−05**	**1.0E−04**
			30	N/A	1.0E+04	1,143	366	N/A	4.4E+04	3,886	1,034	N/A	8.2E−07	**9.3E−06**	**3.5E−05**
			60	N/A	2.6E+04	2,903	898	N/A	1.2E+05	1.0E+04	2,655	N/A	3.1E−07	**3.5E−06**	**1.4E−05**
			100	N/A	6.1E+04	6,659	2,020	N/A	2.7E+05	2.3E+04	5,769	N/A	1.3E−07	**1.6E−06**	**6.2E−06**
			100–1,000	N/A	1.2E+06	1.4E+05	4.1E+04	N/A	2.5E+06	2.1E+05	5.7E+04	N/A	1.4E−08	1.7E−07	6.3E−07
			2,500	N/A	2.4E+07	2.4E+06	7.7E+05	N/A	8.0E+07	4.6E+06	1.1E+06	N/A	4.5E−10	7.8E−09	3.3E−08
			5,000	N/A	8.7E+07	8.5E+06	2.8E+06	N/A	2.4E+08	1.4E+07	3.2E+06	N/A	1.5E−10	2.6E−09	1.1E−08
			10,000	N/A	2.6E+08	2.6E+07	8.3E+06	N/A	7.0E+08	4.2E+07	9.0E+06	N/A	5.2E−11	8.6E−10	4.0E−09
Processing into Formulation	11	9	5	N/A	2.5E+11	1,048	235	N/A	2.7E+11	2,617	513	N/A	1.3E−13	**1.4E−05**	**7.0E−05**
			10	N/A	7.9E+09	824	155	N/A	7.4E+09	1,986	370	N/A	4.8E−12	**1.8E−05**	**9.7E−05**
			30	N/A	1.4E+07	2,063	328	N/A	4.0E+07	4,912	746	N/A	9.0E−10	**7.3E−06**	**4.8E−05**
			60	N/A	9.0E+05	5,046	769	N/A	2.4E+06	1.2E+04	1,760	N/A	1.5E−08	**3.0E−06**	**2.0E−05**
			100	N/A	3.5E+05	1.0E+04	1,563	N/A	1.0E+06	2.5E+04	3,593	N/A	3.6E−08	**1.4E−06**	**1.0E−05**
			100-1,000	N/A	1.1E+06	1.3E+05	2.0E+04	N/A	2.2E+06	2.3E+05	3.5E+04	N/A	1.6E−08	1.6E−07	**1.0E−06**
			2,500	N/A	9.2E+06	1.4E+06	2.4E+05	N/A	3.0E+07	4.1E+06	6.7E+05	N/A	1.2E−09	8.7E−09	5.4E−08
			5,000	N/A	2.4E+07	3.9E+06	7.0E+05	N/A	7.9E+07	1.2E+07	2.1E+06	N/A	4.6E−10	3.0E−09	1.7E−08
			10,000	N/A	6.9E+07	1.1E+07	2.0E+06	N/A	2.1E+08	3.4E+07	6.3E+06	N/A	1.7E−10	1.1E−09	5.7E−09
Import	4	4	5	N/A	7.7E+15	2,054	846	N/A	2.0E+13	9,417	3,846	N/A	1.8E−15	**3.8E−06**	**9.4E−06**
			10	N/A	6.1E+11	1,361	583	N/A	2.0E+10	6,847	3,077	N/A	1.8E−12	**5.3E−06**	**1.2E−05**
			30	N/A	5.8E+06	4,108	1,923	N/A	1.7E+07	2.4E+04	1.0E+04	N/A	2.1E−09	**1.5E−06**	**3.4E−06**
			60	N/A	2.3E+05	1.2E+04	6,061	N/A	9.2E+05	6.8E+04	3.2E+04	N/A	3.9E−08	5.3E−07	**1.1E−06**
			100	N/A	1.1E+05	3.0E+04	1.7E+04	N/A	4.7E+05	1.6E+05	8.7E+04	N/A	7.7E−08	2.3E−07	4.1E−07
			100-1,000	N/A	1.1E+06	9.4E+05	8.1E+05	N/A	1.8E+06	1.5E+06	1.1E+06	N/A	2.0E−08	2.5E−08	3.1E−08
			2,500	N/A	3.9E+07	3.1E+07	2.5E+07	N/A	1.1E+08	9.4E+07	7.9E+07	N/A	3.3E−10	3.8E−10	4.6E−10
			5,000	N/A	3.6E+08	1.5E+08	9.2E+07	N/A	3.4E+08	2.8E+08	2.2E+08	N/A	1.1E−10	1.3E−10	1.7E−10
			10,000	N/A	3.8E+09	5.8E+08	3.1E+08	N/A	7.6E+08	6.0E+08	4.5E+08	N/A	4.7E−11	6.0E−11	7.9E−11

Occupational Exposure Scenario	Number of TRI Facilities		Distance from Facility (meters)	Estimated MOE								Estimated Cancer Risk			
				Non-cancer								Cancer (Benchmark 1E−06)			
				Acute (Benchmark 100)				Chronic (Benchmark 100)							
	Total [a]	w/ Risk		Single Facility	Min Risk [b]	Mean Risk [c]	Max Risk [d]	Single Facility	Min Risk	Mean Risk	Max Risk	Single Facility	Min Risk	Mean Risk	Max Risk
Processing-Incorporation into Articles	1	1	5	323	–	–	–	1,193	–	–	–	**3.0E−05**			
			10	302	–	–	–	1,087	–	–	–	**3.3E−05**			
			30	943	–	–	–	3,448	–	–	–	**1.0E−05**			
			60	2,419	–	–	–	8,915	–	–	–	**4.0E−06**			
			100	5,085	–	–	–	1.8E+04	–	–	–	**2.0E−06**			
			100–1,000	5.4E+04	–	–	–	1.1E+05	–	–	–	3.2E−07			
			2,500	4.8E+05	–	–	–	2.0E+06	–	–	–	1.8E−08			
			5,000	1.4E+06	–	–	–	5.8E+06	–	–	–	6.2E−09			
			10,000	4.0E+06	–	–	–	1.7E+07	–	–	–	2.1E−09			
Manufacturing	2	2	5	N/A	2.1E+10	155	**56**	N/A	3.2E+10	413	148	N/A	1.1E−12	**8.7E−05**	**2.4E−04**
			10	N/A	1.3E+09	116	**41**	N/A	3.5E+09	306	109	N/A	1.0E−11	**1.2E−04**	**3.3E−04**
			30	N/A	6.5E+06	330	118	N/A	2.5E+07	802	287	N/A	1.5E−09	**4.5E−05**	**1.3E−04**
			60	N/A	5.9E+05	805	288	N/A	1.5E+06	1,997	715	N/A	2.4E−08	**1.8E−05**	**5.0E−05**
			100	N/A	2.6E+05	1,704	610	N/A	6.7E+05	4,251	1,523	N/A	5.4E−08	**8.5E−06**	**2.4E−05**
			100–1,000	N/A	7.5E+05	2.1E+04	7,472	N/A	1.6E+06	3.6E+04	1.3E+04	N/A	2.3E−08	**1.0E−06**	**2.8E−06**
			2,500	N/A	3.0E+06	2.2E+05	8.1E+04	N/A	9.2E+06	6.8E+05	2.4E+05	N/A	3.9E−09	5.3E−08	1.5E−07
			5,000	N/A	6.2E+06	5.7E+05	2.1E+05	N/A	2.0E+07	1.9E+06	6.9E+05	N/A	1.8E−09	1.9E−08	5.3E−08
			10,000	N/A	1.4E+07	1.5E+06	5.3E+05	N/A	4.7E+07	5.2E+06	1.9E+06	N/A	7.6E−10	6.9E−09	1.9E−08
Other Uses-Cutting Oils	5	2	5	N/A	7.6E+09	721	157	N/A	1.4E+07	1,654	355	N/A	2.6E−09	**2.2E−05**	**1.0E−04**
			10	N/A	4.1E+06	704	164	N/A	2.2E+06	1,441	321	N/A	1.6E−08	**2.5E−05**	**1.1E−04**
			30	N/A	1.5E+05	2,179	545	N/A	5.4E+05	4,408	1,015	N/A	6.7E−08	**8.2E−06**	**3.5E−05**
			60	N/A	3.4E+05	5,743	1,485	N/A	7.1E+05	1.2E+04	2,752	N/A	5.1E−08	**3.1E−06**	**1.3E−05**
			100	N/A	6.8E+05	1.3E+04	3,352	N/A	1.4E+06	2.6E+04	6,166	N/A	2.5E−08	**1.4E−06**	**5.8E−06**
			100–1,000	N/A	7.9E+06	1.8E+05	5.0E+04	N/A	1.4E+07	2.9E+05	7.7E+04	N/A	2.6E−09	1.2E−07	4.7E−07
			2,500	N/A	8.2E+07	2.2E+06	6.6E+05	N/A	2.2E+08	5.1E+06	1.3E+06	N/A	1.7E−10	7.0E−09	2.7E−08
			5,000	N/A	2.0E+08	6.7E+06	2.0E+06	N/A	5.8E+08	1.6E+07	4.2E+06	N/A	6.2E−11	2.3E−09	8.6E−09
			10,000	N/A	5.0E+08	2.0E+07	5.8E+06	N/A	1.5E+09	4.9E+07	1.3E+07	N/A	2.4E−11	7.4E−10	2.8E−09

Occupational Exposure Scenario	Number of TRI Facilities		Distance from Facility (meters)	Estimated MOE								Estimated Cancer Risk			
				Non-cancer								Cancer (Benchmark 1E−06)			
				Acute (Benchmark 100)				Chronic (Benchmark 100)							
	Total [a]	w/ Risk		Single Facility	Min Risk [b]	Mean Risk [c]	Max Risk [d]	Single Facility	Min Risk	Mean Risk	Max Risk	Single Facility	Min Risk	Mean Risk	Max Risk
Processing as Reactant	1	1	5	606	–	–	–	1,662	–	–	–	**2.2E−05**			
			10	420	–	–	–	1,060	–	–	–	**3.4E−05**			
			30	984	–	–	–	2,609	–	–	–	**1.4E−05**			
			60	2,410	–	–	–	6,550	–	–	–	**5.5E−06**			
			100	5,172	–	–	–	1.4E+04	–	–	–	**2.6E−06**			
			100–1,000	7.3E+04	–	–	–	1.2E+05	–	–	–	3.0E−07			
			2,500	9.3E+05	–	–	–	3.1E+06	–	–	–	1.2E−08			
			5,000	2.8E+06	–	–	–	9.4E+06	–	–	–	3.8E−09			
			10,000	8.5E+06	–	–	–	2.9E+07	–	–	–	1.3E−09			
Recycling and Disposal	2	1	5	N/A	2.2E+04	1.5E+04	1.2E+04	N/A	8.3E+04	5.7E+04	4.3E+04	N/A	4.3E−07	6.3E−07	8.3E−07
			10	N/A	1.2E+04	8,578	6,674	N/A	4.1E+04	3.1E+04	2.5E+04	N/A	8.9E−07	**1.2E−06**	**1.4E−06**
			30	N/A	2.3E+04	1.7E+04	1.3E+04	N/A	8.0E+04	6.2E+04	5.1E+04	N/A	4.5E−07	5.8E−07	7.1E−07
			60	N/A	5.5E+04	3.9E+04	3.1E+04	N/A	2.0E+05	1.5E+05	1.2E+05	N/A	1.8E−07	2.4E−07	2.9E−07
			100	N/A	1.1E+05	8.0E+04	6.3E+04	N/A	4.2E+05	3.1E+05	2.5E+05	N/A	8.5E−08	1.1E−07	1.4E−07
			100–1,000	N/A	1.5E+06	1.1E+06	8.4E+05	N/A	3.3E+06	2.3E+06	1.7E+06	N/A	1.1E−08	1.6E−08	2.1E−08
			2,500	N/A	1.7E+07	1.2E+07	9.6E+06	N/A	8.3E+07	5.7E+07	4.3E+07	N/A	4.4E−10	6.3E−10	8.3E−10
			5,000	N/A	5.2E+07	3.7E+07	2.8E+07	N/A	2.5E+08	1.7E+08	1.3E+08	N/A	1.5E−10	2.1E−10	2.8E−10
			10,000	N/A	1.5E+08	1.1E+08	8.9E+07	N/A	7.3E+08	5.1E+08	3.9E+08	N/A	4.9E−11	7.1E−11	9.3E−11
Repackaging	1	1	5	2,230	–	–	–	9,693	–	–	–	**3.7E−06**			
			10	1,563	–	–	–	7,389	–	–	–	**4.9E−06**			
			30	4,839	–	–	–	2.6E+04	–	–	–	**1.4E−06**			
			60	1.5E+04	–	–	–	8.0E+04	–	–	–	4.5E−07			
			100	4.2E+04	–	–	–	2.2E+05	–	–	–	1.6E−07			
			100–1,000	2.2E+06	–	–	–	3.3E+06	–	–	–	1.1E−08			
			2,500	8.8E+07	–	–	–	1.7E+08	–	–	–	2.2E−10			
			5,000	5.8E+08	–	–	–	4.3E+08	–	–	–	8.4E−11			
			10,000	4.9E+09	–	–	–	8.4E+08	–	–	–	4.3E−11			

Occupational Exposure Scenario	Number of TRI Facilities		Distance from Facility (meters)	Estimated MOE								Estimated Cancer Risk			
				Non-cancer								Cancer (Benchmark 1E−06)			
				Acute (Benchmark 100)				Chronic (Benchmark 100)							
	Total [a]	w/ Risk		Single Facility	Min Risk [b]	Mean Risk [c]	Max Risk [d]	Single Facility	Min Risk	Mean Risk	Max Risk	Single Facility	Min Risk	Mean Risk	Max Risk
Spot Cleaner/ Stain Remover	–	–	5	N/A	5,825	3,896	2,956	N/A	2.8E+04	1.4E+04	8,902	N/A	**1.3E−06**	**2.6E−06**	**4.0E−06**
			10	N/A	3,261	2,668	2,273	N/A	1.5E+04	9,564	6,928	N/A	**2.4E−06**	**3.8E−06**	**5.2E−06**
			30	N/A	7,916	7,505	7,143	N/A	3.8E+04	3.0E+04	2.5E+04	N/A	9.6E−07	**1.2E−06**	**1.5E−06**
			60	N/A	2.3E+04	2.2E+04	2.0E+04	N/A	1.0E+05	8.7E+04	7.6E+04	N/A	3.5E−07	4.1E−07	4.7E−07
			100	N/A	6.2E+04	5.7E+04	5.3E+04	N/A	2.6E+05	2.3E+05	2.0E+05	N/A	1.4E−07	1.6E−07	1.8E−07
			100–1,000	N/A	2.4E+06	2.2E+06	2.0E+06	N/A	3.6E+06	3.3E+06	2.9E+06	N/A	1.0E−08	1.1E−08	1.2E−08
			2,500	N/A	6.4E+07	5.8E+07	5.1E+07	N/A	2.4E+08	1.8E+08	1.3E+08	N/A	1.5E−10	2.0E−10	2.8E−10
			5,000	N/A	2.2E+08	2.1E+08	1.9E+08	N/A	8.8E+08	5.9E+08	4.1E+08	N/A	4.1E−11	6.1E−11	8.9E−11
			10,000	N/A	6.3E+08	5.4E+08	4.9E+08	N/A	2.1E+09	1.5E+09	1.1E+09	N/A	1.7E−11	2.4E−11	3.4E−11
Spray Adhesives	–	–	5	3.6E+11	–	–	–	1.2E+11	–	–	–	3.0E−13			
			10	3.6E+08	–	–	–	9.3E+08	–	–	–	3.9E−11			
			30	6.3E+05	–	–	–	2.4E+06	–	–	–	1.5E−08			
			60	8.2E+04	–	–	–	2.6E+05	–	–	–	1.4E−07			
			100	4.5E+04	–	–	–	1.4E+05	–	–	–	2.6E−07			
			100–1,000	3.7E+05	–	–	–	5.8E+05	–	–	–	6.2E−08			
			2,500	6.7E+06	–	–	–	2.1E+07	–	–	–	1.7E−09			
			5,000	1.7E+07	–	–	–	5.4E+07	–	–	–	6.7E−10			
			10,000	3.7E+07	–	–	–	1.2E+08	–	–	–	3.0E−10			

[a] When (–) is indicated for the total number of facilities, no facilities were identified via TRI reporting. The provided estimates are based on modeling of theoretical facilities.
[b] The minimum risk value is associated with the maximum MOE and the maximum ADR.
[c] The mean risk value is the arithmetic mean MOE.
[d] The maximum risk value is associated with the minimum MOE and the minimum ADR.

3.1.5.1.1 Land Use Considerations

EPA identified risk for 52 of the 64 real or surrogate facilities evaluated based on modeled air concentrations. GIS locations were available for 49 of the 52 facilities with risk. For each of these 49 facilities, EPA evaluated land use patterns to determine whether fenceline community exposures are reasonably anticipated at locations where risk is indicated. Details of this methodology are provided in Section 2.1.2.2. In short, EPA evaluated whether residential, industrial/commercial businesses, or other public spaces are present within those radial distances indicating risk (as opposed to uninhabited areas), as well as whether the radial distance lies outside the boundaries of the facility.

Based on characterization of land use patterns, fenceline community exposures are anticipated for 35 of the 49 (71 percent) GIS-located facilities where risk is indicated based on modeled fenceline air concentrations. Table 3-10 summarizes the number of facilities in each OES for which risk is indicated and where fenceline community exposures are anticipated.

Table 3-10. Summary of Fenceline Community Exposures Expected near Facilities Where Modeled Air Concentrations Indicated Risk for 1-BP

OES[a]	Total Number of Facilities Evaluated	Number of Facilities with Risk Indicated	Number of Facilities with Risk Indicated and Exposures Expected	Percent of Total Facilities with Risk Indicated and Exposures Expected
Degreasing	34	30	26	77%
Formulation	11	9	6	55%
Import	4	4	2	50%
Other Uses-Cutting Oils	5	2	1	20%
Manufacturing	2	2	0	0%
Repackaging	1	1	0	0%
Recycling and Disposal	2	1	0	0%

[a] This table is limited to facilities with specific location information. It excludes surrogate facilities and OES for which TRI data were not available.

3.1.5.2 Co-resident Inhalation Risk

EPA also calculated risk estimated for each of the endpoints in Table 3-2 based on modeling of co-residents living above or adjacent to dry cleaning facilities. See Section 2.1.2.3 for details on the exposure modeling methodology. All risk calculations are provided in Supplemental File SF_FLA_*Air Pathway Co-Resident Exposure Results for 1-BP* (Appendix B). Risks were indicated for all endpoints under all scenarios modeled at high-end exposures and for three of four scenarios at central tendency exposures.

Table 3-11. 1-BP Inhalation Risk for Co-residents of Dry Cleaning Facilities

Building Type	Method for Estimating Q12	Estimated MOE				Estimated Cancer Risk	
		Non-cancer				Cancer (Benchmark 1E−06)	
		Acute (Benchmark 100)		Chronic (Benchmark 100)			
		CT[a] Risk	HE[b] Risk	CT[a] Risk	HE[b] Risk	CT[a] Risk	HE[b] Risk
Building 1	Method 1	325	**58**	377	**67**	**9.5E−05**	**5.4E−04**
	Method 2	**82**	**14**	**97**	**17**	**3.7E−04**	**2.2E−03**
Building 2	Method 1	**5**	**1**	**6**	**1**	**5.7E−03**	**2.7E−02**
	Method 2	**4**	**1**	**5**	**1**	**6.6E−03**	**2.7E−02**

[a] CT = central tendency; risk estimates are based on the 50th percentile of exposure estimates.
[b] HE = central tendency; risk estimates are based on the 95th percentile of exposure estimates.

3.1.6 Confidence and Risk Conclusions for 1-BP Case Study Results

This section illustrates by example EPA's use of results from applying the proposed screening level methodology to make risk conclusions and does not represent final agency action. Any results or risk conclusions presented here are not intended to be used in support of risk management actions or rulemakings as presented.

EPA identified risks relative to the benchmarks at fenceline air concentrations of 1-BP for 52 of the 64 real or surrogate facilities assessed, representing 13 of 14 OES. Based on characterization of land use patterns, fenceline community exposures are anticipated for 35 of the 49 GIS located facilities with risk. EPA also identified risk relative to the benchmarks from 1-BP inhalation for co-residents of dry cleaning facilities in all scenarios modeled.

Risk estimates in Table 3-9 are based on the 95th percentile values of modeled exposure concentrations around individual facilities, and the range of risk estimates covers all facilities under an OES. The consideration of land use patterns also confirms that facilities indicating risk are likely of concern to an expected fenceline community cohort. Therefore, EPA determines that the proposed screening level methodology, as applied for this report, sufficiently captures expected risk to the fenceline communities around these facilities for the exposure pathways evaluated. 95th percentile values represent a conservative, screening-level analysis and may potentially overestimate chronic and/or lifetime cancer risks. However, analysis of risk estimates based on 10th and 50th percentile exposure concentrations in SF_FLA_*Air Pathway Full-Screen Results for 1-BP* (Appendix B) demonstrates that for most facilities cancer risk is also present at lower percentiles, mitigating this uncertainty.

3.2 Methylene Chloride – Air and Water Pathways

3.2.1 Background for MC

Methylene chloride (MC) is a highly volatile, liquid organohalogen. If released to surface water and soil, it will most likely volatilize and enter the atmosphere, where it is persistent and mobile over long ranges. Methylene chloride is also mobile in groundwater but will slowly hydrolyze (U.S. EPA, 2020c). A summary of its physical-chemical properties can be found in Table_Apx A-1.

3.2.2 Human Health Hazard Endpoints for MC

All hazard values used to calculated risk for MC in this report are derived from the previously peer-reviewed PODs in the Final Risk Evaluation for Methylene Chloride (U.S. EPA, 2020c). In the Final Risk Evaluation, EPA utilized the endpoints shown in Table 3-1 for risk determination. For MC, human equivalent concentrations/doses (HECs/HEDs) for non-cancer endpoints were derived for use in occupational and consumer scenarios. Additionally, an inhalation unit risk (IUR) for lifetime cancer risk was applied for both occupational scenarios. Oral/dermal hazard values were extrapolated from inhalation PODs based on an assumed 1.25 m^3/hr inhalation rate for occupational scenarios.

Table 3-12. Hazard Values Used for Risk Estimation in the Methylene Chloride Risk Evaluation

Scenario	Endpoint	Inhalation Hazard Value	Oral/Dermal Hazard Value	Benchmark	Reference
Acute	Neurological: Decreased visual performance	696 mg/m^3 [1.5-hr exposure]	16 mg/kg [1.5-hr exposure]	30	(Putz et al., 1979)
Chronic	Liver: Vacuolization and cell foci	17.2 mg/m^3	2.15 mg/kg	10	(Nitschke et al., 1988)
Cancer	Lung and liver tumors	1.38E−06 per mg/m^3	1.1E−05 per mg/kg	1E-4 (occupational)	(NTP, 1986)

For the analyses in this report, EPA derived POD values for fenceline communities based on a continuous exposure scenario. The acute HEC was derived using the equation from (ten Berge et al., 1986), $C^n \times T = K$, where n = 2 based on the original study conditions of 1.5 hr exposure. This equation was used to derive a 24-hr HEC, although there is significant uncertainty associated with extrapolation to a significantly longer duration. The chronic liver HEC was derived through a PBPK model on a continuous exposure basis, so no adjustment was required. For cancer, the IUR value used in the Risk Evaluation was for occupational scenarios of 8 hr/day, 5 days/week. This value was adjusted for continuous exposure. Additionally, ADAFs were applied to cancer hazard values for younger lifestages based on the conclusion that MC is carcinogenic through a mutagenic mode of action (U.S. EPA, 2020c). HEDs and slope factors were extrapolated from inhalation values similar to the risk evaluation, however for this analysis they were derived based on continuous exposure and 14.7 m^3/day inhalation rate for the general population (U.S. EPA, 2011a). The adjusted POD values for fenceline communities are presented below in Table 3-13. Inhalation hazard values in the Final Risk Evaluation were presented primarily in units of mg/m^3; however, for consistency in risk calculations they have also been converted to ppm using the following equation:

$$\text{ppm} = {}^{\text{mg}}/_{\text{m}^3} \text{ x } 0.2879 \text{ .}$$

Table 3-13. Hazard Values for MC Used in this Fenceline Analysis

Scenario	Endpoint	Fenceline HEC/ IUR	Fenceline HED/ SF	Benchmark	Reference
Acute	Neurological: Decreased visual performance	174 mg/m^3 (50 ppm)	32 mg/kg	30	(Putz et al., 1979)
Chronic	Liver: Vacuolization and Cell Foci	17.2 mg/m^3 (5.0 ppm)	3 mg/kg	10	(Nitschke et al., 1988)
Cancer	Lung and liver tumors	5.8E−06 per mg/m^3 (2.0E−05 per ppm)	4.6E−05 per mg/kg	1E-6	(NTP, 1986)

3.2.2.1 Assumptions and Uncertainties for MC Human Health Hazard

There is some significant uncertainty in the acute POD by applying the (ten Berge et al., 1986) equation to extrapolate from a 1.5 hr study exposure to a 24-hr basis, however it is unknown whether this uncertainty may result in an overestimation or underestimation of toxicity. The chronic non-cancer POD is identical to what was applied in (U.S. EPA, 2020c), while the cancer IUR is adjusted by traditional Haber's rule from an occupational to continuous exposure basis, so there is reduced uncertainty associated with those endpoints. Any other assumptions or uncertainties inherent to the human health hazard assessment in the Final Risk Evaluation for Methylene Chloride (U.S. EPA, 2020c) are still applicable for this analysis.

3.2.3 Environmental Releases for MC

This case study provides information specific to MC fenceline environmental release analysis that is not captured in the general methodology described in Section 2.1.1 and 2.2.1.

3.2.3.1 Step 1: Obtain TRI Data and DMR

For MC, the 2019 TRI dataset used for the air emissions fenceline analysis includes a total of 244 sites that reported stack and fugitive air releases (U.S. EPA, 2021). These data include 16 Form A submissions and 228 Form R submissions.

For MC, the 2016 TRI dataset used for the water release fenceline analysis includes a total of 43 sites that reported water releases (U.S. EPA, 2017). These data do not include Form A submissions (Form A submission assessed as having zero water releases). The 2016 DMR dataset used for the water release fenceline analysis includes a total of 76 sites that reported water releases (U.S. EPA, 2016a).

3.2.3.2 Step 2: Map TRI and DMR to OES

EPA followed the methodology described in Section 2.1.1.2 to map the facilities in 2019 TRI to the OES in the published 2020 Methylene Chloride Risk Evaluation (U.S. EPA, 2020c) (see Appendix E). However, there were a few deviations from this general methodology that EPA encountered during the mapping of MC 2019 TRI sites to OES, which are described below.

- The 2019 TRI data for MC includes many sites that report the TRI uses/sub-uses for "Ancillary or Other use – Cleaner" and "Ancillary or Other use – Degreaser" (U.S. EPA, 2021). EPA was unable to determine the specific types of cleaning or degreasing from the TRI uses/sub-uses, NAICS codes, or internet searches of the facilities. Therefore, for these facilities, EPA assigned the OES as "Cleaner/Degreaser – Unknown." This OES designation is a grouping of the following COUs from the 2020 Methylene Chloride Risk Evaluation (U.S. EPA, 2020c): Conveyorized Vapor Degreasing and Cold Cleaning. EPA did not include the OES for Commercial Aerosol Products (Aerosol Degreasing, Aerosol Lubricants, Automotive Care Products) in this grouping because facilities conducting these types of cleaning and degreasing are not expected to be captured in TRI because they likely use MC at quantities below the reporting threshold or do not use a NAICS code that is included in a TRI-covered industry sector. Batch-Open Top Vapor Degreasing was also not included in this grouping because it had one mapped entry in the 2019 TRI.

- After mapping of the 2019 TRI data to CDR codes using the TRI-to-CDR Use Mapping crosswalk (see Appendix C), EPA found that many CDR codes could not be cleanly mapped to an OES. For these cases, mapping was performed using the primary NAICS code and an internet search of the facility.
- TRI sub-use "Otherwise Use: As a chemical processing aid (Process Solvents)" was mapped to the CDR code U029 "Solvents (for cleaning or degreasing)." These facilities were mapped according to the NAICS code and an internet search of the facility name.
- There were multiple sites in the methylene chloride 2019 TRI data that mapped to the COU for pharmaceutical use (U.S. EPA, 2021). These uses were not assessed in the 2020 Methylene Chloride Risk Evaluation (U.S. EPA, 2020c) and are not included in the fenceline analysis.
- The 2020 Methylene Chloride Risk Evaluation is unique in that it contains an OES for "Miscellaneous Non-aerosol Industrial and Commercial Uses" (U.S. EPA, 2020c). Facilities that could not be classified into other OES were grouped into this miscellaneous category.

The MC fenceline analysis spreadsheet, SF_FLA_*Environmental Releases to Ambient Air for MC* (Appendix B), contains the rationale for the mapping of each facility in 2019 TRI to an OES. Refer to this spreadsheet for details of the mapping at the facility-level.

EPA followed the methodology described in Section 2.2.1.2 to map the facilities in 2016 TRI (U.S. EPA, 2017) and 2016 DMR (U.S. EPA, 2016a) to the OES in the published 2020 Methylene Chloride Risk Evaluation (U.S. EPA, 2020c).

3.2.3.3 Step 3: Estimate Number of Release Days for Each OES

EPA estimated the number of release days for each MC OES according to the methodology in Section 2.1.1.3 and 2.2.1.3. Specifically, the number of release days was assumed to be equal to the number of operating days, which were estimated for each OES as shown in Table 3-14.

Table 3-14. Number of Release Days for Each MC OES

OES	Number of Release Days (days/yr)	Basis for Number of Release Days
Manufacturing	350	Number of release days for "Manufacture of Solvents" discussed in Section 2.1.1.3
Processing as a Reactant	350	Number of release days for "Processing as a Reactant"
Processing – Incorporation into Formulation, Mixture, or Reaction Product	300	Number of release days for "Other Chemical Plant Scenarios"
Repackaging	250	Number of release days for "All Other Scenarios"

OES	Number of Release Days (days/yr)	Basis for Number of Release Days
Batch Open-Top Vapor Degreasing	260	Vapor Degreasing ESD (Organization for Economic and Develop.m.ent, 2017)
Conveyorized Vapor Degreasing	260	Vapor Degreasing ESD (Organization for Economic and Develop.m.ent, 2017)
Cold Cleaning	260	Vapor Degreasing ESD (Organization for Economic and Develop.m.ent, 2017)
Commercial Aerosol Products (Aerosol Degreasing, Aerosol Lubricants, Automotive Care Products)	260 (low-end) and 364 (high-end)	Brake Servicing Near-Field/Far-Field Inhalation Exposure Model
Adhesives and Sealants	250	Number of release days for "All Other Scenarios"
Paints and Coatings	250	Number of release days for "All Other Scenarios"
Adhesive and Caulk Removers	250	Number of release days for "All Other Scenarios"
Fabric Finishing	250	Number of release days for "All Other Scenarios"
Spot Cleaning	289 (50th percentile) and 307 (95th percentile)	Spot Cleaning Near-Field/Far-Field Inhalation Exposure Model
Cellulose Triacetate Film Production	250	Number of release days for "All Other Scenarios"
Flexible Polyurethane Foam Manufacturing	250	Number of release days for "All Other Scenarios"
Laboratory Use	250	Number of release days for "All Other Scenarios"
Plastic Product Manufacturing	250	Number of release days for "All Other Scenarios"
Lithographic Printing Plate Cleaning	250	Number of release days for "All Other Scenarios"
Miscellaneous Non-aerosol Industrial and Commercial Uses	250	Number of release days for "All Other Scenarios"
Waste Handling, Disposal, Treatment, and Recycling	250	Number of release days for "All Other Scenarios"
Paint Remover	250	Number of release days for "All Other Scenarios"

3.2.3.4 Step 4: Estimate Air Emissions for OES with No 2019 TRI Data and Water Releases for OES with No TRI or DMR Data

A summary of the air emission assessment approaches for each MC OES is included in Table 3-15. Of the 21 OES listed in Table 3-15, 16 have directly applicable 2019 TRI data that were used for air emissions. For the remaining five OES without 2019 TRI data, EPA used the hierarchy of alternate air assessment approaches described in Section 2.1.1.4. Specifically, EPA estimated air releases with modeling (two OES) and surrogate OES data (three OES).

Table 3-15. Summary of Air Release Estimation Approaches for Each MC OES

OES	Range of Annual Fugitive Air Release (kg/site-yr)	Range of Annual Fugitive Air Release (kg/site-yr)	Air Release Estimation Approach	Notes
Manufacturing	0 to 2,456[a b c d]	0 to 5,767[b c d e]	2019 TRI (U.S. EPA, 2021)	2019 TRI data are available for 11 sites (no Form As).
Processing as a Reactant	0 to 4,128[a c d f]	0 to 6,350[a c d f]	2019 TRI (U.S. EPA, 2021)	2019 TRI data are available for 15 sites (no Form As).
Processing – Incorporation into Formulation, Mixture, or Reaction Product	0 to 59,528[b c d f]	0 to 4,808[a b c d e f]	2019 TRI (U.S. EPA, 2021)	2019 TRI data are available for 50 sites (four Form As).
Repackaging	0 to 331[b c d f]	0 to 723[a b c d f]	2019 TRI (U.S. EPA, 2021)	2019 TRI data are available for 24 sites (9 Form As).
Batch Open-Top Vapor Degreasing	0 to 11,106[b d f]	0 to 21,870[b d f]	2019 TRI (U.S. EPA, 2021)	2019 TRI data are available for 1 site (not Form A).
Conveyorized Vapor Degreasing	0 to 11,106[b d f]	0 to 12,175[b d f]	2019 TRI (U.S. EPA, 2021)	No sites were classified specifically as conveyorized vapor degreasing. 2019 TRI data are available for 16 sites (one Form A) under "Cleaner/Degreaser – unknown."
Cold Cleaning	0 to 11,106[b d f]	0 to 12,175[b d f]	2019 TRI (U.S. EPA, 2021)	No sites were classified specifically as cold cleaning. 2019 TRI data are available for 16 sites (one Form A) under "Cleaner/Degreaser – unknown."
Commercial Aerosol Products (Aerosol Degreasing, Aerosol Lubricants, Automotive Care Products)	188 to 267	0 (all fugitive)	Modeling	2019 TRI data are not available for this OES. EPA adapted the *Brake Servicing Near-Field/Far-Field Inhalation Exposure Model* and ran it to estimate daily and annual air emissions for this OES.
Adhesives and Sealants	0 to 113,359[a b c d f]	0 to 75,001[b c d f]	Surrogate 2019 TRI	No 2019 TRI data available for this OES. Industrial applications of this COU are

OES	Range of Annual Fugitive Air Release (kg/site-yr)	Range of Annual Fugitive Air Release (kg/site-yr)	Air Release Estimation Approach	Notes
			(U.S. EPA, 2021)	already accounted for within the TRI sites in the "Miscellaneous Non-aerosol Industrial and Commercial Uses" OES and the commercial applications are not applicable for fenceline analysis.
Paints and Coatings	0 to 113,359[a b c d f]	0 to 75,001[b c d f]	Surrogate 2019 TRI (U.S. EPA, 2021)	No 2019 TRI data available for this OES. Industrial applications of this COU are already accounted for within the TRI sites in the "Miscellaneous Non-aerosol Industrial and Commercial Uses" OES and the commercial applications are not applicable for fenceline analysis.
Adhesive and Caulk Removers	0 to 113,359[a b c d f]	0 to 75,001[b c d f]	Surrogate 2019 TRI (U.S. EPA, 2021)	No 2019 TRI data available for this OES. Industrial applications of this COU are already accounted for within the TRI sites in the "Miscellaneous Non-aerosol Industrial and Commercial Uses" OES and the commercial applications are not applicable for fenceline analysis.
Fabric Finishing	340[b] (1 site)	0 (all fugitive)	2019 TRI (U.S. EPA, 2021)	2019 TRI data are available for 1 site (not Form A).
Spot Cleaning	35.6 to 38.4	0 (all fugitive)	Modeling	2019 TRI data are not available for this OES. EPA adapted the *Spot Cleaning Model* and ran it to estimate daily air emissions for this OES.
Cellulose Triacetate Film Production	20 to 13,438[b d]	0 to 630[b d]	2019 TRI (U.S. EPA, 2021)	2019 TRI data are available for 2 sites (no Form As).
Flexible Polyurethane Foam Manufacturing	0 to 102,743[b]	0 to 6,305[b f]	2019 TRI (U.S. EPA, 2021)	2019 TRI data are available for 2 sites (no Form As).

OES	Range of Annual Fugitive Air Release (kg/site-yr)	Range of Annual Fugitive Air Release (kg/site-yr)	Air Release Estimation Approach	Notes
Laboratory Use	0 to 436[a b c f]	55 to 7,200[b c d]	2019 TRI (U.S. EPA, 2021)	2019 TRI data are available for 5 sites (no Form As).
Plastic Product Manufacturing	0 to 54,431[b d]	0 to 18,144[b d f]	2019 TRI (U.S. EPA, 2021)	2019 TRI data are available for 7 sites (no Form As).
Lithographic Printing Plate Cleaning	0 (all stack)[b]	2,295 (1 site)[b]	2019 TRI (U.S. EPA, 2021)	2019 TRI data are available for 1 site (not Form A).
Miscellaneous Non-aerosol Industrial and Commercial Uses	0 to 113,359[a b c d f]	0 to 75,001[b c d f]	2019 TRI (U.S. EPA, 2021)	2019 TRI data are available for 33 sites (two Form As).
Waste Handling, Disposal, Treatment, and Recycling	0 to 755[b c d f]	0 to 7,058[b c d f]	2019 TRI (U.S. EPA, 2021)	2019 TRI data are available for 32 sites (no Form As).
Paint Remover	0 to 7,467[b c d]	4,058 to 21,137[b c d]	2019 TRI (U.S. EPA, 2021)	2019 TRI data are available for 3 sites (no Form As).

[a] This range includes estimates based on periodic or random monitoring data or measurements.
[b] This range includes estimates based on mass balance calculations, such as calculation of the amount of chemical in streams entering and leaving process equipment.
[c] This range includes estimates s based on published emissions factors, such as those relating release quantity to through-put or equipment type (*e.g.,* air emissions factors). This may include emissions factors in a trade association's publication or AP-42.
[d] This range includes estimates based on other approaches such as engineering calculations (*e.g.,* estimating volatilization using published mathematical formulas) or best engineering judgment. This would include applying estimated removal efficiency to a waste stream, even if the composition of the stream before treatment was fully identified through monitoring data.
[e] This range includes estimates based on continuous monitoring data or measurements.
[f] This range includes estimates based on site-specific emissions factors, such as those relating release quantity to through-put or equipment type (*e.g.,* air emissions factors). This may include emissions factors that are developed for a specific piece of equipment and that consider climate conditions on-site.

A summary of the water release assessment approaches for each MC OES is included in Table 3-16. Of the 20 OES listed in Table 3-16, 10 have directly applicable 2016 TRI or 2016 DMR data that were used for water releases. For the remaining 10 OES without TRI or DMR data, EPA used an alternative to the water release approaches described in Section 2.2.1.4. Specifically, EPA estimated water releases using a qualitative approach for all 10 OES without 2016 TRI or 2016 DMR data. Specifically, for the 10 OES where releases are expected but TRI and DMR data were not available, EPA included a qualitative discussion of potential release sources in the initial risk evaluation.

Table 3-16. Summary of Water Release Estimation Approaches for Each Methylene Chloride OES

OES	Range of Water Releases (kg/site-yr)	Water Release Estimation Approach	Notes
Manufacturing	0.1 to 76[a b c d e]	2016 TRI and 2016 DMR	2016 TRI data are available for 8 sites and

OES	Range of Water Releases (kg/site-yr)	Water Release Estimation Approach	Notes
			2016 DMR data are available for 12 sites.
Processing as a Reactant	0.1 to 213[a b e]	2016 TRI and 2016 DMR	2016 TRI data are available for 2 sites and 2016 DMR data are available for 1 site.
Processing – Incorporation into Formulation, Mixture, or Reaction Product	0.2 to 5,785[a c d e]	2016 TRI and 2016 DMR	2016 TRI data are available for 5 sites and 2016 DMR data are available for 4 sites.
Repackaging	2.8E−2 to 144[a c d e]	2016 TRI and 2016 DMR	2016 TRI data are available for 3 sites and 2016 DMR data are available for 2 sites.
Batch Open-Top Vapor Degreasing	N/A	Qualitative	No quantitative assessment made.
Conveyorized Vapor Degreasing	N/A	Qualitative	No quantitative assessment made.
Cold Cleaning	N/A	Qualitative	No quantitative assessment made.
Commercial Aerosol Products (Aerosol Degreasing, Aerosol Lubricants, Automotive Care Products)	N/A	None expected	Due to the volatility of methylene chloride the majority of releases from the use of aerosol products will likely be to air as methylene chloride evaporates from the aerosolized mist and the substrate surface.
Adhesives and Sealants	N/A	Qualitative	No quantitative assessment made; majority of methylene chloride expected to be released to air.
Paints and Coatings	N/A	Qualitative	No quantitative assessment made; majority of methylene chloride expected to be released to air.
Adhesive and Caulk Removers	N/A	Qualitative	No quantitative assessment made; majority of methylene chloride expected to be released to air.
Fabric Finishing	N/A	Qualitative	No quantitative assessment made;

OES	Range of Water Releases (kg/site-yr)	Water Release Estimation Approach	Notes
			majority of methylene chloride expected to be released to air.
Spot Cleaning	0.1 (1 site)[f]	2016 DMR	2016 DMR data are available for 1 site.
Cellulose Triacetate Film Production	29 (1 site)[f]	2016 DMR	2016 DMR data are available for 1 site.
Flexible Polyurethane Foam Manufacturing	2.3 (1 site)[b f]	2016 TRI	2016 TRI data are available for 1 site.
Laboratory Use	N/A	Qualitative	No quantitative assessment made, majority of methylene chloride expected to be released to air or disposed as hazardous waste.
Plastic Product Manufacturing	2.3E−2 to 28[e f]	2016 TRI and 2016 DMR	2016 TRI data are available for 1 site and 2016 DMR data are available for 8 sites.
Lithographic Printing Plate Cleaning	9.3E−4 (1 site)[f]	2016 DMR	2016 DMR data are available for 1 site.
Miscellaneous Non-aerosol Industrial and Commercial Uses	N/A	Qualitative	No quantitative assessment made; majority of methylene chloride expected to be released to air.
Waste Handling, Disposal, Treatment, and Recycling	2.4E−2 to 115,059[a b d e]	2016 TRI and 2016 DMR	2016 TRI data are available for 7 sites and 2016 DMR data are available for 6 sites.

[a] This range includes both direct and indirect discharges.
[b] This range includes TRI estimates based on continuous monitoring data or measurements.
[c] This range includes TRI estimates based on mass balance calculations, such as calculation of the amount of chemical in streams entering and leaving process equipment.
[d] This range includes TRI estimates based on other approaches such as engineering calculations (*e.g.*, estimating volatilization using published mathematical formulas) or best engineering judgment. This would include applying estimated removal efficiency to a waste stream, even if the composition of the stream before treatment was fully identified through monitoring data.
[e] This range includes TRI estimates based on periodic or random monitoring data or measurements.
[f] This range includes direct discharges only.

3.2.3.5 Step 5: Prepare Air Emission and Water Release Summary for Ambient Air and Water Exposure Modeling

Using the work completed in Steps 1 through 4, EPA compiled a summary of air releases on a per-site basis for each MC OES, in the format of Table 2-1. See the supplemental fenceline analysis spreadsheet *SF_FLA_Environmental Releases to Ambient Air for MC* (Appendix B) for this summary. To model exposures resulting from these air emissions, EPA used the daily emissions, site identity and location information, and release duration and pattern information from this summary. For water releases, EPA used the same release estimates as those used in the risk evaluation report and no additional summary was created. Additional information on the modeled MC exposures is provided in the next section.

3.2.4 Exposures for MC

3.2.4.1 Air Pathway

Pre-screening and full-screening level methodologies were utilized to evaluate potential exposures to fenceline communities for MC.

Pre-screening Analysis

Pre-screening work for MC is included in Appendix D. Inputs for all IIOAC model runs for all exposure scenarios are included in Supplemental File *SF_FLA_Air Pathway Input Parameters for IIOAC for 1-BP and MC* (Appendix B). Based on the pre-screening analysis, there is an indication of potential exposures and associated risks to fenceline communities and therefore EPA conducted a full-screening level analysis for MC.

Screening Analysis

A total of 17 OES were evaluated for MC as presented in Table 3-17. A total of 195 real facilities were modeled. Exposure modeling was also performed for those OES where releases were estimated, although there is no real facility associated with those estimates and therefore a "number of facilities" is not applicable for those OES. Inputs for all AERMOD model runs for all exposure scenarios are included in Supplemental File *SF_FLA_Fenceline Air Pathway Input Parameters for AERMOD for 1-BP and MC* (Appendix B).

Table 3-17. Fenceline Community Exposure Scenarios for MC

OES	Release Data Source	Number of Facilities in OES[a]
Batch Open-Top Degreasing	TRI (2019)	1
Cellulose Triacetate Film Production	TRI (2019)	2
Cleaner/Degreaser – Unknown[b]	TRI (2019)	16
Commercial Aerosol Products (Aerosol Degreasing, Aerosol Lubricants, Automotive Care Products)	Estimate	N/A
Fabric Finishing	TRI (2019)	1
Flexible Polyurethane Foam Manufacturing	TRI (2019)	1
Laboratory Use	TRI (2019)	5
Lithographic Printing Plate Cleaning	TRI (2019)	1
Manufacturing	TRI (2019)	11
Miscellaneous Non-aerosol Industrial and Commercial Uses[c]	TRI (2019)	31
Plastic Product Manufacturing	TRI (2019)	7

OES	Release Data Source	Number of Facilities in OES[a]
Processing – Incorporation into Formulation, Mixture, or Reaction Product	TRI (2019)	50
Processing as a Reactant	TRI (2019)	14
Repackaging	TRI (2019)	22
Spot Cleaning	Estimate	N/A
Waste Handling, Disposal, Treatment, and Recycling	TRI (2019)	30
Paint Remover	TRI (2019)	3
	Total	**195**

[a] N/A: No real facilities identified

[b] This OES designation is a grouping of the following COUs from the 2020 Methylene Chloride Risk Evaluation: Conveyorized Vapor Degreasing and Cold Cleaning. See Section 3.2.3.2.

[c] This OES designation includes a grouping of the following COUs from the 2020 Methylene Chloride Risk Evaluation: Adhesives and Sealants, Paints and Coatings, and Adhesive and Caulk Removers

Modeling results for inhalation exposure concentrations are categorized by OES and presented by facility. Daily and annual average concentrations are summarized for three percentile concentrations (10th, 50th, 95th) to cover the range of exposure concentrations across all nine distances modeled (5; 10; 30; 60; 100; 100 to 1,000; 2,500; 5,000; and 10,000 meters) and can be found in Supplemental File *SF_FLA_Air Pathway Full-Screen Results for MC* (Appendix B). Exposure concentrations are presented as total concentration to inform the total exposure to a given receptor at each modeled distance from each releasing facility. EPA did not identify air monitoring data to which modeled concentrations could be compared at the distances modeled. EPA conducted a source attribution analysis which provides exposure concentrations from each release type (fugitive and stack) at each modeled distance for each facility in anticipation of informing future risk management actions and the potential need for a more detailed analyses if risks are identified. For facilities reporting both fugitive and stack releases within TRI, adding the exposure concentrations for each release type at each modeled distance provides the total concentration.

EPA further distilled exposure results for the 95th percentile values across all facilities within each OES, at all nine distances modeled, and presents them in Table 3-18. The purpose of this further distillation is to present a smaller subset of results within the body of this report. The further distilled results presented here are carried into the risk characterization section of the body of this report for risk calculation purposes.

The minimum and maximum concentrations in Table 3-18 represent the lowest and highest 95th percentile concentrations, respectively, among all facilities categorized into the respective OES at each distance modeled. The mean 95th percentile concentrations in Table 3-18 represent arithmetic averages across all facilities within the given OES at each distance modeled. Additionally, for certain OES, there are a variety of industry types and release points (stack, fugitive, stack and fugitive) categorized within an OES which may not be directly comparable. This results in a wide range of modeled exposure concentrations which, in some cases, extends over many orders of magnitude. For example, in the Miscellaneous Non-aerosol Industrial and Commercial Uses OES, there are 31 facilities which may include a variety of industry types. Although releases within an industry type may be comparable, releases across industry types may have considerably different emission profiles and therefore may not be comparable. Further, looking at the release points, EPA found that fugitive releases do not have much lift or dispersion resulting in higher concentrations very close to facilities (around 10 meters) and lower concentrations further away (around 100 meters). In contrast, stack releases often have more lift and dispersion resulting in lower concentrations around 10 meters and higher concentrations around 100 meters. Even with these different concentration profiles, the modeled exposure concentrations from stacks are still several orders of magnitude lower than fugitive concentrations. This can skew the mean of the 95th percentile modeled concentrations across multiple facilities orders of magnitude lower, thus underestimating exposures and associated risks.

1 **Table 3-18. 95th Percentile Exposure Concentration Summary across Facilities within Each OES for MC**

OES	Number of TRI Facilities Evaluated [a]	Distance from Facility (meters)	Concentration (ppm)							
			Daily Average				Annual Average			
			Single Facility	Minimum	Arithmetic Mean	Maximum	Single Facility	Minimum	Arithmetic Mean	Maximum
Batch Open-Top Degreasing	1	5	7.44E−04	–	–	–	1.84E−04	–	–	–
		10	1.03E−03	–	–	–	2.52E−04	–	–	–
		30	5.01E−04	–	–	–	1.20E−04	–	–	–
		60	1.20E−03	–	–	–	3.30E−04	–	–	–
		100	2.10E−03	–	–	–	5.63E−04	–	–	–
		100–1,000	4.78E−04	–	–	–	1.99E−04	–	–	–
		2,500	7.78E−05	–	–	–	1.65E−05	–	–	–
		5,000	2.88E−05	–	–	–	6.28E−06	–	–	–
		10,000	1.05E−05	–	–	–	2.33E−06	–	–	–
Cellulose Triacetate Film Production	2	5	–	3.86E−04	1.63E−01	3.25E−01	–	1.64E−04	7.11E−02	1.42E−01
		10	–	4.77E−04	2.14E−01	4.27E−01	–	2.24E−04	9.46E−02	1.89E−01
		30	–	1.72E−04	7.11E−02	1.42E−01	–	8.20E−05	2.88E−02	5.76E−02
		60	–	8.49E−05	2.66E−02	5.31E−02	–	4.06E−05	9.87E−03	1.97E−02
		100	–	7.06E−05	1.18E−02	2.36E−02	–	3.02E−05	4.08E−03	8.13E−03
		100–1,000	–	1.80E−05	7.14E−04	1.41E−03	–	9.36E−06	3.81E−04	7.53E−04
		2,500	–	3.33E−06	5.82E−05	1.13E−04	–	1.48E−06	1.89E−05	3.64E−05
		5,000	–	1.21E−06	1.91E−05	3.70E−05	–	5.33E−07	6.22E−06	1.19E−05
		10,000	–	4.02E−07	6.15E−06	1.19E−05	–	1.81E−07	2.06E−06	3.93E−06

OES	Number of TRI Facilities Evaluated [a]	Distance from Facility (meters)	Concentration (ppm)							
			Daily Average				Annual Average			
			Single Facility	Minimum	Arithmetic Mean	Maximum	Single Facility	Minimum	Arithmetic Mean	Maximum
Cleaner/Degreaser – Unknown [b]	16	5	–	4.81E−12	4.00E−02	1.54E−01	–	8.00E−12	1.30E−02	5.86E−02
		10	–	3.55E−10	5.16E−02	2.49E−01	–	2.20E−10	1.67E−02	6.74E−02
		30	–	6.51E−07	1.84E−02	1.07E−01	–	2.69E−07	5.64E−03	2.45E−02
		60	–	1.12E−05	7.10E−03	4.23E−02	–	2.91E−06	2.14E−03	9.47E−03
		100	–	2.39E−05	3.42E−03	1.91E−02	–	5.93E−06	1.01E−03	4.35E−03
		100–1,000	–	4.83E−06	2.41E−04	9.98E−04	–	2.03E−06	1.24E−04	5.16E−04
		2,500	–	6.47E−07	2.21E−05	6.33E−05	–	1.55E−07	6.36E−06	2.20E−05
		5,000	–	2.49E−07	7.71E−06	1.98E−05	–	6.95E−08	2.31E−06	7.32E−06
		10,000	–	8.98E−08	2.72E−06	6.69E−06	–	2.97E−08	8.63E−07	2.55E−06
Commercial Aerosol Products (Aerosol Degreasing, Aerosol Lubricants, Automotive Care Products)	–	5	–	1.93E−03	3.38E−03	5.08E−03	–	3.98E−04	9.23E−04	1.58E−03
		10	–	3.40E−03	4.87E−03	6.53E−03	–	7.24E−04	1.29E−03	1.99E−03
		30	–	1.38E−03	1.71E−03	2.04E−03	–	2.86E−04	4.10E−04	5.52E−04
		60	–	4.69E−04	5.89E−04	7.20E−04	–	1.04E−04	1.40E−04	1.79E−04
		100	–	1.74E−04	2.23E−04	2.77E−04	–	4.08E−05	5.35E−05	6.64E−05
		100–1,000	–	4.53E−06	5.59E−06	6.73E−06	–	2.76E−06	3.49E−06	4.21E−06
		2,500	–	1.71E−07	2.14E−07	2.60E−07	–	4.25E−08	6.48E−08	1.07E−07
		5,000	–	4.71E−08	5.98E−08	7.26E−08	–	1.18E−08	2.00E−08	3.48E−08
		10,000	–	1.51E−08	2.24E−08	3.01E−08	–	5.11E−09	8.23E−09	1.38E−08

OES	Number of TRI Facilities Evaluated [a]	Distance from Facility (meters)	Concentration (ppm)							
			Daily Average				Annual Average			
			Single Facility	Minimum	Arithmetic Mean	Maximum	Single Facility	Minimum	Arithmetic Mean	Maximum
Fabric Finishing	1	5	6.33E−03	–	–	–	1.98E−03	–	–	–
		10	7.84E−03	–	–	–	2.85E−03	–	–	–
		30	2.89E−03	–	–	–	1.12E−03	–	–	–
		60	1.14E−03	–	–	–	4.39E−04	–	–	–
		100	5.27E−04	–	–	–	1.99E−04	–	–	–
		100–1,000	3.25E−05	–	–	–	1.86E−05	–	–	–
		2,500	2.50E−06	–	–	–	8.56E−07	–	–	–
		5,000	8.07E−07	–	–	–	2.66E−07	–	–	–
		10,000	2.64E−07	–	–	–	8.46E−08	–	–	–
Flexible Polyurethane Foam Manufacturing	1	5	2.89E+00	–	–	–	1.09E+00	–	–	–
		10	3.76E+00	–	–	–	1.30E+00	–	–	–
		30	1.25E+00	–	–	–	4.75E−01	–	–	–
		60	4.94E−01	–	–	–	1.90E−01	–	–	–
		100	2.30E−01	–	–	–	8.75E−02	–	–	–
		100–1,000	1.47E−02	–	–	–	8.51E−03	–	–	–
		2,500	1.27E−03	–	–	–	4.70E−04	–	–	–
		5,000	4.11E−04	–	–	–	1.53E−04	–	–	–
		10,000	1.36E−04	–	–	–	4.99E−05	–	–	–

OES	Number of TRI Facilities Evaluated [a]	Distance from Facility (meters)	Concentration (ppm)							
			Daily Average				Annual Average			
			Single Facility	Minimum	Arithmetic Mean	Maximum	Single Facility	Minimum	Arithmetic Mean	Maximum
Laboratory Use	5	5	–	4.34E−10	1.54E−03	5.05E−03	–	4.35E−10	6.00E−04	1.96E−03
		10	–	6.11E−08	2.65E−03	9.80E−03	–	1.41E−08	1.01E−03	3.76E−03
		30	–	5.22E−06	1.29E−03	5.20E−03	–	1.67E−06	4.16E−04	1.68E−03
		60	–	2.52E−05	6.00E−04	2.25E−03	–	1.69E−05	1.91E−04	6.95E−04
		100	–	3.49E−05	3.70E−04	1.13E−03	–	1.98E−05	1.25E−04	3.42E−04
		100–1,000	–	3.13E−06	4.96E−05	1.28E−04	–	1.97E−06	2.68E−05	6.97E−05
		2,500	–	4.91E−07	1.09E−05	3.87E−05	–	2.49E−07	3.57E−06	1.30E−05
		5,000	–	2.56E−07	5.71E−06	2.16E−05	–	1.26E−07	1.89E−06	7.40E−06
		10,000	–	1.17E−07	2.80E−06	1.12E−05	–	5.58E−08	8.85E−07	3.61E−06
Lithographic Printing Plate Cleaning	1	5	1.62E−11	–	–	–	2.76E−11	–	–	–
		10	3.26E−09	–	–	–	4.08E−09	–	–	–
		30	4.49E−06	–	–	–	1.64E−06	–	–	–
		60	7.20E−05	–	–	–	3.07E−05	–	–	–
		100	1.62E−04	–	–	–	6.64E−05	–	–	–
		100–1,000	6.29E−05	–	–	–	2.43E−05	–	–	–
		2,500	1.19E−05	–	–	–	2.47E−06	–	–	–
		5,000	4.72E−06	–	–	–	9.70E−07	–	–	–
		10,000	1.77E−06	–	–	–	3.81E−07	–	–	–

OES	Number of TRI Facilities Evaluated [a]	Distance from Facility (meters)	Concentration (ppm)							
			Daily Average				Annual Average			
			Single Facility	Minimum	Arithmetic Mean	Maximum	Single Facility	Minimum	Arithmetic Mean	Maximum
Manufacturing	11	5	–	2.78E−15	9.34E−03	2.93E−02	–	2.72E−15	4.22E−03	1.46E−02
		10	–	7.58E−14	1.55E−02	5.34E−02	–	5.75E−14	7.20E−03	2.78E−02
		30	–	2.54E−11	7.11E−03	2.66E−02	–	1.09E−11	3.23E−03	1.36E−02
		60	–	3.92E−10	3.04E−03	1.15E−02	–	2.70E−10	1.37E−03	5.78E−03
		100	–	9.85E−10	1.58E−03	5.78E−03	–	6.08E−10	7.08E−04	2.87E−03
		100–1,000	–	4.06E−10	1.61E−04	4.94E−04	–	2.11E−10	9.22E−05	3.07E−04
		2,500	–	6.73E−11	2.06E−05	5.04E−05	–	2.21E−11	7.81E−06	2.15E−05
		5,000	–	2.83E−11	8.28E−06	2.10E−05	–	8.55E−12	3.09E−06	9.18E−06
		10,000	–	1.15E−11	3.18E−06	8.24E−06	–	3.15E−12	1.15E−06	3.51E−06
Miscellaneous Non-aerosol Industrial and Commercial Uses [c]	31	5	–	6.27E−12	1.27E−01	3.88E+00	–	8.96E−12	5.85E−02	1.82E+00
		10	–	7.68E−10	1.42E−01	4.20E+00	–	9.99E−10	6.81E−02	2.07E+00
		30	–	4.42E−07	4.83E−02	1.36E+00	–	1.75E−07	2.16E−02	6.35E−01
		60	–	6.63E−06	1.89E−02	5.20E−01	–	2.95E−06	8.25E−03	2.37E−01
		100	–	1.19E−05	9.08E−03	2.36E−01	–	4.26E−06	3.87E−03	1.06E−01
		100–1,000	–	2.63E−06	7.20E−04	1.48E−02	–	1.07E−06	4.30E−04	9.96E−03
		2,500	–	5.87E−07	7.93E−05	1.23E−03	–	1.74E−07	2.85E−05	5.09E−04
		5,000	–	2.13E−07	2.97E−05	3.97E−04	–	9.23E−08	1.02E−05	1.64E−04
		10,000	–	7.27E−08	1.07E−05	1.33E−04	–	3.31E−08	3.58E−06	5.39E−05

OES	Number of TRI Facilities Evaluated [a]	Distance from Facility (meters)	Concentration (ppm)							
			Daily Average				Annual Average			
			Single Facility	Minimum	Arithmetic Mean	Maximum	Single Facility	Minimum	Arithmetic Mean	Maximum
Plastic Product Manufacturing	7	5	–	8.69E−13	2.32E−01	9.13E−01	–	1.59E−11	7.31E−02	2.88E−01
		10	–	4.36E−10	4.07E−01	1.51E+00	–	1.92E−09	1.31E−01	4.71E−01
		30	–	5.63E−06	1.91E−01	6.61E−01	–	1.90E−06	6.34E−02	2.32E−01
		60	–	2.39E−06	8.09E−02	2.80E−01	–	7.67E−07	2.66E−02	9.86E−02
		100	–	1.19E−06	3.99E−02	1.40E−01	–	3.72E−07	1.31E−02	4.98E−02
		100–1,000	–	9.80E−08	3.10E−03	1.14E−02	–	4.75E−08	1.52E−03	5.35E−03
		2,500	–	1.02E−08	2.88E−04	1.11E−03	–	2.72E−09	7.76E−05	3.18E−04
		5,000	–	3.86E−09	1.02E−04	4.00E−04	–	9.43E−10	2.63E−05	1.10E−04
		10,000	–	1.38E−09	3.50E−05	1.40E−04	–	3.24E−10	8.88E−06	3.75E−05
Processing – Incorporation into Formulation, Mixture, or Reaction Product	50	5	–	2.10E−13	3.10E−02	9.23E−01	–	6.95E−13	1.31E−02	3.92E−01
		10	–	6.12E−11	4.36E−02	1.51E+00	–	3.52E−11	1.81E−02	6.07E−01
		30	–	1.22E−08	1.80E−02	6.66E−01	–	4.41E−09	6.86E−03	2.39E−01
		60	–	8.19E−08	7.41E−03	2.79E−01	–	4.98E−08	2.74E−03	9.64E−02
		100	–	1.56E−07	3.54E−03	1.33E−01	–	8.59E−08	1.29E−03	4.50E−02
		100–1,000	–	5.61E−08	2.59E−04	9.29E−03	–	2.70E−08	1.53E−04	5.56E−03
		2,500	–	1.03E−08	2.29E−05	7.70E−04	–	3.46E−09	7.54E−06	2.35E−04
		5,000	–	3.76E−09	7.81E−06	2.50E−04	–	1.22E−09	2.54E−06	7.61E−05
		10,000	–	1.28E−09	2.68E−06	8.22E−05	–	4.19E−10	8.63E−07	2.49E−05

OES	Number of TRI Facilities Evaluated [a]	Distance from Facility (meters)	Concentration (ppm)							
			Daily Average				Annual Average			
			Single Facility	Minimum	Arithmetic Mean	Maximum	Single Facility	Minimum	Arithmetic Mean	Maximum
Processing as a Reactant	14	5	–	7.33E−12	1.11E−02	1.05E−01	–	1.51E−12	4.22E−03	3.96E−02
		10	–	1.14E−10	1.55E−02	1.41E−01	–	3.75E−11	5.92E−03	5.34E−02
		30	–	3.60E−08	5.71E−03	4.95E−02	–	7.96E−09	2.32E−03	2.04E−02
		60	–	4.53E−07	2.37E−03	2.03E−02	–	1.58E−07	9.52E−04	8.22E−03
		100	–	1.01E−06	1.19E−03	9.73E−03	–	4.14E−07	4.78E−04	3.94E−03
		100–1,000	–	3.99E−07	1.19E−04	8.51E−04	–	1.90E−07	6.72E−05	5.03E−04
		2,500	–	1.01E−07	1.47E−05	9.25E−05	–	3.69E−08	4.82E−06	3.07E−05
		5,000	–	4.87E−08	6.27E−06	3.85E−05	–	1.52E−08	1.88E−06	1.16E−05
		10,000	–	1.93E−08	2.53E−06	1.55E−05	–	5.68E−09	7.22E−07	4.40E−06
Repackaging	22	5	–	6.55E−20	2.15E−03	7.95E−03	–	1.14E−15	5.18E−04	1.85E−03
		10	–	1.80E−13	3.10E−03	8.22E−03	–	3.73E−12	6.87E−04	1.95E−03
		30	–	3.47E−07	1.02E−03	3.03E−03	–	2.25E−07	1.99E−04	5.50E−04
		60	–	6.98E−06	3.51E−04	1.06E−03	–	1.34E−06	6.90E−05	1.83E−04
		100	–	2.55E−06	1.50E−04	4.42E−04	–	4.90E−07	3.05E−05	8.35E−05
		100–1,000	–	5.02E−08	5.03E−06	1.88E−05	–	3.71E−08	3.30E−06	1.15E−05
		2,500	–	1.25E−09	1.56E−07	6.20E−07	–	4.75E−10	5.93E−08	2.12E−07
		5,000	–	2.04E−10	3.19E−08	1.64E−07	–	1.61E−10	2.05E−08	7.67E−08
		10,000	–	3.14E−11	9.67E−09	5.44E−08	–	7.62E−11	9.57E−09	3.60E−08

OES	Number of TRI Facilities Evaluated [a]	Distance from Facility (meters)	Concentration (ppm)							
			Daily Average				Annual Average			
			Single Facility	Minimum	Arithmetic Mean	Maximum	Single Facility	Minimum	Arithmetic Mean	Maximum
Spot Cleaning	–	5	–	3.53E−04	5.31E−04	7.05E−04	–	7.25E−05	1.52E−04	2.34E−04
		10	–	6.31E−04	7.76E−04	9.17E−04	–	1.35E−04	2.16E−04	3.00E−04
		30	–	2.60E−04	2.76E−04	2.91E−04	–	5.49E−05	6.92E−05	8.42E−05
		60	–	8.85E−05	9.55E−05	1.03E−04	–	2.02E−05	2.38E−05	2.74E−05
		100	–	3.29E−05	3.61E−05	3.97E−05	–	8.05E−06	9.16E−06	1.02E−05
		100–1,000	–	8.73E−07	9.45E−07	1.02E−06	–	5.71E−07	6.27E−07	7.22E−07
		2,500	–	3.22E−08	3.58E−08	4.04E−08	–	8.64E−09	1.16E−08	1.60E−08
		5,000	–	9.48E−09	1.01E−08	1.09E−08	–	2.35E−09	3.50E−09	5.14E−09
		10,000	–	3.29E−09	3.80E−09	4.23E−09	–	9.67E−10	1.38E−09	1.94E−09
Waste Handling, Disposal, Treatment, and Recycling	30	5	–	9.98E−11	2.73E−03	3.85E−02	–	1.95E−10	1.14E−03	1.96E−02
		10	–	1.08E−08	3.50E−03	3.24E−02	–	2.66E−08	1.46E−03	1.81E−02
		30	–	1.15E−06	1.40E−03	8.63E−03	–	3.80E−07	5.54E−04	4.86E−03
		60	–	4.70E−07	5.83E−04	3.67E−03	–	1.58E−07	2.21E−04	1.70E−03
		100	–	2.33E−07	2.98E−04	1.81E−03	–	7.81E−08	1.09E−04	7.53E−04
		100–1,000	–	2.10E−08	2.86E−05	2.07E−04	–	1.03E−08	1.43E−05	8.11E−05
		2,500	–	2.74E−09	3.20E−06	3.17E−05	–	7.52E−10	9.68E−07	8.38E−06
		5,000	–	1.21E−09	1.15E−06	1.13E−05	–	3.26E−10	3.36E−07	2.95E−06
		10,000	–	4.59E−10	3.99E−07	3.82E−06	–	1.34E−10	1.16E−07	1.01E−06

OES	Number of TRI Facilities Evaluated [a]	Distance from Facility (meters)	Concentration (ppm)							
			Daily Average				Annual Average			
			Single Facility	Minimum	Arithmetic Mean	Maximum	Single Facility	Minimum	Arithmetic Mean	Maximum
Paint Remover	3	5	–	1.2E−09	5.74E−02	1.58E−01	–	1.42E−09	2.43E−02	6.81E−02
		10	–	2.84E−07	9.50E−02	2.63E−01	–	9.30E−08	4.47E−02	1.26E−01
		30	–	5.30E−05	4.23E−02	1.18E−01	–	3.48E−05	2.00E−02	5.65E−02
		60	–	3.65E−04	1.77E−02	4.76E−02	–	2.35E−04	8.32E−03	2.29E−02
		100	–	6.72E−04	9.31E−03	2.23E−02	–	3.42E−04	4.23E−03	1.07E−02
		100–1,000	–	2.08E−04	9.66E−04	1.47E−03	–	1.37E−04	4.87E−04	8.10E−04
		2,500	–	3.90E−05	1.61E−04	3.22E−04	–	2.37E−05	5.96E−05	1.01E−04
		5,000	–	1.48E−05	7.04E−05	1.57E−04	–	8.59E−06	2.62E−05	5.21E−05
		10,000	–	5.22E−06	2.94E−05	7.02E−05	–	2.94E−06	1.05E−05	2.26E−05

[a] When (–) is indicated for the total number of facilities, no facilities were identified via TRI reporting. The provided estimates are based on modeling of theoretical facilities.

[b] This OES designation is a grouping of the following COUs from the 2020 Methylene Chloride Risk Evaluation: Conveyorized Vapor Degreasing and Cold Cleaning. See Section 3.2.3.2.

[c] This OES designation includes a grouping of the following COUs from the 2020 Methylene Chloride Risk Evaluation: Adhesives and Sealants, Paints and Coatings, and Adhesive and Caulk Removers.

3.2.4.2 Water Pathway

3.2.4.2.1 Ambient Water Monitoring Results

Available monitored and measured ambient surface water information was evaluated as part of the original risk evaluation for MC to assess environmental risk (U.S. EPA, 2020c) by evaluating two principal sources of information: (1) extract submitted data to EPA's Water Quality Portal, and (2) conduct a systematic review of surface water concentrations in peer reviewed and grey literature. Full description of these results are available in U.S. EPA (2020c). No new information was found during this evaluation. As described in U.S. EPA (2020c), WQP data ranged from ND to 29 µg/L for the years 2013 to 2017.

Measured concentrations from published literature within the United States was found in two studies. A nation-wide survey of 375 samples collected between 1999 and 2000 found a single detectable value of 2.6 µg/L (USGS, 2003). In another study conducted between 1979 to1981, MC was detected in 93 percent of samples collected from the Eastern Pacific Ocean with values ranging from below detection limit to 0.008 µg/L, with a mean of 0.0031 µg/L (Singh et al., 1983). For measured published values outside the United States, concentrations between the years of 1993 to 2013 ranged from below detection limit to 134 µg/L.

3.2.4.2.2 Drinking Water Monitoring Results

The retrieved six-year review dataset for MC contained 371,905 entries for sample years 2006 through 2011 (See Section 2.2.2.1 for description of dataset). Observations were made in 48 states, the District of Columbia, and American Samoa at 55,712 unique monitoring sites, with 1 to 10,539 samples collected per site (Table 3-19).

For the entire dataset (all years combined), the detection frequency was 0.55% and the reported detection limits ranged from 5.0×10−05 to 1,000 µg/L (or 2.5×10−05 to 500 µg/L when using one-half the detection limit). Since one-half of the detection limit is used in the statistical analysis and some of the samples had reported detection limits that were greater than measured concentrations in other samples, the concentrations ranged from ND (< 2.5×10^{-}05 µg/L) to ND (<500 µg/L).

For the sample concentrations from sample residues detected above the detection limit, concentrations ranged from 5.0×10−04 to 326 µg/L (1.0×10−03 to 100 µg/L in 2006, 5.0×10−04 to 23 µg/L in 2007, 1.3×10−03 to 54 µg/L in 2008, 1.4×10−02 to 290 µg/L in 2009, 0.14 to 326 µg/L in 2010, and 0.10 to 88 µg/L in 2011) with an average concentration of 3.0 µg/L and a standard deviation of 16 µg/L (Table 3-19).

The percentage of detections above methylene chloride's maximum contaminant level (MCL) of 5 µg/L was calculated by dividing the number of sample concentrations greater than 5 µg/L by the number of samples with detected values greater than the detection limit. Overall, the percentage of detections exceeding the MCL is 6.2 percent.

Each year, the evaluated datasets contained between 60,436 and 64,738 drinking water samples collected from 23,229 to 27,168 unique monitoring stations from one of three source water types. The three source water types are groundwater under direct influence of surface water (GU), groundwater (GW), and surface water (SW). When looking at the most current 2011 data set, the detection frequency ranged from 0.31% (SW) to 1.1% (GU). For all 2011 samples, the number of samples ranged from 554 (GU) to 52,124 (GW), with contractions ranging from ND (<2.5×10−04 µg/L) to ND (<500 µg/L), both from GW. When only looking at the sample concentrations from samples detected above the detection limit in 2011, concentrations ranged from 0.10 µg/L (GW) to 88 µg/L (GW) with an overall average concentration of 1.9 µg/L and a standard deviation of 6.1 µg/L. The percentage of detections above methylene chloride's MCL ranged from 0% (GU) to 21% (SW). Each source water type percentage calculation was based on the number of samples with detections above the detection limit representing that water type and not water types combined.

1 **Table 3-19. Measured Concentrations of MC in Drinking Water Obtained from the Six-Year Review Data (2006–2011)[a]**

Year	Source Water Type	Detection Frequency (%)	Concentration in All Samples (µg/L)			Concentrations Only in Samples above the Detection Limit (µg/L)			
			No. of Samples (No. of Stations)	Range [b]	Average ± Standard Deviation	No. of Samples (No. of Stations)	Range [b]	Average ± Standard Deviation	Percentage of Detects > MCL (5 µg/L)
2006	Groundwater Under Direct Infl. of Surf. Water (GU)	0	543 (270)	ND (<5.0E−02) to ND (<1.2)	ND (<0.277) ± 0.14	0 (0)	–	–	–
	Groundwater (GW)	0.62	50,636 (21,033)	ND (<2.5E−04) to ND [c] (<250)	0.30 ± 3.0	315 (240)	1.0E−03 to 100	2.6 ± 7.5	7.9%
	Surface Water (SW)	0.43	9,257 (3,054)	ND (<2.5E−03) to ND [c] (<250)	0.30 ± 2.6	40 (35)	0.21 to 17	2.4 ± 3.6	10%
	All Types	0.59	6,0436 (24,357)	ND (<2.5E−04) to ND[c] (<250)	0.31 ± 2.9	355 (275)	1.0E−03 to 100	2.6 ± 7.1	8.2%
2007	Groundwater Under Direct Influence of Surf. Water (GU)	0.20	500 (239)	ND (<5.0E−02) to 1.0	0.27 ± 0.11	1 (1)	6.0E−02	6.0E−02	0%
	Groundwater (GW)	0.87	52,083 (21,417)	ND (<2.5E−04) to ND [c] (<250)	0.30 ± 2.9	451 (253)	5.0E−04 to 21	1.5 ± 2.2	3.8%
	Surface Water (SW)	0.59	8,937 (3,048)	ND (<2.5E−04) to 23	0.27 ± 0.29	53 (41)	6.0E−02 to 23	1.9 ± 3.2	3.8%
	All Types	0.82	61,520 (24,704)	ND (<2.5E−04) to ND [c] (<250)	0.29 ± 2.7	505 (295)	5.0E−04 to 23	1.5 ± 2.4	3.8%
2008	Groundwater Under Direct Influence of Surf. Water (GU)	1.2	561 (264)	ND (<5.0E−02) to 17	0.31 ± 0.72	7 (4)	0.38 to 17	3.1 ± 6.2	14%
	Groundwater (GW)	0.58	52,850 (20,206)	ND (<2.5E−05) to ND [c] (<250)	0.33 ± 4.1	306 (208)	1.3E−03 to 54	1.8 ± 4.4	4.9%
	Surface Water (SW)	0.59	9,100 (3,276)	ND (<2.5E−04) to ND[c] (<250)	0.32 ± 3.7	54 (31)	0.34 to 24	1.8 ± 3.2	3.7%
	All Types	0.59	62,511 (23,746)	ND (<2.5E−05) to ND [c] (<250)	0.33 ± 4.0	367 (243)	1.3E−03 to 54	1.8 ± 4.3	4.9%

Year	Source Water Type	Detection Frequency (%)	Concentration in All Samples (µg/L)			Concentrations Only in Samples above the Detection Limit (µg/L)			
			No. of Samples (No. of Stations)	Range [b]	Average ± Standard Deviation	No. of Samples (No. of Stations)	Range [b]	Average ± Standard Deviation	Percentage of Detects > MCL (5 µg/L)
2009	Groundwater Under Direct Influence of Surf. Water (GU)	0.53	571 (282)	ND (<2.5E−04) to 9.8	0.28 ± 0.44	3 (3)	0.99 to 9.8	4.3 ± 4.8	33%
	Groundwater (GW)	0.48	5,1423 (21,180)	ND (<2.5E−04) to 290	0.28 ± 2.2	247 (195)	1.4E−02 to 290	4.3 ± 21	7.3%
	Surface Water (SW)	0.56	8,605 (3,059)	ND (<2.5E−04) to ND[c] (<250)	0.29 ± 2.7	48 (37)	0.34 to 11	1.9 ± 2.4	10%
	All Types	0.49	60,599 (24,521)	ND (<2.5E−04) to 290	0.29 ± 2.3	298 (235)	1.4E−02 to 290	3.9 ± 19	8.1%
2010	Groundwater Under Direct Influence of Surf. Water (GU)	0.38	527 (265)	ND (<2.5E−04) to 4.0	0.26 ± 0.17	2 (1)	0.79 to 4.0	2.4 ± 2.3	0%
	Groundwater (GW)	0.43	55,211 (23,793)	ND (<2.5E−04) to 326	0.29 ± 2.6	240 (195)	0.14 to 326	8.5 ± 39	8.3%
	Surface Water (SW)	0.27	9,000 (3,110)	ND (<2.5E−02) to ND[c] (<250)	0.33 ± 4.0	24 (18)	0.50 to 137	6.9 ± 28	4.2%
	All Types	0.41	64,738 (27,168)	ND (<2.5E−04) to 326	0.29 ± 2.8	266 (214)	0.14 to 326	8.3 ± 38	7.9%
2011	Groundwater Under Direct Influence of Surf. Water (GU)	1.1	554 (274)	ND (<5.0E−02) to 4.1	0.27 ± 0.18	6 (6)	0.14 to 4.1	1.3 ± 1.5	0%
	Groundwater (GW)	0.40	52,124 (19,606)	ND (<2.5E−04) to ND [c] (<500)	0.27 ± 2.2	207 (172)	0.10 to 88	1.7 ± 6.2	4.3%
	Surface Water (SW)	0.31	9423 (3,349)	ND (<2.5E−04) to 18	0.25 ± 0.35	29 (20)	0.50 to 18	3.7 ± 5.3	21%
	All Types	0.39	62,101 (23,229)	ND (<2.5E−04) to ND[c] (<500)	0.27 ± 2.0	242 (198)	0.10 to 88	1.9 ± 6.1	6.2%
All 6 Years	Groundwater Under Direct Influence of Surf. Water (GU)	0.58	3,256 (451)	ND (<2.5E−04) to 17	0.28 ± 0.37	19 (11)	6.0E−02 to 17	2.5 ± 4.2	11%
	Groundwater (GW)	0.56	314,327 (51,283)	ND (<2.5E−05) to ND[c] (<500)	0.30 ± 2.9	1,766 (1,100)	5.0E−04 to 326	3.1 ± 17	5.9%
	Surface Water (SW)	0.46	54,322 (3,978)	ND (<2.5E−04) to ND [c] (<250)	0.29 ± 2.7	248 (149)	6.0E−02 to 137	2.6 ± 9.2	8.1%
	All Types	0.55	37,1905 (55,712)	ND (<2.5E−05) to ND [c] (<500)	0.30 ± 2.9	2,033 (1,260)	5.0E−04 to 326	3.0 ± 16	6.2%

Year	Source Water Type	Detection Frequency (%)	Concentration in All Samples (µg/L)			Concentrations Only in Samples above the Detection Limit (µg/L)			
			No. of Samples (No. of Stations)	Range [b]	Average ± Standard Deviation	No. of Samples (No. of Stations)	Range [b]	Average ± Standard Deviation	Percentage of Detects > MCL (5 µg/L)

[a] Data were downloaded from the SYR3 website (Six-Year Review 3 Compliance Monitoring Data (2006-2011) | US EPA) on September 8, 2021.
[b] ND = Not Detected. Value in parentheses represents one-half the reported detection limit or ½ the average overall detection limit for non-detect samples without reported detection limits (overall average detection limit is 0.561 µg/L and one-half overall average is 0.28 µg/L). Reported Detection Limits ranged from 5.0E−05 to 1.0E+03 µg/L.
[c] Maximum value represents ½ detection limit which was greater than the maximum detected value for all samples.

3.2.4.2.3 Modeled Drinking Water

Modeled drinking water estimates are summarized by OES category in Table 3-20 for the 20-day release scenario and in Table 3-21 for the maximum days of release scenario. Results are presented for the adult and infant age class, but complete by facility results across all age classes for all evaluated releases are available in *SF_FLA_Water Pathway Exposure Data for MC* (Appendix B).

For the 20-day release scenario, a total of 66 releases were modeled across all OES with drinking water ADRs across both age classes ranging from 5.0×10^{-10} to 8.7×10^{-03} mg/kg-day, ADDs ranging from 2.4×10^{-12} to 2.2×10^{-05} mg/kg-day and LADDs ranging from 3.1×10^{-14} to 2.8×10^{-07} mg/kg-day. For the maximum days of release scenario, a total of 87 releases were modeled across all OES with drinking water ADRs across both age classes ranging from 4.0×10^{-11} to 1.5 mg/kg-day, ADDs ranging from 2.4×10^{-12} to 6.8×10^{-02} mg/kg-day, and LADDs ranging from 3.1×10^{-14} to 8.8×10^{-04} mg/kg-day. In all cases, estimated exposures were highest in the infant age class in the 20-day release scenarios.

Table 3-20. Summary of MC Drinking Water Exposure by OES for 20 Days of Release Scenarios

OES	No. of Releases Modeled	Age Group	ADR (mg/kg-day)			ADD (mg/kg-day)			LADD (mg/kg-day)		
			Min Exp.[a]	Mean Exp.[b]	Max Exp.[c]	Min Exp.[a]	Mean Exp.[b]	Max Exp.[c]	Min Exp.[a]	Mean Exp.[b]	Max Exp.[c]
Manufacturing	12	Adult (21+)	7.8E−09	1.2E−04	1.3E−03	4.3E−11	3.0E−07	3.0E−06	1.8E−11	1.3E−07	1.3E−06
		Infant (birth to <1)	2.8E−08	4.4E−04	4.6E−03	1.1E−10	7.6E−07	7.8E−06	1.4E−12	9.7E−09	1.0E−07
Import and Repackaging	2	Adult (21+)	4.4E−06	8.7E−06	1.3E−05	2.1E−08	4.4E−08	6.6E−08	9.1E−09	1.9E−08	2.8E−08
		Infant (birth to <1)	1.6E−05	3.0E−05	4.5E−05	5.5E−08	1.1E−07	1.7E−07	7.0E−10	1.4E−09	2.2E−09
Processing as a Reactant	2	Adult (21+)	5.4E−05	7.7E−05	1.0E−04	3.5E−07	3.6E−07	3.7E−07	1.5E−07	1.5E−07	1.6E−07
		Infant (birth to <1)	1.9E−04	2.7E−04	3.5E−04	8.9E−07	9.2E−07	9.4E−07	1.1E−08	1.2E−08	1.2E−08
Processing: Formulation	5	Adult (21+)	3.0E−08	5.0E−04	2.5E−03	1.6E−10	6.4E−07	3.2E−06	6.9E−11	2.7E−07	1.3E−06
		Infant (birth to <1)	1.0E−07	1.8E−03	8.7E−03	4.2E−10	1.6E−06	8.1E−06	5.3E−12	2.1E−08	1.0E−07
Polyurethane Foam	1	Adult (21+)	3.3E−04	3.3E−04	3.3E−04	1.5E−06	1.5E−06	1.5E−06	6.5E−07	6.5E−07	6.5E−07
		Infant (birth to <1)	1.2E−03	1.2E−03	1.2E−03	3.9E−06	3.9E−06	3.9E−06	5.0E−08	5.0E−08	5.0E−08
Plastics Manufacturing	9	Adult (21+)	1.8E−08	2.7E−04	1.3E−03	9.6E−11	1.3E−06	5.8E−06	4.1E−11	5.4E−07	2.5E−06
		Infant (birth to <1)	6.2E−08	9.6E−04	4.4E−03	2.5E−10	3.2E−06	1.5E−05	3.2E−12	4.2E−08	1.9E−07
CTA Film Manufacturing	1	Adult (21+)	3.8E−05	3.8E−05	3.8E−05	2.4E−07	2.4E−07	2.4E−07	1.0E−07	1.0E−07	1.0E−07
		Infant (birth to <1)	1.3E−04	1.3E−04	1.3E−04	6.2E−07	6.2E−07	6.2E−07	7.9E−09	7.9E−09	7.9E−09
Lithographic Printer Cleaner	1	Adult (21+)	1.7E−08	1.7E−08	1.7E−08	9.3E−11	9.3E−11	9.3E−11	3.9E−11	3.9E−11	3.9E−11
		Infant (birth to <1)	6.0E−08	6.0E−08	6.0E−08	2.4E−10	2.4E−10	2.4E−10	3.0E−12	3.0E−12	3.0E−12
Spot Cleaner	1	Adult (21+)	1.9E−06	1.9E−06	1.9E−06	3.2E−09	3.2E−09	3.2E−09	1.4E−09	1.4E−09	1.4E−09
		Infant (birth to <1)	6.6E−06	6.6E−06	6.6E−06	8.2E−09	8.2E−09	8.2E−09	1.1E−10	1.1E−10	1.1E−10
Recycling and Disposal	5	Adult (21+)	3.7E−06	5.0E−04	1.9E−03	1.8E−08	1.1E−06	2.7E−06	7.8E−09	4.8E−07	1.2E−06
		Infant (birth to <1)	1.3E−05	1.8E−03	6.7E−03	4.7E−08	2.9E−06	7.0E−06	6.0E−10	3.7E−08	9.0E−08
Other	10	Adult (21+)	1.4E−10	5.0E−06	3.0E−05	9.5E−13	1.4E−08	9.0E−08	4.0E−13	6.1E−09	3.8E−08
		Infant (birth to <1)	5.0E−10	1.7E−05	1.0E−04	2.4E−12	3.7E−08	2.3E−07	3.1E−14	4.7E−10	3.0E−09
DOD	1	Adult (21+)	6.3E−07	6.3E−07	6.3E−07	4.0E−09	4.0E−09	4.0E−09	1.7E−09	1.7E−09	1.7E−09
		Infant (birth to <1)	2.2E−06	2.2E−06	2.2E−06	1.0E−08	1.0E−08	1.0E−08	1.3E−10	1.3E−10	1.3E−10
WWTP	16	Adult (21+)	4.0E−08	1.3E−04	4.7E−04	2.9E−10	1.5E−06	8.6E−06	1.2E−10	6.5E−07	3.6E−06
		Infant (birth to <1)	1.4E−07	4.4E−04	1.7E−03	7.5E−10	3.9E−06	2.2E−05	9.6E−12	5.1E−08	2.8E−07
Overall	66	Adult (21+)	1.4E−10	1.8E−04	2.5E−03	9.5E−13	7.8E−07	8.6E−06	4.0E−13	3.3E−07	3.6E−06
		Infant (birth to <1)	5.0E−10	6.2E−04	8.7E−03	2.4E−12	2.0E−06	2.2E−05	3.1E−14	2.5E−08	2.8E−07

[a] The minimum exposure for the identified days of release, within the identified OES, and for the identified age group.
[b] The arithmetic mean exposure for the identified days of release, within the identified OES, and for the identified age group.
[c] The maximum exposure for the identified days of release, within the identified OES, and for the identified age group.

Table 3-21. Summary of MC Drinking Water Exposure by OES for Maximum Days of Release Scenarios

OES	No. of Releases Modeled	Age Group	ADR (mg/kg-day)			ADD (mg/kg-day)			LADD (mg/kg-day)		
			Min Exp.[a]	Mean Exp.[b]	Max Exp.[c]	Min Exp.[a]	Mean Exp.[b]	Max Exp.[c]	Min Exp.[a]	Mean Exp.[b]	Max Exp.[c]
Manufacturing	16	Adult (21+)	4.5E−10	5.7E−06	7.4E−05	4.3E−11	2.5E−07	3.1E−06	1.8E−11	1.0E−07	1.3E−06
		Infant (birth to <1)	1.6E−09	2.0E−05	2.6E−04	1.1E−10	6.3E−07	7.8E−06	1.4E−12	8.0E−09	1.0E−07
Import and Repackaging	5	Adult (21+)	1.6E−09	1.6E−04	8.1E−04	1.1E−10	1.0E−05	5.1E−05	4.8E−11	4.3E−06	2.1E−05
		Infant (birth to <1)	5.8E−09	5.7E−04	2.8E−03	2.9E−10	2.6E−05	1.3E−04	3.7E−12	3.4E−07	1.7E−06
Processing as a Reactant	3	Adult (21+)	4.6E−07	3.1E−06	5.6E−06	3.9E−08	2.5E−07	3.7E−07	1.7E−08	1.1E−07	1.5E−07
		Infant (birth to <1)	1.6E−06	1.1E−05	2.0E−05	1.0E−07	6.4E−07	9.3E−07	1.3E−09	8.2E−09	1.2E−08
Processing: Formulation	9	Adult (21+)	9.3E−11	4.3E−03	3.8E−02	7.6E−12	2.7E−04	2.4E−03	3.2E−12	1.1E−04	1.0E−03
		Infant (birth to <1)	3.2E−10	1.5E−02	0.14	1.9E−11	6.8E−04	6.1E−03	2.5E−13	8.7E−06	7.8E−05
Polyurethane Foam	1	Adult (21+)	2.7E−05	2.7E−05	2.7E−05	1.5E−06	1.5E−06	1.5E−06	6.4E−07	6.4E−07	6.4E−07
		Infant (birth to <1)	9.3E−05	9.3E−05	9.3E−05	3.8E−06	3.8E−06	3.8E−06	4.9E−08	4.9E−08	4.9E−08
Plastics Manufacturing	9	Adult (21+)	1.4E−09	2.2E−05	1.0E−04	9.6E−11	1.3E−06	5.9E−06	4.0E−11	5.4E−07	2.5E−06
		Infant (birth to <1)	4.9E−09	7.7E−05	3.6E−04	2.4E−10	3.2E−06	1.5E−05	3.1E−12	4.2E−08	1.9E−07
CTA Film Manufacturing	1	Adult (21+)	3.0E−06	3.0E−06	3.0E−06	2.4E−07	2.4E−07	2.4E−07	1.0E−07	1.0E−07	1.0E−07
		Infant (birth to <1)	1.1E−05	1.1E−05	1.1E−05	6.2E−07	6.2E−07	6.2E−07	7.9E−09	7.9E−09	7.9E−09
Lithographic Printer Cleaner	1	Adult (21+)	1.4E−09	1.4E−09	1.4E−09	9.2E−11	9.2E−11	9.2E−11	3.9E−11	3.9E−11	3.9E−11
		Infant (birth to <1)	4.8E−09	4.8E−09	4.8E−09	2.3E−10	2.3E−10	2.3E−10	3.0E−12	3.0E−12	3.0E−12
Spot Cleaner	1	Adult (21+)	1.5E−07	1.5E−07	1.5E−07	3.2E−09	3.2E−09	3.2E−09	1.4E−09	1.4E−09	1.4E−09
		Infant (birth to <1)	5.3E−07	5.3E−07	5.3E−07	8.2E−09	8.2E−09	8.2E−09	1.1E−10	1.1E−10	1.1E−10
Recycling and Disposal	12	Adult (21+)	1.0E−07	3.6E−02	0.43	1.4E−08	2.3E−03	2.7E−02	5.8E−09	9.6E−04	1.1E−02
		Infant (birth to <1)	3.6E−07	0.13	1.5	3.5E−08	5.8E−03	6.8E−02	4.5E−10	7.4E−05	8.8E−04
Other	12	Adult (21+)	1.1E−11	2.0E−05	2.4E−04	9.5E−13	1.3E−06	1.5E−05	4.0E−13	5.3E−07	6.2E−06
		Infant (birth to <1)	4.0E−11	7.1E−05	8.3E−04	2.4E−12	3.2E−06	3.8E−05	3.1E−14	4.1E−08	4.8E−07
DOD	1	Adult (21+)	5.0E−08	5.0E−08	5.0E−08	4.0E−09	4.0E−09	4.0E−09	1.7E−09	1.7E−09	1.7E−09
		Infant (birth to <1)	1.8E−07	1.8E−07	1.8E−07	1.0E−08	1.0E−08	1.0E−08	1.3E−10	1.3E−10	1.3E−10
WWTP	16	Adult (21+)	2.2E−09	6.9E−06	2.6E−05	2.9E−10	1.5E−06	8.7E−06	1.2E−10	6.6E−07	3.7E−06
		Infant (birth to <1)	7.7E−09	2.4E−05	9.0E−05	7.5E−10	4.0E−06	2.2E−05	9.6E−12	5.1E−08	2.8E−07
Overall	87	Adult (21+)	1.1E−11	5.4E−03	0.43	9.5E−13	3.4E−04	2.7E−02	4.0E−13	1.4E−04	1.1E−02
		Infant (birth to <1)	4.0E−11	1.9E−02	1.5	2.4E−12	8.7E−04	6.8E−02	3.1E−14	1.1E−05	8.8E−04

[a] The minimum exposure for the identified days of release, within the identified OES, and for the identified age group.
[b] The arithmetic mean exposure for the identified days of release, within the identified OES, and for the identified age group.
[c] The maximum exposure for the identified days of release, within the identified OES, and for the identified age group.

3.2.4.2.4 Incidental Oral for MC

Modeled incidental oral estimates are summarized by OES category in Table 3-22 for the 20-day release scenario and in Table 3-23 for the maximum days of release scenario. Results are presented for the adult and youth (11-15 years) age class, but complete by facility results across all age classes for all evaluated releases are available in *SF_FLA_Water Pathway Exposure Data for MC* (Appendix B).

For the 20-day release scenario, a total of 82 releases were modeled across all OES with incidental oral ingestion exposure ADRs across both age groups ranging from 1.2×10−11 to 3.1×10−02 mg/kg-day and ADDs ranging from 3.0×10−13 to 1.7×10−03 mg/kg-day. For the maximum days of release scenario, a total of 106 releases were modeled across all OES with incidental oral ingestion exposure ADRs across both age groups ranging from 9.7×10−13 to 5.7×10−02 mg/kg-day and ADDs ranging from 3.0×10−13 to 1.3×10−02 mg/kg-day. Youths (11 to 15 years) had higher exposures than their adult counterparts due to this age class's higher weighted incidental daily ingestion rate (Table 2-6).

Results here were compared to an alternative method for evaluating incidental oral exposure (U.S. EPA, 2019d). Due to methodological differences between to the two methods, in U.S. EPA (2019d) the 6 to 10 year age class has the highest estimated exposures as compared to the 11 to15 year age class in the presented method. Weighted incidental daily ingestion rates between the two methods for the highest exposure age class between the two models are 6.6×10−03 L/kg-day and 5.4×10−03 L/kg-day respectively, resulting in slightly higher, but comparable overall exposure values. Using the U.S. EPA (2019d) method, the 20-day scenario had a maximum ADR of 3.9×10−02 mg/kg-day and ADD of 2.1×10−03 mg/kg-day, while the maximum days of release scenario had a maximum ADR of 7.0×10−02 mg/kg-day and ADD of 1.6×10−02 mg/kg-day. These results are comparable between the two methodologies and supports confidence in the presented estimated exposures. Complete results for evaluation of incidental oral ingestion using the U.S. EPA (2019d) method are available in *SF_FLA_Water Pathway Exposure Data for MC* (Appendix B).

Table 3-22. Summary of MC Incidental Oral Ingestion Exposure by OES for 20 Days of Release Scenarios

OES	No. of Releases Modeled	Age Group	ADR (mg/kg-day)			ADD (mg/kg-day)		
			Min Exposure[a]	Mean Exposure[b]	Max Exposure[c]	Min Exposure[a]	Mean Exposure[b]	Max Exposure[c]
Manufacturing	14	Adult (21+)	6.7E−10	3.2E−05	2.9E−04	1.3E−11	1.3E−06	1.6E−05
		Youth (11–15)	1.0E−09	4.9E−05	4.4E−04	2.1E−11	2.0E−06	2.4E−05
Import and Repackaging	2	Adult (21+)	3.8E−07	7.4E−07	1.1E−06	6.7E−09	1.4E−08	2.1E−08
		Youth (11–15)	5.9E−07	1.2E−06	1.7E−06	1.0E−08	2.1E−08	3.2E−08
Processing as a Reactant	2	Adult (21+)	4.6E−06	6.6E−06	8.6E−06	1.1E−07	1.1E−07	1.2E−07
		Youth (11–15)	7.2E−06	1.0E−05	1.3E−05	1.7E−07	1.7E−07	1.8E−07
Processing: Formulation	5	Adult (21+)	2.5E−09	4.3E−05	2.1E−04	5.1E−11	2.0E−07	9.9E−07
		Youth (11–15)	4.0E−09	6.6E−05	3.3E−04	7.9E−11	3.1E−07	1.5E−06
Polyurethane Foam	1	Adult (21+)	2.8E−05	2.8E−05	2.8E−05	4.8E−07	4.8E−07	4.8E−07
		Youth (11–15)	4.4E−05	4.4E−05	4.4E−05	7.4E−07	7.4E−07	7.4E−07
Plastics Manufacturing	9	Adult (21+)	1.5E−09	2.4E−05	1.1E−04	3.0E−11	4.0E−07	1.8E−06
		Youth (11–15)	2.3E−09	3.7E−05	1.7E−04	4.7E−11	6.2E−07	2.8E−06
CTA Film Manufacturing	1	Adult (21+)	3.2E−06	3.2E−06	3.2E−06	7.6E−08	7.6E−08	7.6E−08
		Youth (11–15)	5.0E−06	5.0E−06	5.0E−06	1.2E−07	1.2E−07	1.2E−07
Lithographic Printer Cleaner	1	Adult (21+)	1.5E−09	1.5E−09	1.5E−09	2.9E−11	2.9E−11	2.9E−11
		Youth (11–15)	2.3E−09	2.3E−09	2.3E−09	4.5E−11	4.5E−11	4.5E−11
Spot Cleaner	1	Adult (21+)	1.6E−07	1.6E−07	1.6E−07	1.0E−09	1.0E−09	1.0E−09
		Youth (11–15)	2.5E−07	2.5E−07	2.5E−07	1.6E−09	1.6E−09	1.6E−09
Recycling and Disposal	6	Adult (21+)	3.1E−07	2.4E−04	1.2E−03	5.8E−09	1.4E−06	6.7E−06
		Youth (11–15)	4.9E−07	3.7E−04	1.9E−03	9.0E−09	2.2E−06	1.0E−05
Other	10	Adult (21+)	1.2E−11	4.3E−07	2.6E−06	3.0E−13	4.5E−09	2.8E−08
		Youth (11–15)	1.9E−11	6.6E−07	4.0E−06	4.6E−13	7.0E−09	4.4E−08
DOD	1	Adult (21+)	5.4E−08	5.4E−08	5.4E−08	1.2E−09	1.2E−09	1.2E−09
		Youth (11–15)	8.4E−08	8.4E−08	8.4E−08	1.9E−09	1.9E−09	1.9E−09
WWTP	29	Adult (21+)	3.4E−09	7.2E−04	2.0E−02	9.2E−11	3.9E−05	1.1E−03
		Youth (11–15)	5.3E−09	1.1E−03	3.1E−02	1.4E−10	6.1E−05	1.7E−03
Overall	82	Adult (21+)	1.2E−11	2.8E−04	2.0E−02	3.0E−13	1.4E−05	1.1E−03
		Youth (11–15)	1.9E−11	4.4E−04	3.1E−02	4.6E−13	2.2E−05	1.7E−03

[a] The minimum exposure for the identified days of release, within the identified OES, and for the identified age group.
[b] The arithmetic mean exposure for the identified days of release, within the identified OES, and for the identified age group.
[c] The maximum exposure for the identified days of release, within the identified OES, and for the identified age group.

2 **Table 3-23. Summary of MC Incidental Oral Ingestion Exposure by OES for Maximum Days of Release Scenarios**

OES	No. of Releases Modeled	Age Group	ADR (mg/kg-day)			ADD (mg/kg-day)		
			Min Exposure[a]	Mean Exposure[b]	Max Exposure[c]	Min Exposure[a]	Mean Exposure[b]	Max Exposure[c]
Manufacturing	20	Adult (21+)	3.8E−11	1.3E−06	1.6E−05	1.3E−11	9.2E−07	1.6E−05
		Youth (11–15)	5.9E−11	2.0E−06	2.5E−05	2.1E−11	1.4E−06	2.4E−05
Import and Repackaging	5	Adult (21+)	1.4E−10	1.4E−05	6.9E−05	3.5E−11	3.2E−06	1.6E−05
		Youth (11–15)	2.2E−10	2.2E−05	1.1E−04	5.5E−11	5.0E−06	2.5E−05
Processing as a Reactant	3	Adult (21+)	4.0E−08	2.6E−07	4.8E−07	1.2E−08	7.9E−08	1.1E−07
		Youth (11–15)	6.2E−08	4.1E−07	7.5E−07	1.9E−08	1.2E−07	1.8E−07
Processing: Formulation	9	Adult (21+)	7.9E−12	3.7E−04	3.3E−03	2.4E−12	8.4E−05	7.5E−04
		Youth (11–15)	1.2E−11	5.7E−04	5.1E−03	3.7E−12	1.3E−04	1.2E−03
Polyurethane Foam	1	Adult (21+)	2.3E−06	2.3E−06	2.3E−06	4.7E−07	4.7E−07	4.7E−07
		Youth (11–15)	3.5E−06	3.5E−06	3.5E−06	7.3E−07	7.3E−07	7.3E−07
Plastics Manufacturing	9	Adult (21+)	1.2E−10	1.9E−06	8.7E−06	3.0E−11	4.0E−07	1.8E−06
		Youth (11–15)	1.9E−10	2.9E−06	1.3E−05	4.7E−11	6.2E−07	2.9E−06
CTA Film Manufacturing	1	Adult (21+)	2.6E−07	2.6E−07	2.6E−07	7.6E−08	7.6E−08	7.6E−08
		Youth (11–15)	4.0E−07	4.0E−07	4.0E−07	1.2E−07	1.2E−07	1.2E−07
Lithographic Printer Cleaner	1	Adult (21+)	1.2E−10	1.2E−10	1.2E−10	2.9E−11	2.9E−11	2.9E−11
		Youth (11–15)	1.8E−10	1.8E−10	1.8E−10	4.5E−11	4.5E−11	4.5E−11
Spot Cleaner	1	Adult (21+)	1.3E−08	1.3E−08	1.3E−08	1.0E−09	1.0E−09	1.0E−09
		Youth (11–15)	2.0E−08	2.0E−08	2.0E−08	1.6E−09	1.6E−09	1.6E−09
Recycling and Disposal	14	Adult (21+)	8.8E−09	2.7E−03	3.7E−02	4.3E−09	6.1E−04	8.4E−03
		Youth (11–15)	1.4E−08	4.1E−03	5.7E−02	6.7E−09	9.5E−04	1.3E−02
Other	12	Adult (21+)	9.7E−13	1.7E−06	2.0E−05	3.0E−13	4.0E−07	4.6E−06
		Youth (11–15)	1.5E−12	2.7E−06	3.1E−05	4.6E−13	6.1E−07	7.2E−06
DOD	1	Adult (21+)	4.3E−09	4.3E−09	4.3E−09	1.2E−09	1.2E−09	1.2E−09
		Youth (11–15)	6.7E−09	6.7E−09	6.7E−09	1.9E−09	1.9E−09	1.9E−09
WWTP	29	Adult (21+)	1.9E−10	4.0E−05	1.1E−03	9.2E−11	4.0E−05	1.1E−03
		Youth (11–15)	2.9E−10	6.2E−05	1.7E−03	1.4E−10	6.1E−05	1.7E−03
Overall	106	Adult (21+)	9.7E−13	4.0E−04	3.7E−02	3.0E−13	9.9E−05	8.4E−03
		Youth (11–15)	1.5E−12	6.1E−04	5.7E−02	4.6E−13	1.5E−04	1.3E−02

[a] The minimum exposure for the identified days of release, within the identified OES, and for the identified age group.
[b] The arithmetic mean exposure for the identified days of release, within the identified OES, and for the identified age group.
[c] The maximum exposure for the identified days of release, within the identified OES, and for the identified age group.

3

3.2.4.2.5 Incidental Dermal for MC

Modeled incidental dermal estimates are summarized by OES category in Table 3-24 for the 20-day release scenario and in Table 3-25 for the maximum days of release scenario. Results are presented for the adult (21+ years) age class, but complete by facility results across all age classes for all evaluated releases are available in *SF_FLA_Water Pathway Exposure Data for MC* (Appendix B).

For the 20-day release scenario, a total of 82 releases were modeled across all OES with incidental dermal exposure ADRs ranging from 1.9×10−11 to 3.1×10−02 mg/kg-day and ADDs ranging from 4.5×10−13 to 1.7×10−03 mg/kg-day. For the maximum release scenario, a total of 106 releases were modeled across all OES with incidental dermal exposure ADRs ranging from 1.5×10−12 to 5.6×10−02 mg/kg-day and ADDs ranging from 4.5×10−13 to 1.3×10−02 mg/kg-day.

Table 3-24. Summary of MC Incidental Dermal Exposure by OES for 20 Days of Release Scenarios

OES	No. of Releases Modeled	Age Group	ADR (mg/kg-day)			ADD (mg/kg-day)		
			Min Exposure[a]	Mean Exposure[b]	Max Exposure[c]	Min Exposure[a]	Mean Exposure[b]	Max Exposure[c]
Manufacturing	14	Adult (21+)	1.0E−09	4.8E−05	4.3E−04	2.1E−11	2.0E−06	2.4E−05
Import and Repackaging	2	Adult (21+)	5.8E−07	1.1E−06	1.7E−06	1.0E−08	2.1E−08	3.2E−08
Processing as a Reactant	2	Adult (21+)	7.0E−06	1.0E−05	1.3E−05	1.7E−07	1.7E−07	1.8E−07
Processing: Formulation	5	Adult (21+)	3.9E−09	6.5E−05	3.2E−04	7.8E−11	3.0E−07	1.5E−06
Polyurethane Foam	1	Adult (21+)	4.3E−05	4.3E−05	4.3E−05	7.3E−07	7.3E−07	7.3E−07
Plastics Manufacturing	9	Adult (21+)	2.3E−09	3.6E−05	1.6E−04	4.6E−11	6.1E−07	2.8E−06
CTA Film Manufacturing	1	Adult (21+)	4.9E−06	4.9E−06	4.9E−06	1.1E−07	1.1E−07	1.1E−07
Lithographic Printer Cleaner	1	Adult (21+)	2.2E−09	2.2E−09	2.2E−09	4.4E−11	4.4E−11	4.4E−11
Spot Cleaner	1	Adult (21+)	2.4E−07	2.4E−07	2.4E−07	1.5E−09	1.5E−09	1.5E−09
Recycling and Disposal	6	Adult (21+)	4.8E−07	3.6E−04	1.9E−03	8.8E−09	2.1E−06	1.0E−05
Other	10	Adult (21+)	1.9E−11	6.5E−07	3.9E−06	4.5E−13	6.8E−09	4.3E−08
DOD	1	Adult (21+)	8.2E−08	8.2E−08	8.2E−08	1.9E−09	1.9E−09	1.9E−09
WWTP	29	Adult (21+)	5.2E−09	1.1E−03	3.1E−02	1.4E−10	6.0E−05	1.7E−03
Overall	82	Adult (21+)	1.9E−11	4.3E−04	3.1E−02	4.5E−13	2.2E−05	1.7E−03

[a] The minimum exposure for the identified days of release, within the identified OES, and for the identified age group.
[b] The arithmetic exposure ADR for the identified days of release, within the identified OES, and for the identified age group.
[c] The maximum exposure for the identified days of release, within the identified OES, and for the identified age group.

Table 3-25. Summary of Methylene Chloride Incidental Dermal Exposure by OES for Maximum Days of Release Scenarios

OES	No. of Releases Modeled	Age Group	ADR (mg/kg-day)			ADD (mg/kg-day)		
			Min Exposure[a]	Mean Exposure[b]	Max Exposure[c]	Min Exposure[a]	Mean Exposure[b]	Max Exposure[c]
Manufacturing	20	Adult (21+)	5.8E−11	2.0E−06	2.5E−05	2.1E−11	1.4E−06	2.4E−05
Import and Repackaging	5	Adult (21+)	2.1E−10	2.1E−05	1.1E−04	5.4E−11	4.9E−06	2.4E−05
Processing as a Reactant	3	Adult (21+)	6.0E−08	4.0E−07	7.3E−07	1.9E−08	1.2E−07	1.7E−07
Processing: Formulation	9	Adult (21+)	1.2E−11	5.6E−04	5.0E−03	3.6E−12	1.3E−04	1.1E−03
Polyurethane Foam	1	Adult (21+)	3.5E−06	3.5E−06	3.5E−06	7.2E−07	7.2E−07	7.2E−07
Plastics Manufacturing	9	Adult (21+)	1.8E−10	2.9E−06	1.3E−05	4.6E−11	6.1E−07	2.8E−06
CTA Film Manufacturing	1	Adult (21+)	3.9E−07	3.9E−07	3.9E−07	1.1E−07	1.1E−07	1.1E−07
Lithographic Printer Cleaner	1	Adult (21+)	1.8E−10	1.8E−10	1.8E−10	4.4E−11	4.4E−11	4.4E−11
Spot Cleaner	1	Adult (21+)	2.0E−08	2.0E−08	2.0E−08	1.5E−09	1.5E−09	1.5E−09
Recycling and Disposal	14	Adult (21+)	1.3E−08	4.0E−03	5.6E−02	6.6E−09	9.3E−04	1.3E−02
Other	12	Adult (21+)	1.5E−12	2.6E−06	3.1E−05	4.5E−13	6.0E−07	7.0E−06
DOD	1	Adult (21+)	6.6E−09	6.6E−09	6.6E−09	1.9E−09	1.9E−09	1.9E−09
WWTP	29	Adult (21+)	2.9E−10	6.0E−05	1.7E−03	1.4E−10	6.0E−05	1.7E−03
Overall	106	Adult (21+)	1.5E−12	6.0E−04	5.6E−02	4.5E−13	1.5E−04	1.3E−02

[a] The minimum exposure for the identified days of release, within the identified OES, and for the identified age group.
[b] The arithmetic exposure ADR for the identified days of release, within the identified OES, and for the identified age group.
[c] The maximum exposure for the identified days of release, within the identified OES, and for the identified age group.

3.2.5 Risk Characterization for MC

3.2.5.1 Risk Characterization for the Air Pathway

EPA calculated risk estimates for each of the endpoints in Table 3-13 across all known TRI reporters and other modeled facilities under each OES. EPA calculated risk estimates for each facility using the 10th, 50th, and 95th percentile of modeled exposure concentrations around the releasing facility. The 95th percentile estimates were then further distilled across facilities within each OES to present the range from minimum to maximum risk.

Based on the 95th percentile values, risks were indicated for at least one facility relative to benchmark for 8 of 17 OES. Risks were not indicated for any OES beyond 100 meters from a facility. These results are summarized below in Table 3-26. Results for 10th and 50th percentile measurements along with facility-specific results are provided in *SF_FLA_Air Pathway Full-Screen Results for MC* (Appendix B).

Table 3-26. MC Inhalation Risk across OES at Various Distances from Releasing Facility (Based on 95th percentile exposure Concentrations)

Occupational Exposure Scenario	Number of TRI Facilities		Distance from Facility (meters)	Estimated MOE								Estimated Cancer Risk			
				Non-cancer								Cancer (Benchmark 1E−06)			
				Acute (Benchmark 30)				Chronic (Benchmark 10)							
	Total	w/ Risk		Single Facility	Min Risk [b]	Mean Risk [c]	Max Risk [d]	Single Facility	Min Risk	Mean Risk	Max Risk	Single Facility	Min Risk	Mean Risk	Max Risk
Batch Open-Top Degreasing	1	0	5	6.7E+04	–	–	–	2.7E+04	–	–	–	3.7E−09	–	–	–
			10	4.9E+04	–	–	–	2.0E+04	–	–	–	5.0E−09	–	–	–
			30	1.0E+05	–	–	–	4.2E+04	–	–	–	2.4E−09	–	–	–
			60	4.2E+04	–	–	–	1.5E+04	–	–	–	6.6E−09	–	–	–
			100	2.4E+04	–	–	–	88,881	–	–	–	1.1E−08	–	–	–
			100–1,000	1.0E+05	–	–	–	2.5E+04	–	–	–	4.0E−09	–	–	–
			2,500	6.4E+05	–	–	–	3.0E+05	–	–	–	3.3E−10	–	–	–
			5,000	1.7E+06	–	–	–	8.0E+05	–	–	–	1.3E−10	–	–	–
			10,000	4.8E+06	–	–	–	2.1E+06	–	–	–	4.7E−11	–	–	–
Cellulose Triacetate Film Production	2	1	5	N/A	1.3E+05	307	154	N/A	3.0E+04	70	35	N/A	3.3E−09	**1.4E−06**	**2.8E−06**
			10	N/A	1.0E+05	234	117	N/A	2.2E+04	53	26	N/A	4.5E−09	**1.9E−06**	**3.8E−06**
			30	N/A	2.9E+05	703	352	N/A	6.1E+04	173	87	N/A	1.6E−09	5.8E−07	**1.2E−06**
			60	N/A	5.9E+05	1,880	942	N/A	1.2E+05	507	254	N/A	8.1E−10	2.0E−07	3.9E−07
			100	N/A	7.1E+05	4,225	2,119	N/A	1.7E+05	1,225	615	N/A	6.0E−10	8.2E−08	1.6E−07
			100–1,000	N/A	2.8E+06	7.0E+04	3.5E+04	N/A	5.3E+05	1.3E+04	6,640	N/A	1.9E−10	7.6E−09	1.5E−08
			2,500	N/A	1.5E+07	8.6E+05	4.4E+05	N/A	3.4E+06	2.6E+05	1.4E+05	N/A	3.0E−11	3.8E−10	7.3E−10
			5,000	N/A	4.1E+07	2.6E+06	1.4E+06	N/A	9.4E+06	8.0E+05	4.2E+05	N/A	1.1E−11	1.2E−10	2.4E−10
			10,000	N/A	1.2E+08	8.1E+06	4.2E+06	N/A	2.8E+07	2.4E+06	1.3E+06	N/A	3.6E−12	4.1E−11	7.9E−11
Cleaner/ Degreaser – Unknown [e]	16	3	5	N/A	1.0E+13	1,250	325	N/A	6.3E+11	384	85	N/A	1.6E−16	2.6E−07	**1.2E−06**
			10	N/A	1.4E+11	968	201	N/A	2.3E+10	300	74	N/A	4.4E−15	3.3E−07	**1.3E−06**
			30	N/A	7.7E+07	2,721	467	N/A	1.9E+07	887	204	N/A	5.4E−12	1.1E−07	4.9E−07
			60	N/A	4.5E+06	7,046	1,182	N/A	1.7E+06	2,332	528	N/A	5.8E−11	4.3E−08	1.9E−07
			100	N/A	2.1E+06	1.5E+04	2,618	N/A	8.4E+05	4,940	1,149	N/A	1.2E−10	2.0E−08	8.7E−08
			100–1,000	N/A	1.0E+07	2.1E+05	5.0E+04	N/A	2.5E+06	4.0E+04	9,690	N/A	4.1E−11	2.5E−09	1.0E−08
			2,500	N/A	7.7E+07	2.3E+06	7.9E+05	N/A	3.2E+07	7.9E+05	2.3E+05	N/A	3.1E−12	1.3E−10	4.4E−10
			5,000	N/A	2.0E+08	6.5E+06	2.5E+06	N/A	7.2E+07	2.2E+06	6.8E+05	N/A	1.4E−12	4.6E−11	1.5E−10

Occupational Exposure Scenario	Number of TRI Facilities		Distance from Facility (meters)	Estimated MOE								Estimated Cancer Risk			
				Non-cancer								Cancer (Benchmark 1E−06)			
				Acute (Benchmark 30)				Chronic (Benchmark 10)							
	Total	w/ Risk		Single Facility	Min Risk [b]	Mean Risk [c]	Max Risk [d]	Single Facility	Min Risk	Mean Risk	Max Risk	Single Facility	Min Risk	Mean Risk	Max Risk
			10,000	N/A	5.6E+08	1.8E+07	7.5E+06	N/A	1.7E+08	5.8E+06	2.0E+06	N/A	5.9E−13	1.7E−11	5.1E−11
Commercial Aerosol Products (Aerosol Degreasing, Aerosol Lubricants, Automotive Care Products)	– [a]	–	5	N/A	2.6E+04	1.5E+04	9,843	N/A	1.3E+04	5,415	3,165	N/A	8.0E−09	1.8E−08	3.2E−08
			10	N/A	1.5E+04	1.0E+04	7,657	N/A	6,906	3,862	2,513	N/A	1.4E−08	2.6E−08	4.0E−08
			30	N/A	3.6E+04	2.9E+04	2.5E+04	N/A	1.7E+04	1.2E+04	9,058	N/A	5.7E−09	8.2E−09	1.1E−08
			60	N/A	1.1E+05	8.5E+04	6.9E+04	N/A	4.8E+04	3.6E+04	2.8E+04	N/A	2.1E−09	2.8E−09	3.6E−09
			100	N/A	2.9E+05	2.2E+05	1.8E+05	N/A	1.2E+05	9.4E+04	7.5E+04	N/A	8.2E−10	1.1E−09	1.3E−09
			100–1,000	N/A	1.1E+07	9.0E+06	7.4E+06	N/A	1.8E+06	1.4E+06	1.2E+06	N/A	5.5E−11	7.0E−11	8.4E−11
			2,500	N/A	2.9E+08	2.3E+08	1.9E+08	N/A	1.2E+08	7.7E+07	4.7E+07	N/A	8.5E−13	1.3E−12	2.1E−12
			5,000	N/A	1.1E+09	8.4E+08	6.9E+08	N/A	4.2E+08	2.5E+08	1.4E+08	N/A	2.4E−13	4.0E−13	7.0E−13
			10,000	N/A	3.3E+09	2.2E+09	1.7E+09	N/A	9.8E+08	6.1E+08	3.6E+08	N/A	1.0E−13	1.6E−13	2.8E−13
Fabric Finishing	1	0	5	7,899	–	–	–	2,525	–	–	–	4.0E−08	–	–	–
			10	6,378	–	–	–	1,754	–	–	–	5.7E−08	–	–	–
			30	1.7E+04	–	–	–	4,464	–	–	–	2.2E−08	–	–	–
			60	4.4E+04	–	–	–	1.1E+04	–	–	–	8.8E−09	–	–	–
			100	9.5E+04	–	–	–	2.5E+04	–	–	–	4.0E−09	–	–	–
			100–1,000	1.5E+06	–	–	–	2.7E+05	–	–	–	3.7E−10	–	–	–
			2,500	2.0E+07	–	–	–	5.8E+06	–	–	–	1.7E−11	–	–	–
			5,000	6.2E+07	–	–	–	1.9E+07	–	–	–	5.3E−12	–	–	–
			10,000	1.9E+08	–	–	–	5.9E+07	–	–	–	1.7E−12	–	–	–
Flexible Polyurethane Foam Manufacturing	1	1	5	**17**	–	–	–	**5**	–	–	–	**2.2E−05**	–	–	–
			10	**13**	–	–	–	**4**	–	–	–	**2.6E−05**	–	–	–
			30	40	–	–	–	11	–	–	–	**9.5E−06**	–	–	–
			60	101	–	–	–	26	–	–	–	**3.8E−06**	–	–	–
			100	217	–	–	–	57	–	–	–	**1.8E−06**	–	–	–
			100–1,000	3,401	–	–	–	588	–	–	–	1.7E−07	–	–	–
			2,500	3.9E+04	–	–	–	1.1E+04	–	–	–	9.4E−09	–	–	–
			5,000	1.2E+05	–	–	–	3.3E+04	–	–	–	3.1E−09	–	–	–
			10,000	3.7E+05	–	–	–	1.0E+05	–	–	–	1.0E−09	–	–	–

Occupational Exposure Scenario	Number of TRI Facilities		Distance from Facility (meters)	Estimated MOE								Estimated Cancer Risk			
				Non-cancer								Cancer (Benchmark 1E−06)			
				Acute (Benchmark 30)				Chronic (Benchmark 10)							
	Total	w/ Risk		Single Facility	Min Risk [b]	Mean Risk [c]	Max Risk [d]	Single Facility	Min Risk	Mean Risk	Max Risk	Single Facility	Min Risk	Mean Risk	Max Risk
Laboratory Use	5	0	5	N/A	1.2E+11	3.2E+04	9,901	N/A	1.1E+10	8,335	2,551	N/A	8.7E−15	1.2E−08	3.9E−08
			10	N/A	8.2E+08	1.9E+04	5,102	N/A	3.5E+08	4,942	1,330	N/A	2.8E−13	2.0E−08	7.5E−08
			30	N/A	9.6E+06	3.9E+04	9,615	N/A	3.0E+06	1.2E+04	2,976	N/A	3.3E−11	8.3E−09	3.4E−08
			60	N/A	2.0E+06	8.3E+04	2.2E+04	N/A	3.0E+05	2.6E+04	7,194	N/A	3.4E−10	3.8E−09	1.4E−08
			100	N/A	1.4E+06	1.4E+05	4.4E+04	N/A	2.5E+05	4.0E+04	1.5E+04	N/A	4.0E−10	2.5E−09	6.8E−09
			100–1,000	N/A	1.6E+07	1.0E+06	3.9E+05	N/A	2.5E+06	1.9E+05	7.2E+04	N/A	3.9E−11	5.4E−10	1.4E−09
			2,500	N/A	1.0E+08	4.6E+06	1.3E+06	N/A	2.0E+07	1.4E+06	3.8E+05	N/A	5.0E−12	7.1E−11	2.6E−10
			5,000	N/A	2.0E+08	8.8E+06	2.3E+06	N/A	4.0E+07	2.7E+06	6.8E+05	N/A	2.5E−12	3.8E−11	1.5E−10
			10,000	N/A	4.3E+08	1.8E+07	4.5E+06	N/A	9.0E+07	5.7E+06	1.4E+06	N/A	1.1E−12	1.8E−11	7.2E−11
Lithographic Printing Plate Cleaning	1	0	5	3.1E+12	–	–	–	1.8E+11	–	–	–	5.5E−16	–	–	–
			10	1.5E+10	–	–	–	1.2E+09	–	–	–	8.2E−14	–	–	–
			30	1.1E+07	–	–	–	3.0E+06	–	–	–	3.3E−11	–	–	–
			60	6.9E+05	–	–	–	1.6E+05	–	–	–	6.1E−10	–	–	–
			100	3.1E+05	–	–	–	7.5E+04	–	–	–	1.3E−09	–	–	–
			100–1,000	7.9E+05	–	–	–	2.1E+05	–	–	–	4.9E−10	–	–	–
			2,500	4.2E+06	–	–	–	2.0E+06	–	–	–	4.9E−11	–	–	–
			5,000	1.1E+07	–	–	–	5.2E+06	–	–	–	1.9E−11	–	–	–
			10,000	2.8E+07	–	–	–	1.3E+07	–	–	–	7.6E−12	–	–	–
Manufacturing	11	0	5	N/A	1.8E+16	5,354	1,706	N/A	1.8E+15	1,185	342	N/A	5.4E−20	8.4E−08	2.9E−07
			10	N/A	6.6E+14	3,235	936	N/A	8.7E+13	694	180	N/A	1.2E−18	1.4E−07	5.6E−07
			30	N/A	2.0E+12	7,032	1,880	N/A	4.6E+11	1,548	368	N/A	2.2E−16	6.5E−08	2.7E−07
			60	N/A	1.3E+11	1.6E+04	4,348	N/A	1.9E+10	3,646	865	N/A	5.4E−15	2.7E−08	1.2E−07
			100	N/A	5.1E+10	3.2E+04	8,651	N/A	8.2E+09	7,061	1,742	N/A	1.2E−14	1.4E−08	5.7E−08
			100–1,000	N/A	1.2E+11	3.1E+05	1.0E+05	N/A	2.4E+10	5.4E+04	1.6E+04	N/A	4.2E−15	1.8E−09	6.1E−09
			2,500	N/A	7.4E+11	2.4E+06	9.9E+05	N/A	2.3E+11	6.4E+05	2.3E+05	N/A	4.4E−16	1.6E−10	4.3E−10
			5,000	N/A	1.8E+12	6.0E+06	2.4E+06	N/A	5.8E+11	1.6E+06	5.4E+05	N/A	1.7E−16	6.2E−11	1.8E−10
			10,000	N/A	4.3E+12	1.6E+07	6.1E+06	N/A	1.6E+12	4.3E+06	1.4E+06	N/A	6.3E−17	2.3E−11	7.0E−11

Occupational Exposure Scenario	Number of TRI Facilities		Distance from Facility (meters)	Estimated MOE								Estimated Cancer Risk			
				Non-cancer								Cancer (Benchmark 1E−06)			
				Acute (Benchmark 30)				Chronic (Benchmark 10)							
	Total	w/ Risk		Single Facility	Min Risk [b]	Mean Risk [c]	Max Risk [d]	Single Facility	Min Risk	Mean Risk	Max Risk	Single Facility	Min Risk	Mean Risk	Max Risk
Miscellaneous Non-aerosol Industrial and Commercial Uses [f]	31	2	5	N/A	8.0E+12	394	**13**	N/A	5.6E+11	85	**3**	N/A	1.8E−16	**1.2E−06**	**3.6E−05**
			10	N/A	6.5E+10	351	**12**	N/A	5.0E+09	73	**2**	N/A	2.0E−14	**1.4E−06**	**4.1E−05**
			30	N/A	1.1E+08	1,036	37	N/A	2.9E+07	232	**8**	N/A	3.5E−12	4.3E−07	**1.3E−05**
			60	N/A	7.5E+06	2,642	96	N/A	1.7E+06	606	21	N/A	5.9E−11	1.6E−07	**4.7E−06**
			100	N/A	4.2E+06	5,506	212	N/A	1.2E+06	1,293	47	N/A	8.5E−11	7.7E−08	**2.1E−06**
			100–1,000	N/A	1.9E+07	6.9E+04	3,378	N/A	4.7E+06	1.2E+04	502	N/A	2.1E−11	8.6E−09	2.0E−07
			2,500	N/A	8.5E+07	6.3E+05	4.1E+04	N/A	2.9E+07	1.8E+05	9,823	N/A	3.5E−12	5.7E−10	1.0E−08
			5,000	N/A	2.3E+08	1.7E+06	1.3E+05	N/A	5.4E+07	4.9E+05	3.0E+04	N/A	1.8E−12	2.0E−10	3.3E−09
			10,000	N/A	6.9E+08	4.7E+06	3.8E+05	N/A	1.5E+08	1.4E+06	9.3E+04	N/A	6.6E−13	7.2E−11	1.1E−09
Plastic Product Manufacturing	7	2	5	N/A	5.8E+13	215	55	N/A	3.1E+11	68	17	N/A	3.2E−16	**1.5E−06**	**5.8E−06**
			10	N/A	1.1E+11	123	33	N/A	2.6E+09	38	11	N/A	3.8E−14	**2.6E−06**	**9.4E−06**
			30	N/A	8.9E+06	261	76	N/A	2.6E+06	79	22	N/A	3.8E−11	**1.3E−06**	**4.6E−06**
			60	N/A	2.1E+07	618	179	N/A	6.5E+06	188	51	N/A	1.5E−11	5.3E−07	**2.0E−06**
			100	N/A	4.2E+07	1,253	357	N/A	1.3E+07	380	100	N/A	7.4E−12	2.6E−07	1.0E−06
			100-1000	N/A	5.1E+08	1.6E+04	4,386	N/A	1.1E+08	3,297	935	N/A	9.5E−13	3.0E−08	1.1E−07
			2,500	N/A	4.9E+09	1.7E+05	4.5E+04	N/A	1.8E+09	6.4E+04	1.6E+04	N/A	5.4E−14	1.6E−09	6.4E−09
			5,000	N/A	1.3E+10	4.9E+05	1.3E+05	N/A	5.3E+09	1.9E+05	4.5E+04	N/A	1.9E−14	5.3E−10	2.2E−09
			10,000	N/A	3.6E+10	1.4E+06	3.6E+05	N/A	1.5E+10	5.6E+05	1.3E+05	N/A	6.5E−15	1.8E−10	7.5E−10
Processing – Incorporation into Formulation, Mixture, or Reaction Product	50	3	5	N/A	2.4E+14	1,615	54	N/A	7.2E+12	382	13	N/A	1.4E−17	2.6E−07	**7.8E−06**
			10	N/A	8.2E+11	1,148	33	N/A	1.4E+11	276	**8**	N/A	7.0E−16	3.6E−07	**1.2E−05**
			30	N/A	4.1E+09	2,780	75	N/A	1.1E+09	728	21	N/A	8.8E−14	1.4E−07	**4.8E−06**
			60	N/A	6.1E+08	6,745	179	N/A	1.0E+08	1,826	52	N/A	1.0E−12	5.5E−08	**1.9E−06**
			100	N/A	3.2E+08	1.4E+04	376	N/A	5.8E+07	3,887	111	N/A	1.7E−12	2.6E−08	9.0E−07
			100–1000	N/A	8.9E+08	1.9E+05	5,382	N/A	1.9E+08	3.3E+04	899	N/A	5.4E−13	3.1E−09	1.1E−07
			2500	N/A	4.9E+09	2.2E+06	6.5E+04	N/A	1.4E+09	6.6E+05	2.1E+04	N/A	6.9E−14	1.5E−10	4.7E−09
			5000	N/A	1.3E+10	6.4E+06	2.0E+05	N/A	4.1E+09	2.0E+06	6.6E+04	N/A	2.4E−14	5.1E−11	1.5E−09
			10000	N/A	3.9E+10	1.9E+07	6.1E+05	N/A	1.2E+10	5.8E+06	2.0E+05	N/A	8.4E−15	1.7E−11	5.0E−10

Occupational Exposure Scenario	Number of TRI Facilities		Distance from Facility (meters)	Estimated MOE								Estimated Cancer Risk			
				Non-cancer								Cancer (Benchmark 1E−06)			
				Acute (Benchmark 30)				Chronic (Benchmark 10)							
	Total	w/ Risk		Single Facility	Min Risk [b]	Mean Risk [c]	Max Risk [d]	Single Facility	Min Risk	Mean Risk	Max Risk	Single Facility	Min Risk	Mean Risk	Max Risk
Processing as a Reactant	14	1	5	N/A	6.8E+12	4,502	476	N/A	3.3E+12	1,184	126	N/A	3.0E−17	8.4E−08	7.9E−07
			10	N/A	4.4E+11	3,236	355	N/A	1.3E+11	845	94	N/A	7.5E−16	1.2E−07	**1.1E−06**
			30	N/A	1.4E+09	8,755	1,010	N/A	6.3E+08	2,152	245	N/A	1.6E−13	4.6E−08	4.1E−07
			60	N/A	1.1E+08	2.1E+04	2,463	N/A	3.2E+07	5,250	608	N/A	3.2E−12	1.9E−08	1.6E−07
			100	N/A	5.0E+07	4.2E+04	5,139	N/A	1.2E+07	1.0E+04	1,269	N/A	8.3E−12	9.6E−09	7.9E−08
			100-1,000	N/A	1.3E+08	4.2E+05	5.9E+04	N/A	2.6E+07	7.4E+04	9,940	N/A	3.8E−12	1.3E−09	1.0E−08
			2,500	N/A	5.0E+08	3.4E+06	5.4E+05	N/A	1.4E+08	1.0E+06	1.6E+05	N/A	7.4E−13	9.6E−11	6.1E−10
			5,000	N/A	1.0E+09	8.0E+06	1.3E+06	N/A	3.3E+08	2.7E+06	4.3E+05	N/A	3.0E−13	3.8E−11	2.3E−10
			10000	N/A	2.6E+09	2.0E+07	3.2E+06	N/A	8.8E+08	6.9E+06	1.1E+06	N/A	1.1E−13	1.4E−11	8.8E−11
Repackaging	22	0	5	N/A	7.6E+20	2.3E+04	6,289	N/A	4.4E+15	9,658	2,703	N/A	2.3E−20	1.0E−08	3.7E−08
			10	N/A	2.8E+14	1.6E+04	6,083	N/A	1.3E+12	7,279	2,564	N/A	7.5E−17	1.4E−08	3.9E−08
			30	N/A	1.4E+08	4.9E+04	1.7E+04	N/A	2.2E+07	2.5E+04	9,091	N/A	4.5E−12	4.0E−09	1.1E−08
			60	N/A	7.2E+06	1.4E+05	4.7E+04	N/A	3.7E+06	7.2E+04	2.7E+04	N/A	2.7E−11	1.4E−09	3.7E−09
			100	N/A	2.0E+07	3.3E+05	1.1E+05	N/A	1.0E+07	1.6E+05	6.0E+04	N/A	9.8E−12	6.1E−10	1.7E−09
			100-1,000	N/A	1.0E+09	9.9E+06	2.7E+06	N/A	1.3E+08	1.5E+06	4.3E+05	N/A	7.4E−13	6.6E−11	2.3E−10
			2,500	N/A	4.0E+10	3.2E+08	8.1E+07	N/A	1.1E+10	8.4E+07	2.4E+07	N/A	9.5E−15	1.2E−12	4.2E−12
			5,000	N/A	2.5E+11	1.6E+09	3.0E+08	N/A	3.1E+10	2.4E+08	6.5E+07	N/A	3.2E−15	4.1E−13	1.5E−12
			10,000	N/A	1.6E+12	5.2E+09	9.2E+08	N/A	6.6E+10	5.2E+08	1.4E+08	N/A	1.5E−15	1.9E−13	7.2E−13
Spot Cleaning	–	–	5	N/A	1.4E+05	9.4E+04	7.1E+04	N/A	6.9E+04	3.3E+04	2.1E+04	N/A	1.5E−09	3.0E−09	4.7E−09
			10	N/A	7.9E+04	6.4E+04	5.5E+04	N/A	3.7E+04	2.3E+04	1.7E+04	N/A	2.7E−09	4.3E−09	6.0E−09
			30	N/A	1.9E+05	1.8E+05	1.7E+05	N/A	9.1E+04	7.2E+04	5.9E+04	N/A	1.1E−09	1.4E−09	1.7E−09
			60	N/A	5.6E+05	5.2E+05	4.9E+05	N/A	2.5E+05	2.1E+05	1.8E+05	N/A	4.0E−10	4.8E−10	5.5E−10
			100	N/A	1.5E+06	1.4E+06	1.3E+06	N/A	6.2E+05	5.5E+05	4.9E+05	N/A	1.6E−10	1.8E−10	2.0E−10
			100-1,000	N/A	5.7E+07	5.3E+07	4.9E+07	N/A	8.8E+06	8.0E+06	6.9E+06	N/A	1.1E−11	1.3E−11	1.4E−11
			2,500	N/A	1.6E+09	1.4E+09	1.2E+09	N/A	5.8E+08	4.3E+08	3.1E+08	N/A	1.7E−13	2.3E−13	3.2E−13
			5,000	N/A	5.3E+09	5.0E+09	4.6E+09	N/A	2.1E+09	1.4E+09	9.7E+08	N/A	4.7E−14	7.0E−14	1.0E−13
			10,000	N/A	1.5E+10	1.3E+10	1.2E+10	N/A	5.2E+09	3.6E+09	2.6E+09	N/A	1.9E−14	2.8E−14	3.9E−14

Occupational Exposure Scenario	Number of TRI Facilities		Distance from Facility (meters)	Estimated MOE								Estimated Cancer Risk			
				Non-cancer								Cancer (Benchmark 1E−06)			
				Acute (Benchmark 30)				Chronic (Benchmark 10)							
	Total	w/ Risk		Single Facility	Min Risk [b]	Mean Risk [c]	Max Risk [d]	Single Facility	Min Risk	Mean Risk	Max Risk	Single Facility	Min Risk	Mean Risk	Max Risk
Waste Handling, Disposal, Treatment, and Recycling	30	0	5	N/A	5.0E+11	1.8E+04	1,299	N/A	2.6E+10	4,384	255	N/A	3.9E−15	2.3E−08	3.9E−07
			10	N/A	4.6E+09	1.4E+04	1,543	N/A	1.9E+08	3,425	276	N/A	5.3E−13	2.9E−08	3.6E−07
			30	N/A	4.3E+07	3.6E+04	5,794	N/A	1.3E+07	9,023	1,029	N/A	7.6E−12	1.1E−08	9.7E−08
			60	N/A	1.1E+08	8.6E+04	1.4E+04	N/A	3.2E+07	2.3E+04	2,941	N/A	3.2E−12	4.4E−09	3.4E−08
			100	N/A	2.1E+08	1.7E+05	2.8E+04	N/A	6.4E+07	4.6E+04	6,640	N/A	1.6E−12	2.2E−09	1.5E−08
			100–1,000	N/A	2.4E+09	1.7E+06	2.4E+05	N/A	4.9E+08	3.5E+05	6.2E+04	N/A	2.1E−13	2.9E−10	1.6E−09
			2,500	N/A	1.8E+10	1.6E+07	1.6E+06	N/A	6.6E+09	5.2E+06	6.0E+05	N/A	1.5E−14	1.9E−11	1.7E−10
			5,000	N/A	4.1E+10	4.3E+07	4.4E+06	N/A	1.5E+10	1.5E+07	1.7E+06	N/A	6.5E−15	6.7E−12	5.9E−11
			10,000	N/A	1.1E+11	1.3E+08	1.3E+07	N/A	3.7E+10	4.3E+07	5.0E+06	N/A	2.7E−15	2.3E−12	2.0E−11
Paint Remover	3	1	5	N/A	4.2E+10	871	316	N/A	3.5E+09	206	73	N/A	2.8E−14	4.9E−07	**1.4E−06**
			10	N/A	1.8E+08	526	190	N/A	5.4E+07	112	40	N/A	1.9E−12	8.9E−07	**2.5E−06**
			30	N/A	9.4E+05	1,181	424	N/A	1.4E+05	249	88	N/A	7.0E−10	4.0E−07	**1.1E−06**
			60	N/A	1.5E+05	2,826	1,050	N/A	2.14E+04	601	218	N/A	4.7E−09	1.7E−07	4.6E−07
			100	N/A	7.4E+04	5,372	2,242	N/A	1.5E+04	1,183	467	N/A	6.8E−09	8.5E−08	2.1E−07
			100–1,000	N/A	2.4E+04	5.2E+04	3.4E+04	N/A	3.6E+04	1.0E+04	6,173	N/A	2.7E−09	9.7E−09	1.6E−08
			2,500	N/A	1.3E+06	3.1E+05	1.6E+05	N/A	2.1E+05	8.4E+04	5.0E+04	N/A	4.7E−10	1.2E−09	2.0E−09
			5,000	N/A	3.4E+06	7.1E+05	3.2E+05	N/A	5.8E+05	1.9E+05	9.6E+04	N/A	1.7E−10	5.2E−10	1.0E−09
			10,000	N/A	9.6E+06	1.7E+06	7.1E+05	N/A	1.7E+06	4.7E+05	2.2E+05	N/A	5.9E−11	2.1E−10	4.5E−10

[a] When (-) is indicated for the total number of facilities, no facilities were identified via TRI reporting. The provided estimates are based on modeling of theoretical facilities.
[b] The minimum risk value is associated with the maximum MOE and the maximum ADR.
[c] The mean risk value is the arithmetic mean MOE.
[d] The maximum risk value is associated with the minimum MOE and the minimum ADR.
[e] This OES designation is a grouping of the following COUs from the 2020 Methylene Chloride Risk Evaluation: Conveyorized Vapor Degreasing and Cold Cleaning. See Section 3.2.3.2.
[f] This OES designation includes a grouping of the following COUs from the 2020 Methylene Chloride Risk Evaluation: Adhesives and Sealants, Paints and Coatings, and Adhesive and Caulk Removers.

3.2.5.1.1 Land Use Considerations

EPA identified risk for 14 of the 248 facilities evaluated based on modeled air concentrations. GIS locations were available for all 14 facilities with risk. For each of these 14 facilities, EPA evaluated land use patterns to determine whether fenceline community exposures are reasonably anticipated at locations where risk is indicated. Details of this methodology are provided in Section 2.1.2.2. In short, EPA evaluated whether residential, industrial/commercial businesses, or other public spaces are present within those radial distances indicating risk (as opposed to uninhabited areas), as well as whether the radial distance lies outside the boundaries of the facility.

Based on characterization of land use patterns, fenceline community exposures are reasonably anticipated for 2 of the 14 facilities (14 percent) where risk is indicated based on modeled fenceline air concentrations. Table 3-28 summarizes the number of facilities in each OES for which risk is indicated and where fenceline community exposures are reasonably anticipated.

Table 3-27. Summary of Fenceline Community Exposures Expected near Facilities Where Modeled Air Concentrations Indicated Risk for MC

OES	Total Number of Facilities Evaluated	Number of Facilities with Risk Indicated	Number of Facilities with Risk Indicated and Exposures Expected	Percent of Total Facilities with Risk Indicated and Exposures Expected
Miscellaneous Non-aerosol	31	2	1	3%
Cellulose	2	1	0	0%
Processing – Incorporation into Formulation, Mixture or Reaction Product	50	3	0	0%
Flexible Polyurethane Foam Manufacturing	1	1	1	100%
Plastic Product Manufacturing	7	2	0	0%
Processing-Reactant	14	1	0	0%
Cleaner/Degreaser	16	3	0	0%
Paint Remover	3	1	0	0%

3.2.5.2 Risk Characterization for the Water Pathway

3.2.5.2.1 Drinking Water Risk for MC

EPA calculated risk estimates for each of the endpoints in Table 3-13 across all known facilities and modeled release scenarios under each OES. These estimates were then summarized across facilities to present the range from minimum to maximum risk for multiple lifestages under each OES. For cancer, total lifetime cancer risk across lifestages was calculated by integrating partial risk for each lifestage based on differential exposure and consideration of age-dependent adjustment factors (ADAFs, (U.S. EPA, 2005)). For MC, ADAFs were applied for younger lifestages based on the conclusion that MC is carcinogenic through a mutagenic mode of action (U.S. EPA, 2020c).

For the maximum days of release scenario, acute but not chronic non-cancer risks (Table 3-30) and cancer risks (Table 3-31) were indicated relative to the benchmarks for MC for at least one facility in the recycling and disposal OES. Risks relative to benchmark for MC were not indicated for any OES for the 20-day release scenario (Table 3-28, Table 3-29).

Table 3-28. Summary of Non-cancer Risk Estimates for Drinking Water Exposures by OES under 20 Days of Release Scenarios for MC

OES	No. of Releases Modeled	Age Group	Acute MOE (Benchmark = 30)			Chronic MOE (Benchmark = 30)		
			Min Risk [a]	Mean Risk [b]	Max Risk [c]	Min Risk [a]	Mean Risk [b]	Max Risk [c]
Manufacturing	12	Adult (21+)	4.1E+09	9.6E+08	2.5E+04	7.0E+10	1.9E+10	9.9E+05
		Infant (birth to <1)	1.2E+09	2.7E+08	7,012	2.7E+10	7.4E+09	3.9E+05
Import and Repackaging	2	Adult (21+)	7.2E+06	4.9E+06	2.5E+06	1.4E+08	9.3E+07	4.5E+07
		Infant (birth to <1)	2.1E+06	1.4E+06	7.1E+05	5.5E+07	3.6E+07	1.8E+07
Processing as a Reactant	2	Adult (21+)	5.9E+05	4.6E+05	3.2E+05	8.6E+06	8.4E+06	8.2E+06
		Infant (birth to <1)	1.7E+05	1.3E+05	9.1E+04	3.4E+06	3.3E+06	3.2E+06
Processing: Formulation	5	Adult (21+)	1.1E+09	2.5E+08	1.3E+04	1.8E+10	4.5E+09	9.5E+05
		Infant (birth to <1)	3.1E+08	7.3E+07	3,660	7.2E+09	1.8E+09	3.7E+05
Polyurethane Foam	1	Adult (21+)	9.7E+04	9.7E+04	9.7E+04	2.0E+06	2.0E+06	2.0E+06
		Infant (birth to <1)	2.8E+04	2.8E+04	2.8E+04	7.7E+05	7.7E+05	7.7E+05
Plastics Manufacturing	9	Adult (21+)	1.8E+09	2.5E+08	2.5E+04	3.1E+10	4.2E+09	5.2E+05
		Infant (birth to <1)	5.2E+08	7.3E+07	7,232	1.2E+10	1.6E+09	2.0E+05
CTA Film Manufacturing	1	Adult (21+)	8.5E+05	8.5E+05	8.5E+05	1.2E+07	1.2E+07	1.2E+07
		Infant (birth to <1)	2.4E+05	2.4E+05	2.4E+05	4.9E+06	4.9E+06	4.9E+06
Lithographic Printer Cleaner	1	Adult (21+)	1.9E+09	1.9E+09	1.9E+09	3.2E+10	3.2E+10	3.2E+10
		Infant (birth to <1)	5.3E+08	5.3E+08	5.3E+08	1.3E+10	1.3E+10	1.3E+10
Spot Cleaner	1	Adult (21+)	1.7E+07	1.7E+07	1.7E+07	9.3E+08	9.3E+08	9.3E+08
		Infant (birth to <1)	4.9E+06	4.9E+06	4.9E+06	3.7E+08	3.7E+08	3.7E+08
Recycling and Disposal	5	Adult (21+)	8.7E+06	2.6E+06	1.7E+04	1.6E+08	4.9E+07	1.1E+06
		Infant (birth to <1)	2.5E+06	7.5E+05	4,749	6.4E+07	1.9E+07	4.3E+05
Other	10	Adult (21+)	2.3E+11	2.3E+10	1.1E+06	3.2E+12	3.2E+11	3.3E+07
		Infant (birth to <1)	6.4E+10	6.5E+09	3.1E+05	1.2E+12	1.2E+11	1.3E+07
DOD	1	Adult (21+)	5.1E+07	5.1E+07	5.1E+07	7.5E+08	7.5E+08	7.5E+08
		Infant (birth to <1)	1.4E+07	1.4E+07	1.4E+07	2.9E+08	2.9E+08	2.9E+08
WWTP	16	Adult (21+)	8.0E+08	5.2E+07	6.8E+04	1.0E+10	6.7E+08	3.5E+05
		Infant (birth to <1)	2.3E+08	1.5E+07	1.9E+04	4.0E+09	2.6E+08	1.4E+05

OES	No. of Releases Modeled	Age Group	Acute MOE (Benchmark = 30)			Chronic MOE (Benchmark = 30)		
			Min Risk [a]	Mean Risk [b]	Max Risk [c]	Min Risk [a]	Mean Risk [b]	Max Risk [c]
Overall	66	Adult (21+)	2.3E+11	3.7E+09	1.3E+04	3.2E+12	5.3E+10	3.5E+05
		Infant (birth to <1)	6.4E+10	1.1E+09	3,660	1.2E+12	2.1E+10	1.4E+05

[a] The minimum risk value is associated with the maximum MOE and the maximum ADR.
[b] The mean risk value is the arithmetic mean MOE.
[c] The maximum risk value is associated with the minimum MOE and the minimum ADR.

Table 3-29. Summary of Cancer Risk Estimates from Drinking Water Exposure by OES under 20 Days of Release Scenarios for MC

OES	No. of Releases Modeled	Age Group	Cancer Risk		
			Min Risk	Mean Risk	Max Risk
Manufacturing	12	Adult (21+)	8.4E−16	5.8E−12	5.9E−11
		Total Lifetime	6.0E−14	4.2E−10	4.2E−09
Import and Repackaging	2	Adult (21+)	4.2E−13	8.5E−13	1.3E−12
		Total Lifetime	3.0E−11	6.1E−11	9.2E−11
Processing as a Reactant	2	Adult (21+)	6.8E−12	7.0E−12	7.2E−12
		Total Lifetime	4.9E−10	5.0E−10	5.1E−10
Processing: Formulation	5	Adult (21+)	3.2E−15	1.2E−11	6.2E−11
		Total Lifetime	2.3E−13	8.9E−10	4.4E−09
Polyurethane Foam	1	Adult (21+)	3.0E−11	3.0E−11	3.0E−11
		Total Lifetime	2.1E−09	2.1E−09	2.1E−09
Plastics Manufacturing	9	Adult (21+)	1.9E−15	2.5E−11	1.1E−10
		Total Lifetime	1.3E−13	1.8E−09	8.1E−09
CTA Film Manufacturing	1	Adult (21+)	4.7E−12	4.7E−12	4.7E−12
		Total Lifetime	3.4E−10	3.4E−10	3.4E−10
Lithographic Printer Cleaner	1	Adult (21+)	1.8E−15	1.8E−15	1.8E−15
		Total Lifetime	1.3E−13	1.3E−13	1.3E−13
Spot Cleaner	1	Adult (21+)	6.2E−14	6.2E−14	6.2E−14
		Total Lifetime	4.5E−12	4.5E−12	4.5E−12
Recycling and Disposal	5	Adult (21+)	3.6E−13	2.2E−11	5.3E−11
		Total Lifetime	2.6E−11	1.6E−09	3.8E−09
Other	10	Adult (21+)	1.8E−17	2.8E−13	1.8E−12
		Total Lifetime	1.3E−15	2.0E−11	1.3E−10
DOD	1	Adult (21+)	7.8E−14	7.8E−14	7.8E−14
		Total Lifetime	5.6E−12	5.6E−12	5.6E−12
WWTP	16	Adult (21+)	5.7E−15	3.0E−11	1.7E−10
		Total Lifetime	4.1E−13	2.2E−09	1.2E−08
Overall	66	Adult (21+)	1.8E−17	1.5E−11	1.7E−10
		Total Lifetime	1.3E−15	1.1E−09	1.2E−08

Table 3-30. Summary of Risk Estimates for Drinking Water Exposures by OES under Maximum Days of Release Scenarios for MC

OES	No. of Releases Modeled	Age Group	Acute MOE (Benchmark = 30)			Chronic MOE (Benchmark = 30)		
			Min Risk[a]	Mean Risk[b]	Max Risk[c]	Min Risk[a]	Mean Risk[b]	Max Risk[c]
Manufacturing	16	Adult (21+)	7.2E+10	1.4E+10	4.3E+05	7.0E+10	1.6E+10	9.8E+05
		Infant (birth to <1)	2.0E+10	4.1E+09	1.2E+05	2.7E+10	6.2E+09	3.8E+05
Import and Repackaging	5	Adult (21+)	1.9E+10	3.9E+09	4.0E+04	2.7E+10	5.4E+09	5.9E+04
		Infant (birth to <1)	5.5E+09	1.1E+09	1.1E+04	1.0E+10	2.1E+09	2.3E+04
Processing as a Reactant	3	Adult (21+)	6.9E+07	2.8E+07	5.7E+06	7.7E+07	3.1E+07	8.2E+06
		Infant (birth to <1)	2.0E+07	8.1E+06	1.6E+06	3.0E+07	1.2E+07	3.2E+06
Processing: Formulation	9	Adult (21+)	3.5E+11	4.1E+10	831	3.9E+11	4.6E+10	1,252
		Infant (birth to <1)	9.9E+10	1.2E+10	237	1.5E+11	1.8E+10	490
Polyurethane Foam	1	Adult (21+)	1.2E+06	1.2E+06	1.2E+06	2.0E+06	2.0E+06	2.0E+06
		Infant (birth to <1)	3.4E+05	3.4E+05	3.4E+05	7.8E+05	7.8E+05	7.8E+05
Plastics Manufacturing	9	Adult (21+)	2.3E+10	3.2E+09	3.2E+05	3.1E+10	4.2E+09	5.1E+05
		Infant (birth to <1)	6.6E+09	9.2E+08	9.0E+04	1.2E+10	1.6E+09	2.0E+05
CTA Film Manufacturing	1	Adult (21+)	1.1E+07	1.1E+07	1.1E+07	1.2E+07	1.2E+07	1.2E+07
		Infant (birth to <1)	3.0E+06	3.0E+06	3.0E+06	4.9E+06	4.9E+06	4.9E+06
Lithographic Printer Cleaner	1	Adult (21+)	2.3E+10	2.3E+10	2.3E+10	3.3E+10	3.3E+10	3.3E+10
		Infant (birth to <1)	6.7E+09	6.7E+09	6.7E+09	1.3E+10	1.3E+10	1.3E+10
Spot Cleaner	1	Adult (21+)	2.1E+08	2.1E+08	2.1E+08	9.3E+08	9.3E+08	9.3E+08
		Infant (birth to <1)	6.1E+07	6.1E+07	6.1E+07	3.7E+08	3.7E+08	3.7E+08
Recycling and Disposal	12	Adult (21+)	3.1E+08	5.2E+07	75	2.2E+08	5.0E+07	112
		Infant (birth to <1)	8.9E+07	1.5E+07	**21**	8.5E+07	2.0E+07	44
Other	12	Adult (21+)	2.8E+12	2.4E+11	1.4E+05	3.2E+12	2.6E+11	2.0E+05
		Infant (birth to <1)	8.0E+11	6.7E+10	3.9E+04	1.2E+12	1.0E+11	8.0E+04
DOD	1	Adult (21+)	6.4E+08	6.4E+08	6.4E+08	7.6E+08	7.6E+08	7.6E+08
		Infant (birth to <1)	1.8E+08	1.8E+08	1.8E+08	3.0E+08	3.0E+08	3.0E+08
WWTP	16	Adult (21+)	1.5E+10	9.5E+08	1.2E+06	1.0E+10	6.7E+08	3.5E+05
		Infant (birth to <1)	4.2E+09	2.7E+08	3.5E+05	4.0E+09	2.6E+08	1.4E+05
Overall	87	Adult (21+)	2.8E+12	4.0E+10	75	3.2E+12	4.6E+10	112
		Infant (birth to <1)	8.0E+11	1.2E+10	**21**	1.2E+12	1.8E+10	44

[a] The minimum risk value is associated with the maximum MOE and the maximum ADR.
[b] The mean risk value is the arithmetic mean MOE.
[c] The maximum risk value is associated with the minimum MOE and the minimum ADR. The risk identified represents the results of one facility within the OES.

Table 3-31. Summary of Cancer Risk Estimates from Drinking Water Exposure by OES under Maximum Days of Release Scenarios for MC

OES	No. of Releases Modeled	Age Group	Cancer Risk		
			Min Risk	Mean Risk	Max Risk
Manufacturing	16	Adult (21+)	8.4E−16	4.8E−12	6.0E−11
		Total Lifetime	3.4E−15	2.0E−11	2.4E−10
Import and Repackaging	5	Adult (21+)	2.2E−15	2.0E−10	9.9E−10
		Total Lifetime	1.3E−14	1.1E−09	5.7E−09
Processing as a Reactant	3	Adult (21+)	7.6E−13	4.9E−12	7.1E−12
		Total Lifetime	3.1E−12	2.0E−11	2.9E−11
Processing: Formulation	9	Adult (21+)	1.5E−16	5.2E−09	4.7E−08
		Total Lifetime	7.1E−16	2.5E−08	2.2E−07
Polyurethane Foam	1	Adult (21+)	2.9E−11	2.9E−11	2.9E−11
		Total Lifetime	1.7E−10	1.7E−10	1.7E−10
Plastics Manufacturing	9	Adult (21+)	1.9E−15	2.5E−11	1.1E−10
		Total Lifetime	1.1E−14	1.4E−10	6.6E−10
CTA Film Manufacturing	1	Adult (21+)	4.7E−12	4.7E−12	4.7E−12
		Total Lifetime	2.7E−11	2.7E−11	2.7E−11
Lithographic Printer Cleaner	1	Adult (21+)	1.8E−15	1.8E−15	1.8E−15
		Total Lifetime	1.0E−14	1.0E−14	1.0E−14
Spot Cleaner	1	Adult (21+)	6.3E−14	6.3E−14	6.3E−14
		Total Lifetime	3.6E−13	3.6E−13	3.6E−13
Recycling and Disposal	12	Adult (21+)	2.7E−13	4.4E−08	5.2E−07
		Total Lifetime	1.5E−12	2.5E−07	**3.0E−06**
Other	12	Adult (21+)	1.8E−17	2.5E−11	2.9E−10
		Total Lifetime	1.1E−16	1.4E−10	1.6E−09
DOD	1	Adult (21+)	7.7E−14	7.7E−14	7.7E−14
		Total Lifetime	4.4E−13	4.4E−13	4.4E−13
WWTP	16	Adult (21+)	5.7E−15	3.0E−11	1.7E−10
		Total Lifetime	2.2E−14	1.2E−10	6.6E−10
Overall	87	Adult (21+)	1.8E−17	6.7E−09	5.2E−07
		Total Lifetime	1.1E−16	3.8E−08	**3.0E−06**

3.2.5.2.2 Incidental Swimming Risk for MC

EPA calculated risk estimates from incidental swimming for each of the endpoints in Table 3-13 across all known facilities and modeled release scenarios under each OES. These estimates were then summarized across facilities to present the range from minimum to maximum risk for multiple lifestages under each OES. Aggregate risk from incidental ingestion and dermal contact during recreational contact with water are not presented. Risk estimates calculated for each route of exposure independently are at least an order of magnitude from the benchmarks, indicating that aggregating risk across these routes would not result in different risk conclusions. Cancer risk was not estimated for this scenario because regular, repeated exposures from incidental swimming in a particular water body are not expected to continue across a lifetime.

Oral Ingestion

For exposures associated with incidental oral ingestion, risk estimates are shown for adults as well as 11 to 15 years old, the age group with the greatest estimated incidental exposures. Risks relative to benchmark for MC were not indicated for either 20-day (Table 3-32) or maximum (Table 3-33) release scenarios, with all risk estimates greater than an order of magnitude from benchmarks. Therefore, oral ingestion risk from incidental swimming is not expected to result from releases of MC facilities.

Table 3-32. Summary of Non-cancer Risk Estimates for Incidental Oral Ingestion Exposures by OES under 20 Days of Release Scenarios for MC

OES	No. of Releases Modeled	Age Group	Acute MOE (Benchmark = 30)			Chronic MOE (Benchmark = 10)		
			Min Risk [a]	Mean Risk [b]	Max Risk [c]	Min Risk [a]	Mean Risk [b]	Max Risk [c]
Manufacturing	14	Adult (21+)	4.8E+10	9.6E+09	1.1E+05	2.2E+11	5.2E+10	1.9E+05
		Youth (11–15)	3.1E+10	6.2E+09	7.2E+04	1.4E+11	3.3E+10	1.2E+05
Import and Repackaging	2	Adult (21+)	8.4E+07	5.7E+07	2.9E+07	4.5E+08	3.0E+08	1.4E+08
		Youth (11–15)	5.4E+07	3.7E+07	1.9E+07	2.9E+08	1.9E+08	9.3E+07
Processing as a Reactant	2	Adult (21+)	6.9E+06	5.3E+06	3.7E+06	2.7E+07	2.7E+07	2.6E+07
		Youth (11–15)	4.5E+06	3.4E+06	2.4E+06	1.8E+07	1.7E+07	1.7E+07
Processing: Formulation	5	Adult (21+)	1.3E+10	3.0E+09	1.5E+05	5.9E+10	1.4E+10	3.0E+06
		Youth (11–15)	8.1E+09	1.9E+09	9.7E+04	3.8E+10	9.3E+09	1.9E+06
Polyurethane Foam	1	Adult (21+)	1.1E+06	1.1E+06	1.1E+06	6.2E+06	6.2E+06	6.2E+06
		Youth (11–15)	7.3E+05	7.3E+05	7.3E+05	4.0E+06	4.0E+06	4.0E+06
Plastics Manufacturing	9	Adult (21+)	2.1E+10	3.0E+09	3.0E+05	9.9E+10	1.3E+10	1.6E+06
		Youth (11–15)	1.4E+10	1.9E+09	1.9E+05	6.4E+10	8.6E+09	1.1E+06
CTA Film Manufacturing	1	Adult (21+)	9.9E+06	9.9E+06	9.9E+06	4.0E+07	4.0E+07	4.0E+07
		Youth (11–15)	6.4E+06	6.4E+06	6.4E+06	2.6E+07	2.6E+07	2.6E+07
Lithographic Printer Cleaner	1	Adult (21+)	2.2E+10	2.2E+10	2.2E+10	1.0E+11	1.0E+11	1.0E+11
		Youth (11–15)	1.4E+10	1.4E+10	1.4E+10	6.6E+10	6.6E+10	6.6E+10
Spot Cleaner	1	Adult (21+)	2.0E+08	2.0E+08	2.0E+08	3.0E+09	3.0E+09	3.0E+09
		Youth (11–15)	1.3E+08	1.3E+08	1.3E+08	1.9E+09	1.9E+09	1.9E+09
Recycling and Disposal	6	Adult (21+)	1.0E+08	2.6E+07	2.6E+04	5.2E+08	1.3E+08	4.5E+05
		Youth (11–15)	6.6E+07	1.6E+07	1.7E+04	3.3E+08	8.4E+07	2.9E+05
Other	10	Adult (21+)	2.6E+12	2.6E+11	1.3E+07	1.0E+13	1.0E+12	1.1E+08
		Youth (11–15)	1.7E+12	1.7E+11	8.1E+06	6.5E+12	6.6E+11	6.8E+07
DOD	1	Adult (21+)	5.9E+08	5.9E+08	5.9E+08	2.4E+09	2.4E+09	2.4E+09
		Youth (11–15)	3.8E+08	3.8E+08	3.8E+08	1.5E+09	1.5E+09	1.5E+09
WWTP	29	Adult (21+)	9.3E+09	3.6E+08	1,584	3.3E+10	1.2E+09	2,709
		Youth (11–15)	6.0E+09	2.3E+08	1,021	2.1E+10	7.8E+08	1,747

OES	No. of Releases Modeled	Age Group	Acute MOE (Benchmark = 30)			Chronic MOE (Benchmark = 10)		
			Min Risk [a]	Mean Risk [b]	Max Risk [c]	Min Risk [a]	Mean Risk [b]	Max Risk [c]
Overall	82	Adult (21+)	2.6E+12	3.5E+10	1,584	1.0E+13	1.4E+11	2,709
		Youth (11–15)	1.7E+12	2.2E+10	1,021	6.5E+12	8.8E+10	1,747

[a] The minimum risk value is associated with the maximum MOE and the maximum ADR.
[b] The mean risk value is the arithmetic mean MOE.
[c] The maximum risk value is associated with the minimum MOE and the minimum ADR.

Table 3-33. Summary of Non-cancer Risk Estimates for Incidental Oral Ingestion Exposures by OES under Maximum Days of Release Scenarios for MC

OES	No. of Releases Modeled	Age Group	Acute MOE (Benchmark = 30)			Chronic MOE (Benchmark = 10)		
			Min Risk [a]	Mean Risk [b]	Max Risk [c]	Min Risk [a]	Mean Risk [b]	Max Risk [c]
Manufacturing	20	Adult (21+)	8.4E+11	1.3E+11	2.0E+06	2.2E+11	4.1E+10	1.9E+05
		Youth (11–15)	5.4E+11	8.7E+10	1.3E+06	1.4E+11	2.6E+10	1.2E+05
Import and Repackaging	5	Adult (21+)	2.3E+11	4.6E+10	4.6E+05	8.5E+10	1.7E+10	1.9E+05
		Youth (11–15)	1.5E+11	2.9E+10	3.0E+05	5.5E+10	1.1E+10	1.2E+05
Processing as a Reactant	3	Adult (21+)	8.1E+08	3.3E+08	6.6E+07	2.4E+08	9.9E+07	2.6E+07
		Youth (11–15)	5.2E+08	2.1E+08	4.3E+07	1.6E+08	6.4E+07	1.7E+07
Processing: Formulation	9	Adult (21+)	4.0E+12	4.7E+11	9,695	1.3E+12	1.5E+11	3,991
		Youth (11–15)	2.6E+12	3.1E+11	6,250	8.1E+11	9.5E+10	2,573
Polyurethane Foam	1	Adult (21+)	1.4E+07	1.4E+07	1.4E+07	6.3E+06	6.3E+06	6.3E+06
		Youth (11–15)	9.1E+06	9.1E+06	9.1E+06	4.1E+06	4.1E+06	4.1E+06
Plastics Manufacturing	9	Adult (21+)	2.7E+11	3.7E+10	3.7E+06	1.0E+11	1.3E+10	1.6E+06
		Youth (11–15)	1.7E+11	2.4E+10	2.4E+06	6.4E+10	8.6E+09	1.0E+06
CTA Film Manufacturing	1	Adult (21+)	1.2E+08	1.2E+08	1.2E+08	4.0E+07	4.0E+07	4.0E+07
		Youth (11–15)	8.0E+07	8.0E+07	8.0E+07	2.6E+07	2.6E+07	2.6E+07
Lithographic Printer Cleaner	1	Adult (21+)	2.7E+11	2.7E+11	2.7E+11	1.0E+11	1.0E+11	1.0E+11
		Youth (11–15)	1.8E+11	1.8E+11	1.8E+11	6.7E+10	6.7E+10	6.7E+10
Spot Cleaner	1	Adult (21+)	2.5E+09	2.5E+09	2.5E+09	3.0E+09	3.0E+09	3.0E+09
		Youth (11–15)	1.6E+09	1.6E+09	1.6E+09	1.9E+09	1.9E+09	1.9E+09
Recycling and Disposal	14	Adult (21+)	3.7E+09	6.6E+08	875	6.9E+08	1.7E+08	357
		Youth (11–15)	2.4E+09	4.2E+08	564	4.5E+08	1.1E+08	230
Other	12	Adult (21+)	3.3E+13	2.8E+12	1.6E+06	1.0E+13	8.4E+11	6.5E+05
		Youth (11–15)	2.1E+13	1.8E+12	1.0E+06	6.5E+12	5.4E+11	4.2E+05
DOD	1	Adult (21+)	7.4E+09	7.4E+09	7.4E+09	2.4E+09	2.4E+09	2.4E+09
		Youth (11–15)	4.8E+09	4.8E+09	4.8E+09	1.6E+09	1.6E+09	1.6E+09
WWTP	29	Adult (21+)	1.7E+11	6.6E+09	2.9E+04	3.3E+10	1.2E+09	2,699
		Youth (11–15)	1.1E+11	4.2E+09	1.9E+04	2.1E+10	7.9E+08	1,740
Overall	106	Adult (21+)	3.3E+13	3.9E+11	875	1.0E+13	1.2E+11	357
		Youth (11–15)	2.1E+13	2.5E+11	564	6.5E+12	7.7E+10	230

[a] The minimum risk value is associated with the maximum MOE and the maximum ADR.
[b] The mean risk value is the arithmetic mean MOE.
[c] The maximum risk value is associated with the minimum MOE and the minimum ADR.

Dermal

For exposures associated with incidental dermal exposure, risk estimates are shown for adults, the age group with the highest relative exposure. Risks relative to benchmarks for MC were not indicated for either 20-day (Table 3-34) or maximum (Table 3-35) release scenarios, with all risk estimates greater than an order of magnitude from the benchmark. Therefore, dermal risk from incidental swimming is not expected to result from releases of MC facilities.

Table 3-34. Summary of Non-cancer Risk Estimates for Incidental Dermal Exposures by OES under 20 Days of Release Scenarios for MC

OES	No. of Releases Modeled	Age Group	Acute MOE (Benchmark = 30)			Chronic MOE (Benchmark = 10)		
			Min Risk [a]	Mean Risk [b]	Max Risk [c]	Min Risk [a]	Mean Risk [b]	Max Risk [c]
Manufacturing	14	Adult (21+)	3.1E+10	6.3E+09	7.4E+04	1.5E+11	3.4E+10	1.3E+05
Import and Repackaging	2	Adult (21+)	5.5E+07	3.7E+07	1.9E+07	2.9E+08	1.9E+08	9.5E+07
Processing as a Reactant	2	Adult (21+)	4.6E+06	3.5E+06	2.4E+06	1.8E+07	1.8E+07	1.7E+07
Processing: Formulation	5	Adult (21+)	8.3E+09	2.0E+09	9.9E+04	3.9E+10	9.5E+09	2.0E+06
Polyurethane Foam	1	Adult (21+)	7.4E+05	7.4E+05	7.4E+05	4.1E+06	4.1E+06	4.1E+06
Plastics Manufacturing	9	Adult (21+)	1.4E+10	2.0E+09	1.9E+05	6.5E+10	8.7E+09	1.1E+06
CTA Film Manufacturing	1	Adult (21+)	6.5E+06	6.5E+06	6.5E+06	2.6E+07	2.6E+07	2.6E+07
Lithographic Printer Cleaner	1	Adult (21+)	1.4E+10	1.4E+10	1.4E+10	6.8E+10	6.8E+10	6.8E+10
Spot Cleaner	1	Adult (21+)	1.3E+08	1.3E+08	1.3E+08	2.0E+09	2.0E+09	2.0E+09
Recycling and Disposal	6	Adult (21+)	6.7E+07	1.7E+07	1.7E+04	3.4E+08	8.6E+07	3.0E+05
Other	10	Adult (21+)	1.7E+12	1.7E+11	8.2E+06	6.7E+12	6.7E+11	7.0E+07
DOD	1	Adult (21+)	3.9E+08	3.9E+08	3.9E+08	1.6E+09	1.6E+09	1.6E+09
WWTP	29	Adult (21+)	6.1E+09	2.4E+08	1,042	2.1E+10	8.0E+08	1,783
Overall	82	Adult (21+)	1.7E+12	2.3E+10	1,042	6.7E+12	9.0E+10	1,783

[a] The minimum risk value is associated with the maximum MOE and the maximum ADR.
[b] The mean risk value is the arithmetic mean MOE.
[c] The maximum risk value is associated with the minimum MOE and the minimum ADR.

Table 3-35. Summary of Non-cancer Risk Estimates for Incidental Dermal Exposures by OES under Maximum Days of Release Scenarios for MC

OES	No. of Releases Modeled	Age Group	Acute MOE (Benchmark = 30)			Chronic MOE (Benchmark = 10)		
			Min Risk [a]	Mean Risk [b]	Max Risk [c]	Min Risk [a]	Mean Risk [b]	Max Risk [c]
Manufacturing	20	Adult (21+)	5.5E+11	8.9E+10	1.3E+06	1.5E+11	2.7E+10	1.3E+05
Import and Repackaging	5	Adult (21+)	1.5E+11	3.0E+10	3.0E+05	5.6E+10	1.1E+10	1.2E+05
Processing as a Reactant	3	Adult (21+)	5.3E+08	2.2E+08	4.4E+07	1.6E+08	6.5E+07	1.7E+07
Processing: Formulation	9	Adult (21+)	2.7E+12	3.1E+11	6,380	8.2E+11	9.7E+10	2,626
Polyurethane Foam	1	Adult (21+)	9.2E+06	9.2E+06	9.2E+06	4.2E+06	4.2E+06	4.2E+06
Plastics Manufacturing	9	Adult (21+)	1.8E+11	2.5E+10	2.4E+06	6.6E+10	8.8E+09	1.1E+06
CTA Film Manufacturing	1	Adult (21+)	8.2E+07	8.2E+07	8.2E+07	2.6E+07	2.6E+07	2.6E+07
Lithographic Printer Cleaner	1	Adult (21+)	1.8E+11	1.8E+11	1.8E+11	6.8E+10	6.8E+10	6.8E+10
Spot Cleaner	1	Adult (21+)	1.6E+09	1.6E+09	1.6E+09	2.0E+09	2.0E+09	2.0E+09
Recycling and Disposal	14	Adult (21+)	2.4E+09	4.3E+08	576	4.6E+08	1.1E+08	235
Other	12	Adult (21+)	2.2E+13	1.8E+12	1.0E+06	6.6E+12	5.6E+11	4.3E+05
DOD	1	Adult (21+)	4.9E+09	4.9E+09	4.9E+09	1.6E+09	1.6E+09	1.6E+09
WWTP	29	Adult (21+)	1.1E+11	4.3E+09	1.9E+04	2.2E+10	8.0E+08	1,776
Overall	106	Adult (21+)	2.2E+13	2.5E+11	576	6.6E+12	7.8E+10	235

[a] The minimum risk value is associated with the maximum MOE and the maximum ADR.
[b] The mean risk value is the arithmetic mean MOE.
[c] The maximum risk value is associated with the minimum MOE and the minimum ADR.

3.2.5.2.3 Ambient and Drinking Water Monitoring Information for MC

Ambient surface water monitoring information (Section 3.2.4.2.1) was evaluated as part of the original MC risk evaluation for ecological exposures and no new sources of information were found during this evaluation. The three modeled releases with coincident monitoring data described in the original risk evaluation had no detectable levels of MC in proximate monitored results and showed no drinking water, incidental oral, or incidental dermal risk in this evaluation. The one modeled release indicating risk in this evaluation had no nearby monitoring information that could be used to ground-truth that modeled estimate.

Available monitored drinking water information (Section 3.2.4.2.2) was collected for the years 2006 to 2011 and was therefore not coincident in time with modeled releases. Relating the physical location of the evaluated monitored results was beyond the scope of this fenceline evaluation. Additionally, these monitoring results represent concentrations measured at the point of distribution into drinking water systems, making relating these concentrations to modeled results difficult. These results show that although the majority of sampled results show measures of MC to be below detectable levels, there are instances of detectable levels of MC in water being used for drinking water and in some cases greater than the MCL of 5 μg/L.

3.2.6 Confidence and Risk Conclusions for MC Case Study Results

This section illustrates by example EPA's use of results from applying the proposed screening level methodology to make risk conclusions and does not represent final agency action. Any results or risk conclusions presented here are not intended to be used in support of risk management actions or rulemakings as presented.

EPA identified risk relative to the benchmarks from fenceline air concentrations of MC for 14 of the 248 facilities assessed, representing 8 of 17 OES. Based on characterization of land use patterns, fenceline community exposures are reasonably anticipated for 2 of the 14 facilities where EPA identified risk. Risk estimates in Table 3-26 are based on the 95th percentile of modeled exposure concentrations around individual facilities, and the range of risk estimates covers all facilities under an OES. The consideration of land use patterns also confirms that facilities indicating risk are likely of concern to an expected fenceline community cohort. Therefore, EPA determines that the proposed screening level methodology, as applied for this report, sufficiently captures expected risk to the fenceline communities around these facilities for the exposure pathways evaluated. Ninety-fifth percentile values represent a conservative, screening-level analysis and may potentially overestimate chronic and/or lifetime cancer risks. However, analysis of risk estimates based on 10th and 50th percentile release measurements in *SF_FLA_Air Pathway Ful-Screen Results for MC* (Appendix B) demonstrates that risk is also indicated at lower percentiles for 7 out of the 14 facilities demonstrating cancer risk based on 95 percent values. These seven facilities indicating risk at lower percentile exposure concentrations include both facilities with expected general population exposures in Table 3-28, therefore mitigating this uncertainty.

EPA identified acute non-cancer and cancer risks relative to the benchmarks from fenceline exposure to MC through drinking water for at least one facility in the recycling and disposal OES under the maximum days of release scenario. Risks are not expected for adults, however acute non-cancer risks to infants and total lifetime cancer risk were identified. EPA did not identify risks from fenceline exposure to MC through recreational contact with water. The use of surface water concentration estimates based on the point of release are likely to result in a higher-end estimate of fenceline community exposure from drinking water and incidental swimming (Section 2.4.4). When also considering the inclusion of more sensitive lifestages and risk estimates based on maximum releases across all facilities, these risk conclusions incorporate health-protective assumptions based on the parameters used in these analyses.

3.3 n-Methylpyrrolidone (Water Pathway)

3.3.1 Background for NMP

N-Methylpyrrolidone (NMP) is a polar, liquid solvent that is fully miscible in water. Because of its high water solubility and low volatility, NMP is most likely to partition to water. It is subject to aerobic biodegradation in surface water and oxidative degradation in the atmosphere, and is therefore unlikely to persist in either medium (U.S. EPA, 2020d). Table_Apx A-1 contains a summary of NMP's physical-chemical properties.

3.3.2 Human Health Hazard Endpoints for NMP

All hazard values used to calculated risk in this report are derived from the previously peer-reviewed PODs published in the Final Risk Evaluation for n-Methylpyrrolidone (U.S. EPA, 2020d). In the Final Risk Evaluation, EPA utilized the endpoints shown in Table 3-36 for risk determination. For NMP, internal PODs for non-cancer endpoints were derived using a PBPK model. External oral equivalents were also calculated from the internal rodent doses based on the original study conditions. Cancer risk is not evaluated because EPA concluded that the reasonably available data was insufficient to support a quantitative evaluation of cancer risks from NMP.

Table 3-36. Hazard Values Used for Risk Estimation in the n-Methylpyrrolidone Risk Evaluation

Scenario	Endpoint	Hazard Value	Benchmark	Reference(s)
Acute	Developmental: Resorptions/fetal mortality	437 mg/L C_{max} (418 mg/kg)	30	(Saillenfait et al., 2003; Saillenfait et al., 2002)
Chronic	Reproductive: Decreased male fertility	183 hr-mg/L AUC (28 mg/kg)	30	(Exxon, 1991)

The existing human PBPK model is not readily applicable to general population/fenceline exposure scenarios and is not designed to predict internal doses resulting from drinking water exposures. Therefore, to evaluate risks to fenceline communities, EPA converted the internal dose PODs to external dose PODs (presented in parentheses in Table 3-36).

For the analyses in this report, EPA derived POD values for fenceline communities based on a continuous exposure scenario. All of the studies used for the above PODs involved continuous exposure and therefore no duration adjustment was required for application to fenceline communities. The external oral equivalent PODs as published in the Risk Evaluation were based on the rat PBPK model. Therefore, allometric scaling was applied to those values based on EPA guidance on body weight scaling (U.S. EPA, 2011b). Based on the study conditions, the acute POD was adjusted using the measured body weight value for Sprague−Dawley rats (0.259 kg) from (Saillenfait et al., 2003; Saillenfait et al., 2002) and an estimated body weight of 65.9 kg for pregnant adolescent human females (the body weight assumed for derivation of internal dose PODs in (U.S. EPA, 2020d, see Table 2-77)). The chronic POD was adjusted using the average of male and female subchronic body weight for Sprague−Dawley rat adults (0.2355 kg, value taken from (U.S. EPA, 1988)) and the default adult human body weight of 80 kg. The resulting dosimetric adjustment factors were 0.25 and 0.23 for acute and chronic PODs, respectively, applied to the external dose PODs from Table 3-36.

Table 3-37. Hazard Values for NMP Used in this Fenceline Analysis

Scenario	Endpoint	Fenceline HED	Benchmark	Reference(s)
Acute	Developmental: Resorptions/fetal mortality	105 mg/kg	30[a]	(Saillenfait et al., 2003; Saillenfait et al., 2002)
Chronic	Reproductive: Decreased male fertility	6.5 mg/kg	30[a]	(Exxon, 1991)

[a] In the Final Risk Evaluation for n-Methylpyrrolidone (U.S. EPA, 2020d), EPA applied a benchmark MOE of 30 to the risk estimates for incidental ingestion and dermal exposure. Upon reanalysis, EPA determined that those oral equivalent values were rodent-specific and should have used a benchmark MOE of 100. The allometrically scaled values presented above are applied to the correct benchmark MOE of 30.

3.3.2.1 Assumptions and Uncertainties for NMP Human Health Hazard

The HEDs were derived based on allometric scaling in accordance with EPA guidance (U.S. EPA, 2011b). Allometric scaling reduces the overall uncertainty in the resulting HED compared to using standard uncertainty factors, however it is less precise than the internal PBPK-modeled PODs. Body weight for the acute endpoint was specific to the susceptible subpopulation of pregnant females, and the more health-protective body weight for a younger pregnant woman was used.

The endpoint for decreased male fertility was observed in a multigenerational study, so it is unknown if any particular lifestage is particularly susceptible to this effect. Both fetal and childhood exposure, and potentially also adult exposure, are considered relevant for this health effect. In the absence of more information on the most susceptible lifestage, HEDs were derived via allometric scaling based on conservatively comparing younger rats to average adults.

The acute developmental toxicity endpoint is assumed to only be relevant to pregnant females since it represents an *in utero* outcome. For the chronic effect of decreased male fertility, the sensitive exposure lifestage is unknown because the effect was observed in a 2-generation reproductive toxicity study. In this study male reproductive toxicity may have resulted from *in utero* exposure, exposure during postnatal development, or as an adult prior to/during mating. Therefore, this endpoint is considered applicable to both pregnant women and all male lifestages.

Any other assumptions or uncertainties inherent to the human health hazard assessment in the Final Risk Evaluation for n-Methylpyrrolidone (U.S. EPA, 2020d) are still applicable for this analysis.

3.3.3 Environmental Releases for NMP

In Appendix E of the Final Risk Evaluation for NMP (U.S. EPA, 2020d), EPA presented a "first-tier" aquatic exposure assessment for NMP by using TRI data for facilities with the highest NMP discharges. Specifically, 2015 and 2018 TRI data on direct and indirect environmental releases were used to estimate NMP concentrations in surface water (U.S. EPA, 2019b, 2017). The DMR database does not contain NMP data. To capture "high-end" surface water concentrations, EPA compiled the release data for nine facilities that reported the largest NMP direct water releases. This represented 100 % of the total volume of NMP reported as a direct discharge to surface water during the 2015 and 2018 TRI reporting periods. Since there were many more facilities reporting indirect releases of NMP to surface water, seven of the facilities reporting the largest indirect water releases (representing ~11 percent of the total number of facilities reporting indirect discharges) were compiled. The volume of NMP released from these facilities encompassed more than 87 percent of the total volume of NMP reported as an indirect discharge to surface water (U.S. EPA, 2020d).

A summary of the water releases for each NMP OES is included in Table 3-38. This summary uses the same release data used for the first-tier assessment in Appendix E of the Final Risk Evaluation for NMP (U.S. EPA, 2020d). Of the 17 OES listed in Table 3-38, six have directly applicable 2015 and/or 2018 TRI data that were used for water releases in the first-tier assessment. For the remaining 11 OES without TRI data, EPA did not estimate releases for the first-tier assessment.

Table 3-38. Summary of Water Release Estimation Approaches for Each NMP OES

OES	Range of Water Releases (kg/site-yr)	Water Release Estimation Approach	Notes
Manufacturing	N/A	N/A	No assessment was made for this OES in the first-tier assessment.
Repackaging	N/A	N/A	No assessment was made for this OES in the first-tier assessment.
Chemical Processing, Excluding Formulation	0.91 to 434,458[a,e,f,g,h]	2015 and 2018 TRI (U.S. EPA, 2019b, 2017)	2015 TRI data are available for 8 sites and 2018 TRI data are available for 10 sites.

OES	Range of Water Releases (kg/site-yr)	Water Release Estimation Approach	Notes
Incorporation into Formulation, Mixture, or Reaction Product	10 to 20[b e]	2015 and 2018 TRI (U.S. EPA, 2019b, 2017)	2015 TRI data and 2018 TRI data are available for 1 site (the same site).
Metal Finishing	0.91 (one site)[b f]	2015 TRI (U.S. EPA, 2017)	2015 TRI data are available for 1 site.
Application of Paints, Coatings, Adhesives and Sealants	N/A	N/A	No assessment was made for this OES in the first-tier assessment.
Recycling and Disposal	179,246 (one site)[c d]	2018 TRI (U.S. EPA, 2019b)	2018 TRI data are available for 1 site.
Removal of Paints, Coatings, Adhesives and Sealants	N/A	N/A	No assessment was made for this OES in the first-tier assessment.
Other Electronics Manufacturing	6.4 to 308,443[a e f g]	2015 and 2018 TRI (U.S. EPA, 2019b, 2017)	2015 TRI data are available for 2 sites and 2018 TRI data are available for 5 sites.
Semiconductor Manufacturing	N/A	N/A	No assessment was made for this OES in the first-tier assessment.
Printing and Writing	N/A	N/A	No assessment was made for this OES in the first-tier assessment.
Soldering	N/A	N/A	No assessment was made for this OES in the first-tier assessment.
Commercial Automotive Servicing	N/A	N/A	No assessment was made for this OES in the first-tier assessment.
Laboratory Use	N/A	N/A	No assessment was made for this OES in the first-tier assessment.
Lithium-Ion Cell Manufacturing	N/A	N/A	No assessment was made for this OES in the first-tier assessment.
Cleaning	65,622 (one site)[c e]	2018 TRI (U.S. EPA, 2019b)	2018 TRI data are available for 1 site.
Fertilizer Application	N/A	N/A	No assessment was made for this OES in the first-tier assessment.

[a] This range includes both direct and indirect discharges.
[b] This range includes direct discharges only.
[c] This range includes indirect discharges only.
[d] This range includes TRI estimates based on continuous monitoring data or measurements.
[e] This range includes TRI estimates based on periodic or random monitoring data or measurements.
[f] This range includes TRI estimates based on mass balance calculations, such as calculation of the amount of chemical in streams entering and leaving process equipment.
[g] This range includes TRI estimates based on published emissions factors, such as those relating release quantity to through-put or equipment type.
[h] This range includes TRI estimates based on other approaches such as engineering calculations (*e.g.*, estimating volatilization using published mathematical formulas) or best engineering judgment. This would include applying estimated removal efficiency to a waste stream, even if the composition of the stream before treatment was fully identified through monitoring data.

3.3.4 Exposures for NMP

3.3.4.1 Drinking Water for NMP

Modeled drinking water estimates are summarized by OES category in Table 3-39 for the 12-day release scenario and in Table 3-40 for the maximum days of release scenario. Results are presented for the adult, pregnant female, and infant age class, but complete by facility results across all age classes for all evaluated releases are available in *SF_FLA_Water Pathway Exposure Data for NMP* (Appendix B).

For the 12-day release scenario, a total of 9 releases were modeled across all OES with drinking water ADRs across all presented age classes ranging from 2.0×10−07 to 1.9×10−02 mg/kg-day, ADDs ranging from 1.2×10−09 to 4.3×10−05 mg/kg-day and LADDs ranging from 3.9×10−11 to 1.1×10−05 mg/kg-day. For the maximum days of release scenario, a total of 19 releases were modeled across all OES with drinking water ADRs across all presented age classes ranging from 1.8×1008 to 1.9×1002 mg/kg-day, ADDs ranging from 2.7×10−09 to 1.9×10−02 mg/kg-day, and LADDs ranging from 8.9×10−11 to 5.0×10−03 mg/kg-day.

Table 3-39. Summary of NMP Drinking Water Exposure by OES for 12 Days of Release Scenarios

OES	No. of Releases Modeled [d]	Age Group	ADR (mg/kg-day)			ADD (mg/kg-day)			LADD (mg/kg-day)		
			Min Exposure [a]	Mean Exposure [b]	Max Exposure [c]	Min Exposure [a]	Mean Exposure [b]	Max Exposure [c]	Min Exposure [a]	Mean Exposure [b]	Max Exposure [c]
Chemical Processing, Excluding Formulation	5	Adult (21+)	2.0E−07	7.8E−04	3.4E−03	1.2E−09	2.2E−06	9.5E−06	5.0E−10	9.2E−07	4.0E−06
		Pregnant Female	2.2E−07	8.7E−04	3.8E−03	1.9E−09	3.5E−06	1.5E−05	8.0E−10	1.5E−06	6.4E−06
		Infant (birth to <1)	7.0E−07	2.7E−03	1.2E−02	3.0E−09	5.5E−06	2.4E−05	3.9E−11	7.1E−08	3.1E−07
Electronics Manufacturing	2	Adult (21+)	1.2E−03	1.6E−03	1.9E−03	2.2E−06	4.3E−06	6.3E−06	9.4E−07	1.8E−06	2.7E−06
		Pregnant Female	1.3E−03	1.7E−03	2.2E−03	3.6E−06	6.8E−06	1.0E−05	1.5E−06	2.9E−06	4.3E−06
		Infant (birth to <1)	4.1E−03	5.5E−03	6.8E−03	5.7E−06	1.1E−05	1.6E−05	7.3E−08	1.4E−07	2.1E−07
Formulation	1	Adult (21+)	5.3E−03	5.3E−03	5.3E−03	1.7E−05	1.7E−05	1.7E−05	7.2E−06	7.2E−06	7.2E−06
		Pregnant Female	5.9E−03	5.9E−03	5.9E−03	2.7E−05	2.7E−05	2.7E−05	1.1E−05	1.1E−05	1.1E−05
		Infant (birth to <1)	1.9E−02	1.9E−02	1.9E−02	4.3E−05	4.3E−05	4.3E−05	5.5E−07	5.5E−07	5.5E−07
Metal Finishing	1	Adult (21+)	6.9E−04	6.9E−04	6.9E−04	1.2E−06	1.2E−06	1.2E−06	5.2E−07	5.2E−07	5.2E−07
		Pregnant Female	7.6E−04	7.6E−04	7.6E−04	1.9E−06	1.9E−06	1.9E−06	8.2E−07	8.2E−07	8.2E−07
		Infant (birth to <1)	2.4E−03	2.4E−03	2.4E−03	3.1E−06	3.1E−06	3.1E−06	4.0E−08	4.0E−08	4.0E−08
Disposal and Recycling	0	Adult (21+)	–	–	–	–	–	–	–	–	–
		Pregnant Female	–	–	–	–	–	–	–	–	–
		Infant (birth to <1)	–	–	–	–	–	–	–	–	–
Cleaning	0	Adult (21+)	–	–	–	–	–	–	–	–	–
		Pregnant Female	–	–	–	–	–	–	–	–	–
		Infant (birth to <1)	–	–	–	–	–	–	–	–	–
Overall	9	Adult (21+)	2.0E−07	1.4E−03	5.3E−03	1.2E−09	4.2E−06	1.7E−05	5.0E−10	1.8E−06	7.2E−06
		Pregnant Female	2.2E−07	1.6E−03	5.9E−03	1.9E−09	6.7E−06	2.7E−05	8.0E−10	2.8E−06	1.1E−05
		Infant (birth to <1)	7.0E−07	5.1E−03	1.9E−02	3.0E−09	1.1E−05	4.3E−05	3.9E−11	1.4E−07	5.5E−07

[a] The minimum exposure for the identified days of release, within the identified OES, and for the identified age group.
[b] The arithmetic mean exposure for the identified days of release, within the identified OES, and for the identified age group.
[c] The maximum exposure for the identified days of release, within the identified OES, and for the identified age group.
[d] For OES with 0 releases, no exposure is anticipated, and thus are represented with a "–."

Table 3-40. Summary of NMP Drinking Water Exposure by OES for Maximum Days of Release Scenarios

OES	No. of Releases Modeled	Age Group	ADR (mg/kg-day)			ADD (mg/kg-day)			LADD (mg/kg-day)		
			Min Exposure [a]	Mean Exposure [b]	Max Exposure [c]	Min Exposure [a]	Mean Exposure [b]	Max Exposure [c]	Min Exposure [a]	Mean Exposure [b]	Max Exposure [c]
Chemical Processing, Excluding Formulation	10	Adult (21+)	1.8E−08	7.6E−03	3.3E−02	2.7E−09	1.2E−03	7.3E−03	1.2E−09	5.1E−04	3.1E−03
		Pregnant Female	2.0E−08	8.4E−03	3.6E−02	4.3E−09	1.9E−03	1.2E−02	1.8E−09	8.2E−04	5.0E−03
		Infant (birth to <1)	6.4E−08	2.7E−02	0.1146475	6.9E−09	3.1E−03	1.9E−02	8.9E−11	4.0E−05	2.4E−04
Electronics Manufacturing	5	Adult (21+)	5.6E−05	5.4E−03	2.6E−02	2.3E−06	2.1E−04	8.5E−04	9.6E−07	9.0E−05	3.6E−04
		Pregnant Female	6.2E−05	5.9E−03	2.8E−02	3.6E−06	3.4E−04	1.4E−03	1.5E−06	1.4E−04	5.8E−04
		Infant (birth to <1)	2.0E−04	1.9E−02	9.0E−02	5.8E−06	5.4E−04	2.2E−03	7.4E−08	6.9E−06	2.8E−05
Formulation	1	Adult (21+)	2.2E−04	2.2E−04	2.2E−04	1.7E−05	1.7E−05	1.7E−05	7.2E−06	7.2E−06	7.2E−06
		Pregnant Female	2.4E−04	2.4E−04	2.4E−04	2.7E−05	2.7E−05	2.7E−05	1.2E−05	1.2E−05	1.2E−05
		Infant (birth to <1)	7.6E−04	7.6E−04	7.6E−04	4.4E−05	4.4E−05	4.4E−05	5.6E−07	5.6E−07	5.6E−07
Metal Finishing	1	Adult (21+)	3.1E−05	3.1E−05	3.1E−05	1.1E−06	1.1E−06	1.1E−06	4.8E−07	4.8E−07	4.8E−07
		Pregnant Female	3.4E−05	3.4E−05	3.4E−05	1.8E−06	1.8E−06	1.8E−06	7.6E−07	7.6E−07	7.6E−07
		Infant (birth to <1)	1.1E−04	1.1E−04	1.1E−04	2.9E−06	2.9E−06	2.9E−06	3.7E−08	3.7E−08	3.7E−08
Disposal and Recycling	1	Adult (21+)	–	–	–	–	–	–	–	–	–
		Pregnant Female	–	–	–	–	–	–	–	–	–
		Infant (birth to <1)	–	–	–	–	–	–	–	–	–
Cleaning	1	Adult (21+)	–	–	–	–	–	–	–	–	–
		Pregnant Female	–	–	–	–	–	–	–	–	–
		Infant (birth to <1)	–	–	–	–	–	–	–	–	–
Overall	19	Adult (21+)	1.8E−08	5.4E−03	3.3E−02	2.7E−09	7.0E−04	7.3E−03	1.2E−09	3.0E−04	3.1E−03
		Pregnant Female	2.0E−08	6.0E−03	3.6E−02	4.3E−09	1.1E−03	1.2E−02	1.8E−09	4.7E−04	5.0E−03
		Infant (birth to <1)	6.4E−08	1.9E−02	0.1146475	6.9E−09	1.8E−03	1.9E−02	8.9E−11	2.3E−05	2.4E−04

[a] The minimum exposure for the identified days of release, within the identified OES, and for the identified age group.
[b] The arithmetic mean exposure for the identified days of release, within the identified OES, and for the identified age group.
[c] The maximum exposure for the identified days of release, within the identified OES, and for the identified age group.

3.3.4.2 Incidental Oral for NMP

Modeled incidental oral estimates are summarized by OES category in Table 3-41 for the 20-day release scenario and in Table 3-42 for the maximum days of release scenario. Results are presented for the adult, pregnant female, and youth (11 to 15 years) age classes, but complete by facility results across all age classes for all evaluated releases are available in *SF_FLA_Water Pathway Exposure Data for NMP* (Appendix B).

For the 12-day release scenario, a total of 9 releases were modeled across all OES with incidental oral ingestion exposure ADRs across all presented age groups ranging from 1.7×10−08 to 7.1×10−04 mg/kg-day and ADDs ranging from 3.7×10−10 to 8.2×10−06 mg/kg-day. For the maximum days of release scenario, a total of 19 releases were modeled across all OES with incidental oral ingestion exposure ADRs across all presented age groups ranging from 1.6×10−09 to 4.3×10−03 mg/kg-day and ADDs ranging from 8.5×10−10 to 3.6×10−03 mg/kg-day. Youths (11 to 15 years) had higher exposures than the other age classes due to this age class's higher weighted incidental daily ingestion rate (Table 2-6).

Results here were compared to an alternative method for evaluating incidental oral exposure (U.S. EPA, 2019d). Due to methodological differences between to the two methods, in U.S. EPA (2019d) the 6 to 10 year age class has the highest estimated exposures as compared to the 11 to 15 year age class in the presented method. Weighted incidental daily ingestion rates between the two methods for the highest exposure age class between the two models are 6.6×10^{-03} L/kg-day and 5.4×10^{-03} L/kg-day respectively, resulting in slightly higher, but comparable overall exposure values. Using the U.S. EPA (2019d) method, the 12-day scenario had a maximum ADR of 8.8×10^{-04} mg/kg-day and ADD of 1.0×10^{-05} mg/kg-day, while the maximum days of release scenario had a maximum ADR of 5.4×10^{-03} mg/kg-day and ADD of 4.4×10^{-03} mg/kg-day. These results are comparable between the two methodologies and supports confidence in the presented estimated exposures. Complete results for evaluation of incidental oral ingestion using the U.S. EPA (2019d) method are available in *SF_FLA_Water Pathway Exposure Data for NMP* (Appendix B).

1 **Table 3-41. Summary of NMP Incidental Oral Ingestion Exposure by OES for 12 Days of Release Scenarios**

OES	No. of Releases Modeled[d]	Age Group	ADR (mg/kg-day)			ADD (mg/kg-day)		
			Min Exposure[a]	Mean Exposure[b]	Max Exposure[c]	Min Exposure[a]	Mean Exposure[b]	Max Exposure[c]
Chemical Processing, Excluding Formulation	5	Adult (21+)	1.7E−08	6.7E−05	2.9E−04	3.7E−10	6.8E−07	3.0E−06
		Pregnant Female	2.1E−08	8.1E−05	3.5E−04	4.5E−10	8.2E−07	3.6E−06
		Youth (11–15)	2.6E−08	1.0E−04	4.5E−04	5.8E−10	1.1E−06	4.6E−06
Electronics Manufacturing	2	Adult (21+)	1.0E−04	1.3E−04	1.7E−04	7.0E−07	1.3E−06	2.0E−06
		Pregnant Female	1.2E−04	1.6E−04	2.0E−04	8.5E−07	1.6E−06	2.4E−06
		Youth (11–15)	1.6E−04	2.1E−04	2.6E−04	1.1E−06	2.1E−06	3.1E−06
Formulation	1	Adult (21+)	4.6E−04	4.6E−04	4.6E−04	5.3E−06	5.3E−06	5.3E−06
		Pregnant Female	5.6E−04	5.6E−04	5.6E−04	6.4E−06	6.4E−06	6.4E−06
		Youth (11–15)	7.1E−04	7.1E−04	7.1E−04	8.2E−06	8.2E−06	8.2E−06
Metal Finishing	1	Adult (21+)	5.9E−05	5.9E−05	5.9E−05	3.8E−07	3.8E−07	3.8E−07
		Pregnant Female	7.1E−05	7.1E−05	7.1E−05	4.6E−07	4.6E−07	4.6E−07
		Youth (11–15)	9.1E−05	9.1E−05	9.1E−05	5.9E−07	5.9E−07	5.9E−07
Disposal and Recycling	0	Adult (21+)	–	–	–	–	–	–
		Pregnant Female	–	–	–	–	–	–
		Youth (11–15)	–	–	–	–	–	–
Cleaning	0	Adult (21+)	–	–	–	–	–	–
		Pregnant Female	–	–	–	–	–	–
		Youth (11–15)	–	–	–	–	–	–
Overall	9	Adult (21+)	1.7E−08	1.2E−04	4.6E−04	3.7E−10	1.3E−06	5.3E−06
		Pregnant Female	2.1E−08	1.5E−04	5.6E−04	4.5E−10	1.6E−06	6.4E−06
		Youth (11–15)	2.6E−08	1.9E−04	7.1E−04	5.8E−10	2.0E−06	8.2E−06

[a] The minimum exposure for the identified days of release, within the identified OES, and for the identified age group.
[b] The arithmetic mean exposure for the identified days of release, within the identified OES, and for the identified age group.
[c] The maximum exposure for the identified days of release, within the identified OES, and for the identified age group.
[d] For OES with 0 releases, no exposure is anticipated, and thus are represented with a "–."

Table 3-42. Summary of NMP Incidental Oral Ingestion Exposure by OES for Maximum Days of Release Scenarios

OES	No. of Releases Modeled	Age Group	ADR (mg/kg-day)			ADD (mg/kg-day)		
			Min Exposure[a]	Mean Exposure[b]	Max Exposure[c]	Min Exposure[a]	Mean Exposure[b]	Max Exposure[c]
Chemical Processing, Excluding Formulation	10	Adult (21+)	1.6E−09	6.5E−04	2.8E−03	8.5E−10	3.8E−04	2.3E−03
		Pregnant Female	1.9E−09	7.9E−04	3.4E−03	1.0E−09	4.6E−04	2.8E−03
		Youth (11–15)	2.4E−09	1.0E−03	4.3E−03	1.3E−09	5.9E−04	3.6E−03
Electronics Manufacturing	5	Adult (21+)	4.8E−06	4.6E−04	2.2E−03	7.1E−07	6.7E−05	2.7E−04
		Pregnant Female	5.8E−06	5.6E−04	2.7E−03	8.6E−07	8.1E−05	3.2E−04
		Youth (11–15)	7.4E−06	7.1E−04	3.4E−03	1.1E−06	1.0E−04	4.2E−04
Formulation	1	Adult (21+)	1.8E−05	1.8E−05	1.8E−05	5.4E−06	5.4E−06	5.4E−06
		Pregnant Female	2.2E−05	2.2E−05	2.2E−05	6.5E−06	6.5E−06	6.5E−06
		Youth (11–15)	2.9E−05	2.9E−05	2.9E−05	8.3E−06	8.3E−06	8.3E−06
Metal Finishing	1	Adult (21+)	2.7E−06	2.7E−06	2.7E−06	3.5E−07	3.5E−07	3.5E−07
		Pregnant Female	3.2E−06	3.2E−06	3.2E−06	4.3E−07	4.3E−07	4.3E−07
		Youth (11–15)	4.1E−06	4.1E−06	4.1E−06	5.5E−07	5.5E−07	5.5E−07
Disposal and Recycling	1	Adult (21+)	5.0E−05	5.0E−05	5.0E−05	1.7E−05	1.7E−05	1.7E−05
		Pregnant Female	6.1E−05	6.1E−05	6.1E−05	2.1E−05	2.1E−05	2.1E−05
		Youth (11–15)	7.8E−05	7.8E−05	7.8E−05	2.7E−05	2.7E−05	2.7E−05
Cleaning	1	Adult (21+)	2.1E−06	2.1E−06	2.1E−06	8.3E−07	8.3E−07	8.3E−07
		Pregnant Female	2.5E−06	2.5E−06	2.5E−06	1.0E−06	1.0E−06	1.0E−06
		Youth (11–15)	3.2E−06	3.2E−06	3.2E−06	1.3E−06	1.3E−06	1.3E−06
Overall	19	Adult (21+)	1.6E−09	4.7E−04	2.8E−03	8.5E−10	2.2E−04	2.3E−03
		Pregnant Female	1.9E−09	5.7E−04	3.4E−03	1.0E−09	2.7E−04	2.8E−03
		Youth (11–15)	2.4E−09	7.2E−04	4.3E−03	1.3E−09	3.4E−04	3.6E−03

[a] The minimum exposure for the identified days of release, within the identified OES, and for the identified age group.
[b] The arithmetic mean exposure for the identified days of release, within the identified OES, and for the identified age group.
[c] The maximum exposure for the identified days of release, within the identified OES, and for the identified age group.

3.3.4.3 Incidental Dermal for NMP

Modeled incidental dermal estimates are summarized by OES category in Table 3-43 for the 20-day release scenario and in Table 3-44 for the maximum days of release scenario. Results are presented for the adult (21+ years) and pregnant female age class, but complete by facility results across all age classes for all evaluated releases are available in *SF_FLA_Water Pathway Exposure Data for NMP* (Appendix B).

For the 12-day release scenario, a total of 9 releases were modeled across all OES with incidental dermal exposure ADRs ranging from 1.7×10^{-09} to 5.3×10^{-05} mg/kg-day and ADDs ranging from 3.8×10^{-11} to 6.2×10^{-07} mg/kg-day. For the maximum release scenario, a total of 19 releases were modeled across all OES with incidental dermal exposure ADRs ranging from 1.6×10^{-10} to 3.3×10^{-04} mg/kg-day and ADDs ranging from 8.6×10^{-11} to 2.7×10^{-04} mg/kg-day.

Table 3-43. Summary of NMP Incidental Dermal Exposure by OES for 12 Days of Release Scenarios

OES	No. of Releases Modeled[d]	Age Group	ADR (mg/kg-day)			ADD (mg/kg-day)		
			Min Exposure[a]	Mean Exposure[b]	Max Exposure[c]	Min Exposure[a]	Mean Exposure[b]	Max Exposure[c]
Chemical Processing, Excluding Formulation	5	Adult (21+)	1.7E−09	6.8E−06	3.0E−05	3.8E−11	6.9E−08	3.0E−07
		Pregnant Female	2.0E−09	7.8E−06	3.4E−05	4.4E−11	7.9E−08	3.5E−07
Electronics Manufacturing	2	Adult (21+)	1.0E−05	1.4E−05	1.7E−05	7.1E−08	1.4E−07	2.0E−07
		Pregnant Female	1.2E−05	1.6E−05	1.9E−05	8.2E−08	1.6E−07	2.3E−07
Formulation	1	Adult (21+)	4.6E−05	4.6E−05	4.6E−05	5.4E−07	5.4E−07	5.4E−07
		Pregnant Female	5.3E−05	5.3E−05	5.3E−05	6.2E−07	6.2E−07	6.2E−07
Metal Finishing	1	Adult (21+)	6.0E−06	6.0E−06	6.0E−06	3.9E−08	3.9E−08	3.9E−08
		Pregnant Female	6.9E−06	6.9E−06	6.9E−06	4.5E−08	4.5E−08	4.5E−08
Disposal and Recycling	0	Adult (21+)	–	–	–	–	–	–
		Pregnant Female	–	–	–	–	–	–
Cleaning	0	Adult (21+)	–	–	–	–	–	–
		Pregnant Female	–	–	–	–	–	–
Overall	9	Adult (21+)	1.7E−09	1.3E−05	4.6E−05	3.8E−11	1.3E−07	5.4E−07
		Pregnant Female	2.0E−09	1.5E−05	5.3E−05	4.4E−11	1.5E−07	6.2E−07

[a] The minimum exposure for the identified days of release, within the identified OES, and for the identified age group.
[b] The arithmetic mean exposure for the identified days of release, within the identified OES, and for the identified age group.
[c] The maximum exposure for the identified days of release, within the identified OES, and for the identified age group.
[d] For OES with 0 releases, no exposure is anticipated, and thus are represented with a "–."

4 **Table 3-44. Summary of NMP Incidental Dermal Exposure by OES for Maximum Days of Release Scenarios**

OES	No. of Releases Modeled	Age Group	ADR (mg/kg-day)			ADD (mg/kg-day)		
			Min Exposure[a]	Mean Exposure[b]	Max Exposure[c]	Min Exposure[a]	Mean Exposure[b]	Max Exposure[c]
Chemical Processing, Excluding Formulation	10	Adult (21+)	1.6E−10	6.6E−05	2.8E−04	8.6E−11	3.9E−05	2.3E−04
		Pregnant Female	1.8E−10	7.6E−05	3.3E−04	1.0E−10	4.4E−05	2.7E−04
Electronics Manufacturing	5	Adult (21+)	4.9E−07	4.7E−05	2.2E−04	7.2E−08	6.7E−06	2.7E−05
		Pregnant Female	5.6E−07	5.4E−05	2.6E−04	8.3E−08	7.8E−06	3.1E−05
Formulation	1	Adult (21+)	1.9E−06	1.9E−06	1.9E−06	5.4E−07	5.4E−07	5.4E−07
		Pregnant Female	2.2E−06	2.2E−06	2.2E−06	6.3E−07	6.3E−07	6.3E−07
Metal Finishing	1	Adult (21+)	2.7E−07	2.7E−07	2.7E−07	3.6E−08	3.6E−08	3.6E−08
		Pregnant Female	3.1E−07	3.1E−07	3.1E−07	4.1E−08	4.1E−08	4.1E−08
Disposal and Recycling	1	Adult (21+)	5.1E−06	5.1E−06	5.1E−06	1.8E−06	1.8E−06	1.8E−06
		Pregnant Female	5.9E−06	5.9E−06	5.9E−06	2.0E−06	2.0E−06	2.0E−06
Cleaning	1	Adult (21+)	2.1E−07	2.1E−07	2.1E−07	8.4E−08	8.4E−08	8.4E−08
		Pregnant Female	2.4E−07	2.4E−07	2.4E−07	9.7E−08	9.7E−08	9.7E−08
Overall	19	Adult (21+)	1.6E−10	4.7E−05	2.8E−04	8.6E−11	2.2E−05	2.3E−04
		Pregnant Female	1.8E−10	5.4E−05	3.3E−04	1.0E−10	2.6E−05	2.7E−04

[a] The minimum exposure for the identified days of release, within the identified OES, and for the identified age group.
[b] The arithmetic mean exposure for the identified days of release, within the identified OES, and for the identified age group.
[c] The maximum exposure for the identified days of release, within the identified OES, and for the identified age group.

5

3.3.5 Risk Characterization for NMP

3.3.5.1 Drinking Water Risk for NMP

EPA calculated risk estimates for each of the endpoints in Table 3-37 across all known facilities and modeled release scenarios under each OES. These estimates were then summarized across facilities to present the range from minimum to maximum risk for multiple lifestages under each OES. In addition to adults, risk estimates are shown for the most sensitive lifestage for each endpoint—pregnant women for developmental toxicity (acute) and infants for male reproductive toxicity (chronic).

Risks relative to benchmark for NMP were not indicated for either 12-day (Table 3-45) or maximum (Table 3-46) release scenarios, with all risk estimates indicating that exposures are more than 10-fold below levels which would result in risk. Therefore, fenceline drinking water risk is not expected to result from releases of NMP facilities.

Table 3-45. Summary of Non-cancer Risk Estimates for Drinking Water Exposures by OES for Various Lifestages under 12 Days of Release Scenarios for NMP

OES	No. of Releases Modeled [a]	Age Group	Acute MOE (Benchmark = 30) Min Risk [b]	Acute MOE Mean Risk [c]	Acute MOE Max Risk [d]	Chronic MOE (Benchmark = 30) Min Risk [b]	Chronic MOE Mean Risk [c]	Chronic MOE Max Risk [d]
Chemical Processing, Excluding Formulation	5	Adult (21+)	5.3E+08	1.1E+08	3.1E+04	5.5E+09	1.1E+09	6.9E+05
		Pregnant Female	4.8E+08	9.6E+07	2.8E+04	3.4E+09	6.9E+08	4.3E+05
		Infant (birth to <1)	N/A [e]	N/A	N/A	2.1E+09	4.3E+08	2.7E+05
Electronics Manufacturing	2	Adult (21+)	9.0E+04	7.2E+04	5.4E+04	2.9E+06	2.0E+06	1.0E+06
		Pregnant Female	8.1E+04	6.5E+04	4.9E+04	1.8E+06	1.2E+06	6.4E+05
		Infant (birth to <1)	N/A	N/A	N/A	1.1E+06	7.7E+05	4.0E+05
Formulation	1	Adult (21+)	2.0E+04	2.0E+04	2.0E+04	3.8E+05	3.8E+05	3.8E+05
		Pregnant Female	1.8E+04	1.8E+04	1.8E+04	2.4E+05	2.4E+05	2.4E+05
		Infant (birth to <1)	N/A	N/A	N/A	1.5E+05	1.5E+05	1.5E+05
Metal Finishing	1	Adult (21+)	1.5E+05	1.5E+05	1.5E+05	5.3E+06	5.3E+06	5.3E+06
		Pregnant Female	1.4E+05	1.4E+05	1.4E+05	3.3E+06	3.3E+06	3.3E+06
		Infant (birth to <1)	N/A	N/A	N/A	2.1E+06	2.1E+06	2.1E+06
Disposal and Recycling	0	Adult (21+)	–	–	–	–	–	–
		Pregnant Female	–	–	–	–	–	–
		Infant (birth to <1)	–	–	–	–	–	–
Cleaning	0	Adult (21+)	–	–	–	–	–	–
		Pregnant Female	–	–	–	–	–	–
		Infant (birth to <1)	–	–	–	–	–	–
Overall	9	Adult (21+)	5.3E+08	5.9E+07	2.0E+04	5.5E+09	6.1E+08	3.8E+05
		Pregnant Female	4.8E+08	5.3E+07	1.8E+04	3.4E+09	3.8E+08	2.4E+05
		Infant (birth to <1)	N/A	N/A	N/A	2.1E+09	2.4E+08	1.5E+05

[a] For OES with 0 releases, no risks were estimated, and thus are represented with a "–."
[b] The minimum risk value is associated with the maximum MOE and the maximum ADR.
[c] The mean risk value is the arithmetic mean MOE.
[d] The maximum risk value is associated with the minimum MOE and the minimum ADR.
[e] Not applicable to the endpoint used for POD derivation (see Section 3.3.2.1).

Table 3-46. Summary of Non-cancer Risk Estimates for Drinking Water Exposures by OES for Various Lifestages under Maximum Days of Release Scenarios for NMP

OES	No. of Releases Modeled	Age Group	Acute MOE (Benchmark = 30)			Chronic MOE (Benchmark = 30)		
			Min Risk [a]	Mean Risk [b]	Max Risk [c]	Min Risk [b]	Mean Risk [c]	Max Risk [d]
Chemical Processing, Excluding Formulation	10	Adult (21+)	5.8E+09	5.8E+08	3,213	2.4E+09	2.4E+08	886
		Pregnant Female	5.2E+09	5.3E+08	2,903	1.5E+09	1.5E+08	554
		Infant (birth to <1)	N/A [d]	N/A	N/A	9.4E+08	9.5E+07	347
Electronics Manufacturing	5	Adult (21+)	1.9E+06	6.8E+05	4,107	2.9E+06	8.1E+05	7,622
		Pregnant Female	1.7E+06	6.1E+05	3,711	1.8E+06	5.1E+05	4,769
		Infant (birth to <1)	N/A	N/A	N/A	1.1E+06	3.2E+05	2,984
Formulation	1	Adult (21+)	4.9E+05	4.9E+05	4.9E+05	3.8E+05	3.8E+05	3.8E+05
		Pregnant Female	4.4E+05	4.4E+05	4.4E+05	2.4E+05	2.4E+05	2.4E+05
		Infant (birth to <1)	N/A	N/A	N/A	1.5E+05	1.5E+05	1.5E+05
Metal Finishing	1	Adult (21+)	3.4E+06	3.4E+06	3.4E+06	5.8E+06	5.8E+06	5.8E+06
		Pregnant Female	3.1E+06	3.1E+06	3.1E+06	3.6E+06	3.6E+06	3.6E+06
		Infant (birth to <1)	N/A	N/A	N/A	2.3E+06	2.3E+06	2.3E+06
Disposal and Recycling	1	Adult (21+)	1.8E+05	1.8E+05	1.8E+05	1.2E+05	1.2E+05	1.2E+05
		Pregnant Female	1.6E+05	1.6E+05	1.6E+05	7.3E+04	7.3E+04	7.3E+04
		Infant (birth to <1)	N/A	N/A	N/A	4.6E+04	4.6E+04	4.6E+04
Cleaning	1	Adult (21+)	4.3E+06	4.3E+06	4.3E+06	2.5E+06	2.5E+06	2.5E+06
		Pregnant Female	3.9E+06	3.9E+06	3.9E+06	1.5E+06	1.5E+06	1.5E+06
		Infant (birth to <1)	N/A	N/A	N/A	9.7E+05	9.7E+05	9.7E+05
Overall	19	Adult (21+)	5.8E+09	3.1E+08	3,213	2.4E+09	1.3E+08	886
		Pregnant Female	5.2E+09	2.8E+08	2,903	1.5E+09	8.1E+07	554
		Infant (birth to <1)	N/A	N/A	N/A	9.4E+08	5.0E+07	347

[a] The minimum risk value is associated with the maximum MOE and the maximum ADR.
[b] The mean risk value is the arithmetic mean MOE.
[c] The maximum risk value is associated with the minimum MOE and the minimum ADR.
[d] Not applicable to the endpoint used for POD derivation (see Section 3.3.2.1).

3.3.5.2 Incidental Swimming Risk for NMP

EPA calculated risk estimates from incidental swimming for each of the endpoints in Table 3-37 across all known facilities and modeled release scenarios under each OES. These estimates were then summarized across facilities to present the range from minimum to maximum risk for multiple lifestages under each OES. Aggregate risk from incidental ingestion and dermal contact during recreational contact with water are not presented. Risk estimates calculated for each route of exposure independently are at least an order of magnitude from the benchmarks, indicating that aggregating risk across these routes would not result in different risk conclusions.

3.3.5.2.1 Incidental Oral for NMP

In addition to adults, risk estimates are shown for more sensitive lifestages/subpopulations for each endpoint— both pregnant females and 11-to-15 year olds. Risks relative to benchmark for NMP were not indicated for either 12-day (Table 3-47) or maximum (Table 3-48) release scenarios, with all risk estimates greater than two orders of magnitude away from benchmark. Therefore, oral ingestion risk from incidental swimming is not expected to result from releases of NMP facilities.

Table 3-47. Summary of Non-cancer Incidental Oral Ingestion Risk by OES for Various Lifestages under 12 Days of Release Scenario for NMP

OES	No. of Releases Modeled [a]	Age Group	Acute MOE (Benchmark = 30)			Chronic MOE (Benchmark = 30)		
			Min Risk [b]	Mean Risk [c]	Max Risk [d]	Min Risk [b]	Mean Risk [c]	Max Risk [d]
Chemical Processing, Excluding Formulation	5	Adult (21+)	6.2E+09	1.2E+09	3.6E+05	1.7E+10	3.5E+09	2.2E+06
		Pregnant Female	5.1E+09	1.0E+09	3.0E+05	1.4E+10	2.9E+09	1.8E+06
		Youth (11–15)	4.0E+09	8.0E+08	2.3E+05	1.1E+10	2.3E+09	1.4E+06
Electronics Manufacturing	2	Adult (21+)	1.1E+06	8.4E+05	6.3E+05	9.3E+06	6.3E+06	3.3E+06
		Pregnant Female	8.7E+05	6.9E+05	5.2E+05	7.7E+06	5.2E+06	2.7E+06
		Youth (11–15)	6.8E+05	5.4E+05	4.1E+05	6.0E+06	4.0E+06	2.1E+06
Formulation	1	Adult (21+)	2.3E+05	2.3E+05	2.3E+05	1.2E+06	1.2E+06	1.2E+06
		Pregnant Female	1.9E+05	1.9E+05	1.9E+05	1.0E+06	1.0E+06	1.0E+06
		Youth (11–15)	1.5E+05	1.5E+05	1.5E+05	7.9E+05	7.9E+05	7.9E+05
Metal Finishing	1	Adult (21+)	1.8E+06	1.8E+06	1.8E+06	1.7E+07	1.7E+07	1.7E+07
		Pregnant Female	1.5E+06	1.5E+06	1.5E+06	1.4E+07	1.4E+07	1.4E+07
		Youth (11–15)	1.1E+06	1.1E+06	1.1E+06	1.1E+07	1.1E+07	1.1E+07
Disposal and Recycling	0	Adult (21+)	–	–	–	–	–	–
		Pregnant Female	–	–	–	–	–	–
		Youth (11–15)	–	–	–	–	–	–
Cleaning	0	Adult (21+)	–	–	–	–	–	–
		Pregnant Female	–	–	–	–	–	–
		Youth (11–15)	–	–	–	–	–	–
Overall	9	Adult (21+)	6.2E+09	6.9E+08	2.3E+05	1.7E+10	2.0E+09	1.2E+06
		Pregnant Female	5.1E+09	5.7E+08	1.9E+05	1.4E+10	1.6E+09	1.0E+06
		Youth (11–15)	4.0E+09	4.4E+08	1.5E+05	1.1E+10	1.3E+09	7.9E+05

[a] For OES with 0 releases, no risk is anticipated, and thus are represented with a "–."
[b] The minimum risk value is associated with the maximum MOE and the maximum ADR.
[c] The mean risk value is the arithmetic mean MOE.
[d] The maximum risk value is associated with the minimum MOE and the minimum ADR.

Table 3-48. Summary of Non-cancer Incidental Oral Ingestion Risk by OES for Various Lifestages under Maximum Days of Release Scenario for NMP

OES	No. of Releases Modeled	Age Group	Acute MOE (Benchmark = 30)			Chronic MOE (Benchmark = 30)		
			Min Risk [a]	Mean Risk [b]	Max Risk [c]	Min Risk [a]	Mean Risk [b]	Max Risk [c]
Chemical Processing, Excluding Formulation	10	Adult (21+)	6.7E+10	6.8E+09	3.7E+04	7.6E+09	7.8E+08	2,823
		Pregnant Female	5.5E+10	5.6E+09	3.1E+04	6.3E+09	6.4E+08	2,325
		Youth (11–15)	4.3E+10	4.4E+09	2.4E+04	4.9E+09	5.0E+08	1,820
Electronics Manufacturing	5	Adult (21+)	2.2E+07	7.9E+06	4.8E+04	9.2E+06	2.6E+06	2.4E+04
		Pregnant Female	1.8E+07	6.5E+06	3.9E+04	7.6E+06	2.1E+06	2.0E+04
		Youth (11–15)	1.4E+07	5.1E+06	3.1E+04	5.9E+06	1.7E+06	1.6E+04
Formulation	1	Adult (21+)	5.7E+06	5.7E+06	5.7E+06	1.2E+06	1.2E+06	1.2E+06
		Pregnant Female	4.7E+06	4.7E+06	4.7E+06	1.0E+06	1.0E+06	1.0E+06
		Youth (11–15)	3.7E+06	3.7E+06	3.7E+06	7.8E+05	7.8E+05	7.8E+05
Metal Finishing	1	Adult (21+)	4.0E+07	4.0E+07	4.0E+07	1.8E+07	1.8E+07	1.8E+07
		Pregnant Female	3.3E+07	3.3E+07	3.3E+07	1.5E+07	1.5E+07	1.5E+07
		Youth (11–15)	2.5E+07	2.5E+07	2.5E+07	1.2E+07	1.2E+07	1.2E+07
Disposal and Recycling	1	Adult (21+)	2.1E+06	2.1E+06	2.1E+06	3.7E+05	3.7E+05	3.7E+05
		Pregnant Female	1.7E+06	1.7E+06	1.7E+06	3.1E+05	3.1E+05	3.1E+05
		Youth (11–15)	1.3E+06	1.3E+06	1.3E+06	2.4E+05	2.4E+05	2.4E+05
Cleaning	1	Adult (21+)	5.1E+07	5.1E+07	5.1E+07	7.9E+06	7.9E+06	7.9E+06
		Pregnant Female	4.2E+07	4.2E+07	4.2E+07	6.5E+06	6.5E+06	6.5E+06
		Youth (11–15)	3.3E+07	3.3E+07	3.3E+07	5.1E+06	5.1E+06	5.1E+06
Overall	19	Adult (21+)	6.7E+10	3.6E+09	3.7E+04	7.6E+09	4.1E+08	2,823
		Pregnant Female	5.5E+10	3.0E+09	3.1E+04	6.3E+09	3.4E+08	2,325
		Youth (11–15)	4.3E+10	2.3E+09	2.4E+04	4.9E+09	2.6E+08	1,820

[a] The minimum risk value is associated with the maximum MOE and the maximum ADR.
[b] The mean risk value is the arithmetic mean MOE.
[c] The maximum risk value is associated with the minimum MOE and the minimum ADR.

3.3.5.2.2 Incidental Dermal for NMP

In addition to adults, risk estimates are shown for the more sensitive subpopulation of pregnant females (adult exposure is greater than youth exposure, so risk estimates for that lifestage are not presented). Risks relative to benchmark for NMP were not indicated for either 12-day (Table 3-49) or maximum (Table 3-50) release scenarios, with all risk estimates greater than two orders of magnitude away from benchmark. Therefore, dermal exposure risk from incidental swimming is not expected to result from releases of NMP facilities.

Table 3-49. Summary of Non-cancer Risk Estimates for Incidental Dermal Exposure by OES for Various Lifestages under 12 Days of Release Scenario for NMP

OES	No. of Releases Modeled [a]	Age Group	Acute MOE (Benchmark = 30)			Chronic MOE (Benchmark = 30)		
			Min Risk [b]	Mean Risk [c]	Max Risk [d]	Min Risk [b]	Mean Risk [c]	Max Risk [d]
Chemical Processing, Excluding Formulation	5	Adult (21+)	6.1E+10	1.2E+10	3.5E+06	1.7E+11	3.5E+10	2.2E+07
		Pregnant Female	5.3E+10	1.1E+10	3.1E+06	1.5E+11	3.0E+10	1.9E+07
Electronics Manufacturing	2	Adult (21+)	1.0E+07	8.3E+06	6.2E+06	9.2E+07	6.2E+07	3.2E+07
		Pregnant Female	9.0E+06	7.2E+06	5.4E+06	8.0E+07	5.4E+07	2.8E+07
Formulation	1	Adult (21+)	2.3E+06	2.3E+06	2.3E+06	1.2E+07	1.2E+07	1.2E+07
		Pregnant Female	2.0E+06	2.0E+06	2.0E+06	1.0E+07	1.0E+07	1.0E+07
Metal Finishing	1	Adult (21+)	1.8E+07	1.8E+07	1.8E+07	1.7E+08	1.7E+08	1.7E+08
		Pregnant Female	1.5E+07	1.5E+07	1.5E+07	1.5E+08	1.5E+08	1.5E+08
Disposal and Recycling	0	Adult (21+)	–	–	–	–	–	–
		Pregnant Female	–	–	–	–	–	–
Cleaning	0	Adult (21+)	–	–	–	–	–	–
		Pregnant Female	–	–	–	–	–	–
Overall	9	Adult (21+)	6.1E+10	6.8E+09	2.3E+06	1.7E+11	1.9E+10	1.2E+07
		Pregnant Female	5.3E+10	5.9E+09	2.0E+06	1.5E+11	1.7E+10	1.0E+07

[a] For OES with 0 releases, no risk is anticipated, and thus are represented with a "–".
[b] The minimum risk value is associated with the maximum MOE and the maximum ADR.
[c] The mean risk value is the arithmetic mean MOE.
[d] The maximum risk value is associated with the minimum MOE and the minimum ADR.

Table 3-50. Summary of Non-cancer Risk Estimates for Incidental Dermal Exposure by OES for Various Lifestages under Maximum Days of Release Scenario for NMP

OES	No. of Releases Modeled	Age Group	Acute MOE (Benchmark = 30)			Chronic MOE (Benchmark = 30)		
			Min Risk [a]	Mean Risk [b]	Max Risk [c]	Min Risk [a]	Mean Risk [b]	Max Risk [c]
Chemical Processing, Excluding Formulation	10	Adult (21+)	6.6E+11	6.7E+10	3.7E+05	7.5E+10	7.7E+09	2.8E+04
		Pregnant Female	5.8E+11	5.8E+10	3.2E+05	6.5E+10	6.6E+09	2.4E+04
Electronics Manufacturing	5	Adult (21+)	2.2E+08	7.8E+07	4.7E+05	9.1E+07	2.5E+07	2.4E+05
		Pregnant Female	1.9E+08	6.8E+07	4.1E+05	7.9E+07	2.2E+07	2.1E+05
Formulation	1	Adult (21+)	5.6E+07	5.6E+07	5.6E+07	1.2E+07	1.2E+07	1.2E+07
		Pregnant Female	4.9E+07	4.9E+07	4.9E+07	1.0E+07	1.0E+07	1.0E+07
Metal Finishing	1	Adult (21+)	3.9E+08	3.9E+08	3.9E+08	1.8E+08	1.8E+08	1.8E+08
		Pregnant Female	3.4E+08	3.4E+08	3.4E+08	1.6E+08	1.6E+08	1.6E+08
Disposal and Recycling	1	Adult (21+)	2.1E+07	2.1E+07	2.1E+07	3.7E+06	3.7E+06	3.7E+06
		Pregnant Female	1.8E+07	1.8E+07	1.8E+07	3.2E+06	3.2E+06	3.2E+06
Cleaning	1	Adult (21+)	5.0E+08	5.0E+08	5.0E+08	7.8E+07	7.8E+07	7.8E+07
		Pregnant Female	4.3E+08	4.3E+08	4.3E+08	6.7E+07	6.7E+07	6.7E+07
Overall	19	Adult (21+)	6.6E+11	3.5E+10	3.7E+05	7.5E+10	4.1E+09	2.8E+04
		Pregnant Female	5.8E+11	3.1E+10	3.2E+05	6.5E+10	3.5E+09	2.4E+04

[a] The minimum risk value is associated with the maximum MOE and the maximum ADR.
[b] The mean risk value is the arithmetic mean MOE.
[c] The maximum risk value is associated with the minimum MOE and the minimum ADR.

3.3.6 Confidence and Risk Conclusions for NMP Case Study Results

This section illustrates by example EPA's use of results from applying the proposed screening level methodology to make risk conclusions and does not represent final agency action. Any results or risk conclusions presented here are not intended to be used in support of risk management actions or rulemakings as presented.

EPA did not identify risks relative to the benchmarks from fenceline exposure to NMP through drinking water or recreational contact with water. Exposures were more than 10-fold below levels which would result in risk for all exposure scenarios, and therefore EPA does not expect that any small variation in assumptions would result in different risk conclusions. The use of surface water concentration estimates based on the point of release are likely to result in a higher-end estimate of fenceline community exposure from drinking water and incidental swimming (Section 2.4.4). When also considering the inclusion of more sensitive lifestages and risk estimates based on maximum releases across all facilities, these risk conclusions incorporate health-protective assumptions based on the parameters used in these analyses.

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Appendix A ABBREVIATIONS AND PHYSICAL-CHEMICAL PROPERTIES

A.1 Abbreviations

1,4-D	1,4-Dioxane
1-BP	1-Bromopropane
ACGIH	American Conference of Governmental Industrial Hygienists
AEGL	Acute Exposure Guideline Level
AERMOD	American Meteorological Society/Environmental Protection Agency Regulatory Model
ATSDR	Agency for Toxic Substances and Disease Registry
BAF	Bioaccumulation factor
BCF	Bioconcentration factor
BMD	Benchmark dose
BMR	Benchmark response
CAA	Clean Air Act
CASRN	Chemical Abstracts Service Registry Number
CBI	Confidential Business Information
CDR	Chemical Data Reporting
CEHD	Chemical Exposure Health Data
CEPA	Canadian List of Toxic Substances
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
CHIRP	Chemical Risk Information Platform
CNS	Central nervous system
COC	Concentration(s) of concern
CoCAP	Cooperative Chemicals Assessment Program
COHb	Carboxyhemoglobin
CPSA	Consumer Product Safety Act
CPSC	Consumer Product Safety Commission
CSCL	Chemical Substances Control Law
CSHO	Certified Safety and Health Official
CTC	Carbon tetrachloride
CWA	Clean Water Act
MC	Dichloromethane (methylene chloride)
DIY	Do it yourself
DMR	Discharge Monitoring Report
DOT	Department of Transportation
EC50	Effect concentration at which 50% of test organisms exhibit an effect
ECHA	European Chemicals Agency
E-FAST	Exposure and Fate Assessment Screening Tool
EG	Effluent Guidelines
EHC	Environmental Health Criteria
EPA	Environmental Protection Agency
EPCRA	Emergency Planning and Community Right-to-Know Act
ESD	Emission Scenario Document
EU	European Union
FDA	Food and Drug Administration
FFDCA	Federal Food, Drug, and Cosmetic Act

FSHA	Federal Hazardous Substance Act
HAP	Hazardous Air Pollutant
HEC	Human Equivalent Concentration
HED	Human Equivalent Dose
HERO	Health and Environmental Research Online (Database)
HFC	Hydrofluorocarbon
HHE	Health hazard evaluation
HMTA	Hazardous Materials Transportation Act
HPV	High Production Volume
IARC	International Agency for Research on Cancer
ICIS	Integrated Compliance Information System
IDLH	Immediately Dangerous to Life and Health
IECCU	Indoor Environment Concentration in Buildings with Conditioned and Unconditioned Zones
IIOAC	Integrated Indoor/Outdoor Air Calculator
IMAP	Inventory Multi-Tiered Assessment and Prioritisation
IRIS	Integrated Risk Information System
ISHA	Industrial Safety and Health Act
Koc	Soil organic carbon: water partitioning coefficient
Kow	Octanol: water partition coefficient
LC50	Lethal concentration at which 50% of test organisms die
LD50	Lethal dose at which 50% of test organisms die
LOD	Limit of detection
Log Koc	Logarithmic organic carbon: water partition coefficient
Log Kow	Logarithmic octanol: water partition coefficient
MACT	Maximum Achievable Control Technology
MC	Methylene chloride
MCL	Maximum Contaminant Level
MCLG	Maximum Contaminant Level Goal
MOA	Mode of action
MSW	Municipal solid waste
NAC	National Advisory Committee
NAICS	North American Industry Classification System
NATA	National Scale Air-Toxics Assessment
NAWQA	National Water Quality Assessment Program
ND	Non-detect
NEI	National Emissions Inventory
NESHAP	National Emission Standards for Hazardous Air Pollutants
NHANES	National Health and Nutrition Examination Survey
NICNAS	National Industrial Chemicals Notification and Assessment Scheme
NIH	National Institutes of Health
NIOSH	National Institute for Occupational Safety and Health
NITE	National Institute of Technology and Evaluation
NMP	n-Methyl-2-pyrrolidone
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NPDWR	National Primary Drinking Water Regulation
NRC	National Research Council
NTP	National Toxicology Program

NWIS	National Water Information System
OCSPP	Office of Chemical Safety and Pollution Prevention
OECD	Organisation for Economic Co-operation and Development
OEHHA	Office of Environmental Health Hazard Assessment
OEL	Occupational exposure limit
OES	Occupational exposure scenario(s)
ONU	Occupational non-user
OPPT	Office of Pollution Prevention and Toxics
OSHA	Occupational Safety and Health Administration
OTVD	Open-top vapor degreaser
PBPK	Physiologically based pharmacokinetic
PBZ	Personal breathing zone
PECO	Population, exposure, comparator, and outcome
PEL	Permissible Exposure Limit
PESS	Potentially exposed or susceptible subpopulations
POD	Point of departure
POTW	Publicly owned treatment works
PPE	Personal protective equipment
PSD	Particle size distribution
PV	Production volume
QC	Quality control
RCRA	Resource Conservation and Recovery Act
REACH	Registration, Evaluation, Authorization and Restriction of Chemicals (European Union)
REL	Recommended Exposure Limit
RICE	Reciprocating internal combustion engines
RTR	Risk and technology review
SDS	Safety data sheet
SDWA	Safe Drinking Water Act
SIDS	Screening Information Data Set
SMAC	Spacecraft Maximum Allowable Concentrations
SNAP	Significant New Alternatives Policy
SpERC	Specific Environmental Release Categories
STEL	Short-Term Exposure Limit
STORET	STOrage and RETrieval and Water Quality exchange
TCCR	Transparent, clear, consistent, and reasonable
TLV	Threshold Limit Value
TRI	Toxics Release Inventory
TSCA	Toxic Substances Control Act
TTO	Total toxic organics
TWA	Time-weighted average
U.S.	United States
USGS	United States Geological Survey
VOC	Volatile organic compound
VP	Vapor pressure
WHO	World Health Organization

A.2 Select Physical-Chemical Properties of Case Study Chemicals

Table_Apx A-1 summarizes the basic physical-chemical properties of the chemicals chosen for the case studies in this document. All of the properties appear in the chemicals' respective final risk evaluations, for which they were identified using the systematic review procedures described in those documents (1-BP: (U.S. EPA, 2020b); MC: (U.S. EPA, 2020c); NMP: (U.S. EPA, 2020d)).

Table_Apx A-1. Select Physical-Chemical Properties of Case Study Chemicals

Property	1-Bromopropane	Methylene Chloride	N-Methylpyrrolidone
Molecular formula	C_3H_7Br	CH_2Cl_2	C_5H_9ON
Molecular mass	122.99	84.93	99.1
Melting point	−110 °C (O'Neil, 2013)	−95 °C (O'Neil, 2013)	−25 °C (Ashford, 1994)
Boiling point	71 °C (O'Neil, 2013)	39.7 °C (O'Neil, 2013)	202 °C (O'Neil et al., 2006)
Density	1.353 g/cm^3 at 20 °C (O'Neil, 2013)	1.33 g/cm^3 at 20 °C (O'Neil, 2013)	1.03 g/cm^3 at 25 °C (O'Neil et al., 2006)
Vapor pressure	110.8 mmHg at 20 °C (Boublík et al., 1984)	435 mmHg at 25 °C (Boublík et al., 1984)	0.345 mmHg at 25 °C (Daubert and Danner, 1989)
Vapor density (air = 1)	4.25 (Patty et al., 1963)	2.93 (Holbrook, 2003)	3.4 (NFPA, 1997)
Water solubility	2.450 g/L at 20 °C (Yalkowsky et al., 2010)	13 g/L at 25 °C (Horvath, 1982)	1,000 g/L at 25 °C (miscible) (O'Neil et al., 2006)
Henry's law constant	7.3×10−3 atm·m^3/mol (U.S. EPA, 2012b)	2.91×10^{-3} atm·m^3/mol (Leighton and Calo, 1981)	3.2×10^{-9} atm·m^3/mol (Kim et al., 2000)
log K_{OW}	2.10 (Hansch, 1995)	2.27 (Hansch, 1995)	−0.38 (Sasaki et al., 1988)

Appendix B LIST OF SUPPLEMENTAL FILES

List of supplemental documents (see Docket: https://www.regulations.gov/docket/EPA-HQ-OPPT-2021-0415 for access to all files):

01. SF_FLA_Air Pathway Input Parameters for AERMOD for 1-BP and MC

02. SF_FLA_Air Pathway Pre-screening Results for 1-BP

03. SF_FLA_Air Pathway Pre-screening Results for MC

04. SF_FLA_Air Pathway Co-Resident Exposure Results for 1-BP

05. SF_FLA_Air Pathway Full-Screen Results for 1-BP

06. SF_FLA_Air Pathway Full-Screen Results for MC

07. SF_FLA_Air Pathway Summary Statistics of Exposure Concentrations for 1-BP

08. SF_FLA_Air Pathway Summary Statistics of Exposure Concentrations for MC

09. SF_FLA_Air Pathway Information for Co-Resident Modeling for 1-BP

10. SF_FLA_Dry-Cleaning Model_3rd Gen_Emission Results for 1-BP

11. SF_FLA_Environmental Releases to Ambient Air for 1-BP

12. SF_FLA_Environmental Releases to Ambient Air for MC

13. SF_FLA_Water Pathway Exposure Data for MC

14. SF_FLA_Water Pathway Exposure Data for NMP

15. SF_FLA_Air Pathway Input Parameters for IIOAC for 1-BP and MC

16. SF_FLA_README File Co-Resident Exposure Modeling

Appendix C TRI-CDR CROSSWALK

Table_Apx C-1 presents the TRI-CDR Crosswalk used to map facilities to the OES for each chemical. Blanks in the 2016 CDR code column indicate there is no corresponding CDR code that matches the TRI code.

Table_Apx C-1. TRI-CDR Use Code Crosswalk

TRI Section	TRI Description	TRI Sub-use Code	TRI Sub-use Code Name	2016 CDR Code	2016 CDR Code Name	2016 CDR Functional Use Definition
3.1.a	Manufacture: Produce					
3.1.b	Manufacture: Import					
3.1.c	Manufacture: For on-site use/processing					
3.1.d	Manufacture: For sale/distribution					
3.1.e	Manufacture: As a byproduct					
3.1.f	Manufacture: As an impurity					
3.2.a	Processing: As a reactant			PC	Processing as a reactant	Chemical substance is used in chemical reactions for the manufacturing of another chemical substance or product.
3.2.a	Processing: As a reactant	P101	Feedstocks			
3.2.a	Processing: As a reactant	P102	Raw Materials			
3.2.a	Processing: As a reactant	P103	Intermediates	U015	Intermediates	Chemical substances consumed in a reaction to produce other chemical substances for commercial advantage. A residual of the intermediate chemical substance which has no separate function may remain in the reaction product.

TRI Section	TRI Description	TRI Sub-use Code	TRI Sub-use Code Name	2016 CDR Code	2016 CDR Code Name	2016 CDR Functional Use Definition
3.2.a	Processing: As a reactant	P104	Initiators	U024	Process regulators	Chemical substances used to change the rate of a chemical reaction, start or stop the reaction, or otherwise influence the course of the reaction. Process regulators may be consumed or become part of the reaction product.
3.2.a	Processing: As a reactant	P199	Other	U016	Ion exchange agents	Chemical substances, usually in the form of a solid matrix, that are used to selectively remove targeted ions from a solution. Examples generally consist of an inert hydrophobic matrix such as styrenedivinylbenzene or phenol-formaldehyde, cross-linking polymer such as divinylbenzene, and ionic functional groups including sulfonic, carboxylic or phosphonic acids. This code also includes aluminosilicate zeolites.
3.2.a	Processing: As a reactant	P199	Other	U019	Oxidizing/reducing agent	Chemical substances used to alter the valence state of another substance by donating or accepting electrons or by the addition or removal of hydrogen to a substance. Examples of oxidizing agents include nitric acid, perchlorates, hexavalent chromium compounds, and peroxydisulfuric acid salts. Examples of reducing agents include hydrazine, sodium thiosulfate, and coke produced from coal.
3.2.a	Processing: As a reactant	P199	Other	U999	Other (specify)	
3.2.b	Processing: As a formulation component			PF	Processing- incorporation into formulation, mixture, or reaction product	Chemical substance is added to a product (or product mixture) prior to further distribution of the product.
3.2.b	Processing: As a formulation component	P201	Additives	U007	Corrosion inhibitors and antiscaling agents	Chemical substances used to prevent or retard corrosion or the formation of scale. Examples include phenylenediamine, chromates, nitrates, phosphates, and hydrazine.

TRI Section	TRI Description	TRI Sub-use Code	TRI Sub-use Code Name	2016 CDR Code	2016 CDR Code Name	2016 CDR Functional Use Definition
3.2.b	Processing: As a formulation component	P201	Additives	U009	Fillers	Chemical substances used to provide bulk, increase strength, increase hardness, or improve resistance to impact. Fillers incorporated in a matrix reduce production costs by minimizing the amount of more expensive substances used in the production of articles. Examples include calcium carbonate, barium sulfate, silicates, clays, zinc oxide and aluminum oxide.
3.2.b	Processing: As a formulation component	P201	Additives	U010	Finishing agents	Chemical substances used to impart such functions as softening, staticproofing, wrinkle resistance, and water repellence. Substances may be applied to textiles, paper, and leather. Examples include quaternary ammonium compounds, ethoxylated amines, and silicone compounds.
3.2.b	Processing: As a formulation component	P201	Additives	U017	Lubricants and lubricant additives	Chemical substances used to reduce friction, heat, or wear between moving parts or adjacent solid surfaces, or that enhance the lubricity of other substances. Examples of lubricants include mineral oils, silicate and phosphate esters, silicone oil, greases, and solid film lubricants such as graphite and PTFE. Examples of lubricant additives include molybdenum disulphide and tungsten disulphide.
3.2.b	Processing: As a formulation component	P201	Additives	U034	Paint additives and coating additives not described by other codes	Chemical substances used in a paint or coating formulation to enhance properties such as water repellence, increased gloss, improved fade resistance, ease of application, foam prevention, etc. Examples of paint additives and coating additives include polyols, amines, vinyl acetate ethylene emulsions, and aliphatic polyisocyanates.
3.2.b	Processing: As a formulation component	P202	Dyes	U008	Dyes	Chemical substances used to impart color to other materials or mixtures (*i.e.*, substrates) by penetrating into the surface of the substrate. Examples types include azo, anthraquinone, amino azo, aniline, eosin, stilbene, acid, basic or cationic, reactive, dispersive, and natural dyes.

TRI Section	TRI Description	TRI Sub-use Code	TRI Sub-use Code Name	2016 CDR Code	2016 CDR Code Name	2016 CDR Functional Use Definition
3.2.b	Processing: As a formulation component	P202	Dyes	U021	Pigments	Chemical substances used to impart color to other materials or mixtures (*i.e.*, substrates) by attaching themselves to the surface of the substrate through binding or adhesion. This code includes fluorescent agents, luminescent agents, whitening agents, pearlizing agents, and opacifiers. Examples include metallic oxides of iron, titanium, zinc, cobalt, and chromium; metal powder suspensions; lead chromates; vegetable and animal products; and synthetic organic pigments.
3.2.b	Processing: As a formulation component	P203	Reaction Diluents	U030	Solvents (which become part of product formulation or mixture)	Chemical substances used to dissolve another substance (solute) to form a uniformly dispersed mixture (solution) at the molecular level. Examples include diluents used to reduce the concentration of an active material to achieve a specified effect and low gravity materials added to reduce cost.
3.2.b	Processing: As a formulation component	P203	Reaction Diluents	U032	Viscosity adjustors	Chemical substances used to alter the viscosity of another substance. Examples include viscosity index (VI) improvers, pour point depressants, and thickeners.
3.2.b	Processing: As a formulation component	P204	Initiators	U024	Process Regulators	Chemical substances used to change the rate of a chemical reaction, start or stop the reaction, or otherwise influence the course of the reaction. Process regulators may be consumed or become part of the reaction product.
3.2.b	Processing: As a formulation component	P205	Solvents	U030	Solvents (which become part of product formulation or mixture)	Chemical substances used to dissolve another substance (solute) to form a uniformly dispersed mixture (solution) at the molecular level. Examples include diluents used to reduce the concentration of an active material to achieve a specified effect and low gravity materials added to reduce cost.
3.2.b	Processing: As a formulation component	P206	Inhibitors	U024	Process Regulators	Chemical substances used to change the rate of a chemical reaction, start or stop the reaction, or otherwise influence the course of the reaction. Process regulators

TRI Section	TRI Description	TRI Sub-use Code	TRI Sub-use Code Name	2016 CDR Code	2016 CDR Code Name	2016 CDR Functional Use Definition
						may be consumed or become part of the reaction product.
3.2.b	Processing: As a formulation component	P207	Emulsifiers	U003	Adsorbents and Absorbents	Chemical substances used to retain other substances by accumulation on their surface or by assimilation. Examples of adsorbents include silica gel, activated alumina, and activated carbon. Examples of absorbents include straw oil, alkaline solutions, and kerosene.
3.2.b	Processing: As a formulation component	P208	Surfactants	U002	Adhesives and Sealant Chemicals	Chemical substances used to promote bonding between other substances, promote adhesion of surfaces, or prevent seepage of moisture or air. Examples include epoxides, isocyanates, acrylamides, phenol, urea, melamine, and formaldehyde.
3.2.b	Processing: As a formulation component	P208	Surfactants	U023	Plating agents and surface treating agents	Chemical substances applied to metal, plastic, or other surfaces to alter physical or chemical properties of the surface. Examples include metal surface treating agents, strippers, etchants, rust and tarnish removers, and descaling agents.
3.2.b	Processing: As a formulation component	P208	Surfactants	U031	Surface active agents	Chemical substances used to modify surface tension when dissolved in water or water solutions, or reduce interfacial tension between two liquids or between a liquid and a solid or between liquid and air. Examples include carboxylates, sulfonates, phosphates, carboxylic acid, esters, and quaternary ammonium salts.
3.2.b	Processing: As a formulation component	P209	Lubricants	U017	Lubricants and lubricant additives	Chemical substances used to reduce friction, heat, or wear between moving parts or adjacent solid surfaces, or that enhance the lubricity of other substances. Examples of lubricants include mineral oils, silicate and phosphate esters, silicone oil, greases, and solid film lubricants such as graphite and PTFE. Examples of lubricant additives include molybdenum disulphide and tungsten disulphide.
3.2.b	Processing: As a formulation component	P210	Flame Retardants	U011	Flame retardants	Chemical substances used on the surface of or incorporated into combustible materials to reduce or eliminate their tendency to ignite when exposed to heat

TRI Section	TRI Description	TRI Sub-use Code	TRI Sub-use Code Name	2016 CDR Code	2016 CDR Code Name	2016 CDR Functional Use Definition
						or a flame for a short period of time. Examples include inorganic salts, chlorinated or brominated organic compounds, and organic phosphates/phosphonates.
3.2.b	Processing: As a formulation component	P211	Rheological Modifiers	U022	Plasticizers	Chemical substances used in plastics, cement, concrete, wallboard, clay bodies, or other materials to increase their plasticity or fluidity. Examples include phthalates, trimellitates, adipates, maleates, and lignosulphonates.
3.2.b	Processing: As a formulation component	P211	Rheological Modifiers	U032	Viscosity adjustors	Chemical substances used to alter the viscosity of another substance. Examples include viscosity index (VI) improvers, pour point depressants, and thickeners.
3.2.b	Processing: As a formulation component	P299	Other	U003	Adsorbents and Absorbents	Chemical substances used to retain other substances by accumulation on their surface or by assimilation. Examples of adsorbents include silica gel, activated alumina, and activated carbon. Examples of absorbents include straw oil, alkaline solutions, and kerosene.
3.2.b	Processing: As a formulation component	P299	Other	U016	Ion exchange agents	Chemical substances, usually in the form of a solid matrix, that are used to selectively remove targeted ions from a solution. Examples generally consist of an inert hydrophobic matrix such as styrenedivinylbenzene or phenol-formaldehyde, cross-linking polymer such as divinylbenzene, and ionic functional groups including sulfonic, carboxylic or phosphonic acids. This code also includes aluminosilicate zeolites.
3.2.b	Processing: As a formulation component	P299	Other	U018	Odor agents	Chemical substances used to control odors, remove odors, mask odors, or impart odors. Examples include benzenoids, terpenes and terpenoids, musk chemicals, aliphatic aldehydes, aliphatic cyanides, and mercaptans.
3.2.b	Processing: As a formulation component	P299	Other	U019	Oxidizing/reducing agent	Chemical substances used to alter the valence state of another substance by donating or accepting electrons or by the addition or removal of hydrogen to a substance. Examples of oxidizing agents include nitric acid, perchlorates, hexavalent chromium compounds, and peroxydisulfuric acid salts. Examples of reducing agents

TRI Section	TRI Description	TRI Sub-use Code	TRI Sub-use Code Name	2016 CDR Code	2016 CDR Code Name	2016 CDR Functional Use Definition
						include hydrazine, sodium thiosulfate, and coke produced from coal.
3.2.b	Processing: As a formulation component	P299	Other	U020	Photosensitive chemicals	Chemical substances used for their ability to alter their physical or chemical structure through absorption of light, resulting in the emission of light, dissociation, discoloration, or other chemical reaction. Examples include sensitizers, fluorescents, photovoltaic agents, ultraviolet absorbers, and ultraviolet stabilizers.
3.2.b	Processing: As a formulation component	P299	Other	U027	Propellants and blowing agents	Chemical substances used to dissolve or suspend other substances and either to expel those substances from a container in the form of an aerosol or to impart a cellular structure to plastics, rubber, or thermo set resins. Examples include compressed gasses and liquids and substances which release ammonia, carbon dioxide, or nitrogen.
3.2.b	Processing: As a formulation component	P299	Other	U028	Solid separation agents	Chemical substances used to promote the separation of suspended solids from a liquid. Examples include flotation aids, flocculants, coagulants, dewatering aids, and drainage aids.
3.2.b	Processing: As a formulation component	P299	Other	U999	Other (specify)	
3.2.c	Processing: As an article component			PA	Processing-incorporation into article	Chemical substance becomes an integral component of an article distributed for industrial, trade, or consumer use.
3.2.c	Processing: As an article component			U008	Dyes	Chemical substances used to impart color to other materials or mixtures (*i.e.*, substrates) by penetrating into the surface of the substrate. Examples types include azo, anthraquinone, amino azo, aniline, eosin, stilbene, acid, basic or cationic, reactive, dispersive, and natural dyes.
3.2.c	Processing: As an article component			U009	Fillers	Chemical substances used to provide bulk, increase strength, increase hardness, or improve resistance to impact. Fillers incorporated in a matrix reduce

TRI Section	TRI Description	TRI Sub-use Code	TRI Sub-use Code Name	2016 CDR Code	2016 CDR Code Name	2016 CDR Functional Use Definition
						production costs by minimizing the amount of more expensive substances used in the production of articles. Examples include calcium carbonate, barium sulfate, silicates, clays, zinc oxide and aluminum oxide.
3.2.c	Processing: As an article component			U021	Pigments	Chemical substances used to impart color to other materials or mixtures (*i.e.*, substrates) by attaching themselves to the surface of the substrate through binding or adhesion. This code includes fluorescent agents, luminescent agents, whitening agents, pearlizing agents, and opacifiers. Examples include metallic oxides of iron, titanium, zinc, cobalt, and chromium; metal powder suspensions; lead chromates; vegetable and animal products; and synthetic organic pigments.
3.2.c	Processing: As an article component			U034	Paint additives and coating additives not described by other codes	Chemical substances used in a paint or coating formulation to enhance properties such as water repellence, increased gloss, improved fade resistance, ease of application, foam prevention, etc. Examples of paint additives and coating additives include polyols, amines, vinyl acetate ethylene emulsions, and aliphatic polyisocyanates.
3.2.c	Processing: As an article component			U999	Other (specify)	
3.2.d	Processing: Repackaging			PK	Processing-repackaging	Preparation of a chemical substance for distribution in commerce in a different form, state, or quantity. This includes transferring the chemical substance from a bulk container into smaller containers. This definition does not apply to sites that only relabel or redistribute the reportable chemical substance without removing the chemical substance from the container in which it is received or purchased.
3.2.e	Processing: As an impurity					

TRI Section	TRI Description	TRI Sub-use Code	TRI Sub-use Code Name	2016 CDR Code	2016 CDR Code Name	2016 CDR Functional Use Definition
3.2.f	Processing: Recycling					
3.3.a	Otherwise Use: As a chemical processing aid			U	Use-non incorporative Activities	Chemical substance is otherwise used (*e.g.*, as a chemical processing or manufacturing aid).
3.3.a	Otherwise Use: As a chemical processing aid	Z101	Process Solvents	U029	Solvents (for cleaning or degreasing)	Chemical substances used to dissolve oils, greases, and similar materials from textiles, glassware, metal surfaces, and other articles. Examples include trichloroethylene, perchloroethylene, methylene chloride, liquid carbon dioxide, and n-propyl bromide.
3.3.a	Otherwise Use: As a chemical processing aid	Z102	Catalysts	U020	Photosensitive chemicals	Chemical substances used for their ability to alter their physical or chemical structure through absorption of light, resulting in the emission of light, dissociation, discoloration, or other chemical reaction. Examples include sensitizers, fluorescents, photovoltaic agents, ultraviolet absorbers, and ultraviolet stabilizers.
3.3.a	Otherwise Use: As a chemical processing aid	Z102	Catalysts	U025	Processing aids, specific to petroleum production	Chemical substances added to water-, oil-, or synthetic drilling muds or other petroleum production fluids to control viscosity, foaming, corrosion, alkalinity and pH, microbiological growth, hydrate formation, etc., during the production of oil, gas, and other products from beneath the earth's surface.
3.3.a	Otherwise Use: As a chemical processing aid	Z102	Catalysts	U026	Processing aids, not otherwise listed	Chemical substances used to improve the processing characteristics or the operation of process equipment or to alter or buffer the pH of the substance or mixture, when added to a process or to a substance or mixture to be processed. Processing agents do not become a part of the reaction product and are not intended to affect the function of a substance or article created. Examples include buffers, dehumidifiers, dehydrating agents, sequestering agents, and chelators.

TRI Section	TRI Description	TRI Sub-use Code	TRI Sub-use Code Name	2016 CDR Code	2016 CDR Code Name	2016 CDR Functional Use Definition
3.3.a	Otherwise Use: As a chemical processing aid	Z103	Inhibitors	U024	Process Regulators	Chemical substances used to change the rate of a chemical reaction, start or stop the reaction, or otherwise influence the course of the reaction. Process regulators may be consumed or become part of the reaction product.
3.3.a	Otherwise Use: As a chemical processing aid	Z103	Inhibitors	U025	Processing aids, specific to petroleum production	Chemical substances added to water-, oil-, or synthetic drilling muds or other petroleum production fluids to control viscosity, foaming, corrosion, alkalinity and pH, microbiological growth, hydrate formation, etc., during the production of oil, gas, and other products from beneath the earth's surface.
3.3.a	Otherwise Use: As a chemical processing aid	Z103	Inhibitors	U026	Processing aids, not otherwise listed	Chemical substances used to improve the processing characteristics or the operation of process equipment or to alter or buffer the pH of the substance or mixture, when added to a process or to a substance or mixture to be processed. Processing agents do not become a part of the reaction product and are not intended to affect the function of a substance or article created. Examples include buffers, dehumidifiers, dehydrating agents, sequestering agents, and chelators.
3.3.a	Otherwise Use: As a chemical processing aid	Z104	Initiators	U024	Process Regulators	Chemical substances used to change the rate of a chemical reaction, start or stop the reaction, or otherwise influence the course of the reaction. Process regulators may be consumed or become part of the reaction product.
3.3.a	Otherwise Use: As a chemical processing aid	Z104	Initiators	U025	Processing aids, specific to petroleum production	Chemical substances added to water-, oil-, or synthetic drilling muds or other petroleum production fluids to control viscosity, foaming, corrosion, alkalinity and pH, microbiological growth, hydrate formation, etc., during the production of oil, gas, and other products from beneath the earth's surface.

TRI Section	TRI Description	TRI Sub-use Code	TRI Sub-use Code Name	2016 CDR Code	2016 CDR Code Name	2016 CDR Functional Use Definition
3.3.a	Otherwise Use: As a chemical processing aid	Z104	Initiators	U026	Processing aids, not otherwise listed	Chemical substances used to improve the processing characteristics or the operation of process equipment or to alter or buffer the pH of the substance or mixture, when added to a process or to a substance or mixture to be processed. Processing agents do not become a part of the reaction product and are not intended to affect the function of a substance or article created. Examples include buffers, dehumidifiers, dehydrating agents, sequestering agents, and chelators.
3.3.a	Otherwise Use: As a chemical processing aid	Z105	Reaction Terminators	U024	Process Regulators	Chemical substances used to change the rate of a chemical reaction, start or stop the reaction, or otherwise influence the course of the reaction. Process regulators may be consumed or become part of the reaction product.
3.3.a	Otherwise Use: As a chemical processing aid	Z105	Reaction Terminators	U025	Processing aids, specific to petroleum production	Chemical substances added to water-, oil-, or synthetic drilling muds or other petroleum production fluids to control viscosity, foaming, corrosion, alkalinity and pH, microbiological growth, hydrate formation, etc., during the production of oil, gas, and other products from beneath the earth's surface.
3.3.a	Otherwise Use: As a chemical processing aid	Z105	Reaction Terminators	U026	Processing aids, not otherwise listed	Chemical substances used to improve the processing characteristics or the operation of process equipment or to alter or buffer the pH of the substance or mixture, when added to a process or to a substance or mixture to be processed. Processing agents do not become a part of the reaction product and are not intended to affect the function of a substance or article created. Examples include buffers, dehumidifiers, dehydrating agents, sequestering agents, and chelators.
3.3.a	Otherwise Use: As a chemical processing aid	Z106	Solution Buffers	U026	Processing aids, not otherwise listed	Chemical substances used to improve the processing characteristics or the operation of process equipment or to alter or buffer the pH of the substance or mixture, when added to a process or to a substance or mixture to

TRI Section	TRI Description	TRI Sub-use Code	TRI Sub-use Code Name	2016 CDR Code	2016 CDR Code Name	2016 CDR Functional Use Definition
						be processed. Processing agents do not become a part of the reaction product and are not intended to affect the function of a substance or article created. Examples include buffers, dehumidifiers, dehydrating agents, sequestering agents, and chelators.
3.3.a	Otherwise Use: As a chemical processing aid	Z199	Other	U002	Adhesives and Sealant Chemicals	Chemical substances used to promote bonding between other substances, promote adhesion of surfaces, or prevent seepage of moisture or air. Examples include epoxides, isocyanates, acrylamides, phenol, urea, melamine, and formaldehyde.
3.3.a	Otherwise Use: As a chemical processing aid	Z199	Other	U006	Bleaching agents	Chemical substances used to lighten or whiten a substrate through chemical reaction, usually an oxidative process which degrades the color system. Examples generally fall into one of two groups: chlorine containing bleaching agents (*e.g.*, chlorine, hypochlorites, N-chloro compounds and chlorine dioxide); and, peroxygen bleaching agents (*e.g.*, hydrogen peroxide, potassium permanganate, and sodium perborate).
3.3.a	Otherwise Use: As a chemical processing aid	Z199	Other	U018	Odor agents	Chemical substances used to control odors, remove odors, mask odors, or impart odors. Examples include benzenoids, terpenes and terpenoids, musk chemicals, aliphatic aldehydes, aliphatic cyanides, and mercaptans.
3.3.a	Otherwise Use: As a chemical processing aid	Z199	Other	U023	Plating agents and surface treating agents	Chemical substances applied to metal, plastic, or other surfaces to alter physical or chemical properties of the surface. Examples include metal surface treating agents, strippers, etchants, rust and tarnish removers, and descaling agents.
3.3.a	Otherwise Use: As a chemical processing aid	Z199	Other	U025	Processing aids, specific to petroleum production	Chemical substances added to water-, oil-, or synthetic drilling muds or other petroleum production fluids to control viscosity, foaming, corrosion, alkalinity and pH, microbiological growth, hydrate formation, etc., during the production of oil, gas, and other products from beneath the earth's surface.

TRI Section	TRI Description	TRI Sub-use Code	TRI Sub-use Code Name	2016 CDR Code	2016 CDR Code Name	2016 CDR Functional Use Definition
3.3.a	Otherwise Use: As a chemical processing aid	Z199	Other	U026	Processing aids, not otherwise listed	Chemical substances used to improve the processing characteristics or the operation of process equipment or to alter or buffer the pH of the substance or mixture, when added to a process or to a substance or mixture to be processed. Processing agents do not become a part of the reaction product and are not intended to affect the function of a substance or article created. Examples include buffers, dehumidifiers, dehydrating agents, sequestering agents, and chelators.
3.3.a	Otherwise Use: As a chemical processing aid	Z199	Other	U028	Solid separation agents	Chemical substances used to promote the separation of suspended solids from a liquid. Examples include flotation aids, flocculants, coagulants, dewatering aids, and drainage aids.
3.3.b	Otherwise Use: As a manufacturing aid			U	Use−non incorporative Activities	Chemical substance is otherwise used (*e.g.*, as a chemical processing or manufacturing aid).
3.3.b	Otherwise Use: As a manufacturing aid	Z201	Process Lubricants	U017	Lubricants and lubricant additives	Chemical substances used to reduce friction, heat, or wear between moving parts or adjacent solid surfaces, or that enhance the lubricity of other substances. Examples of lubricants include mineral oils, silicate and phosphate esters, silicone oil, greases, and solid film lubricants such as graphite and PTFE. Examples of lubricant additives include molybdenum disulphide and tungsten disulphide.
3.3.b	Otherwise Use: As a manufacturing aid	Z202	Metalworking Fluids	U007	Corrosion inhibitors and antiscaling agents	Chemical substances used to prevent or retard corrosion or the formation of scale. Examples include phenylenediamine, chromates, nitrates, phosphates, and hydrazine.
3.3.b	Otherwise Use: As a manufacturing aid	Z202	Metalworking Fluids	U014	Functional fluids (open systems)	Liquid or gaseous chemical substances used for one or more operational properties in an open system. Examples include antifreezes and de−icing fluids such as ethylene and propylene glycol, sodium formate, potassium

TRI Section	TRI Description	TRI Sub-use Code	TRI Sub-use Code Name	2016 CDR Code	2016 CDR Code Name	2016 CDR Functional Use Definition
						acetate, and, sodium acetate. This code also includes substances incorporated into metal working fluids.
3.3.b	Otherwise Use: As a manufacturing aid	Z203	Coolants	U013	Functional fluids (closed systems)	Liquid or gaseous chemical substances used for one or more operational properties in a closed system. Examples include: heat transfer agents (*e.g.*, coolants and refrigerants) such as polyalkylene glycols, silicone oils, liquified propane, and carbon dioxide; hydraulic/transmission fluids such as mineral oils, organophosphate esters, silicone, and propylene glycol; and dielectric fluids such as mineral insulating oil and high flash point kerosene. This code does not include fluids used as lubricants.
3.3.b	Otherwise Use: As a manufacturing aid	Z204	Refrigerants	U013	Functional fluids (closed systems)	Liquid or gaseous chemical substances used for one or more operational properties in a closed system. Examples include: heat transfer agents (*e.g.*, coolants and refrigerants) such as polyalkylene glycols, silicone oils, liquified propane, and carbon dioxide; hydraulic/transmission fluids such as mineral oils, organophosphate esters, silicone, and propylene glycol; and dielectric fluids such as mineral insulating oil and high flash point kerosene. This code does not include fluids used as lubricants.
3.3.b	Otherwise Use: As a manufacturing aid	Z205	Hydraulic Fluids	U013	Functional fluids (closed systems)	Liquid or gaseous chemical substances used for one or more operational properties in a closed system. Examples include: heat transfer agents (*e.g.*, coolants and refrigerants) such as polyalkylene glycols, silicone oils, liquified propane, and carbon dioxide; hydraulic/transmission fluids such as mineral oils, organophosphate esters, silicone, and propylene glycol; and dielectric fluids such as mineral insulating oil and high flash point kerosene. This code does not include fluids used as lubricants.

TRI Section	TRI Description	TRI Sub-use Code	TRI Sub-use Code Name	2016 CDR Code	2016 CDR Code Name	2016 CDR Functional Use Definition
3.3.b	Otherwise Use: As a manufacturing aid	Z299	Other	U013	Functional fluids (closed systems)	Liquid or gaseous chemical substances used for one or more operational properties in a closed system. Examples include: heat transfer agents (*e.g.*, coolants and refrigerants) such as polyalkylene glycols, silicone oils, liquified propane, and carbon dioxide; hydraulic/transmission fluids such as mineral oils, organophosphate esters, silicone, and propylene glycol; and dielectric fluids such as mineral insulating oil and high flash point kerosene. This code does not include fluids used as lubricants.
3.3.b	Otherwise Use: As a manufacturing aid	Z299	Other	U023	Plating agents and surface treating agents	Chemical substances applied to metal, plastic, or other surfaces to alter physical or chemical properties of the surface. Examples include metal surface treating agents, strippers, etchants, rust and tarnish removers, and descaling agents.
3.3.c	Otherwise Use: Ancillary or other use			U	Use−non incorporative Activities	Chemical substance is otherwise used (*e.g.*, as a chemical processing or manufacturing aid).
3.3.c	Otherwise Use: Ancillary or other use	Z301	Cleaner	U007	Corrosion inhibitors and antiscaling agents	Chemical substances used to prevent or retard corrosion or the formation of scale. Examples include phenylenediamine, chromates, nitrates, phosphates, and hydrazine.
3.3.c	Otherwise Use: Ancillary or other use	Z301	Cleaner	U029	Solvents (for cleaning or degreasing)	Chemical substances used to dissolve oils, greases, and similar materials from textiles, glassware, metal surfaces, and other articles. Examples include trichloroethylene, perchloroethylene, methylene chloride, liquid carbon dioxide, and n-propyl bromide.
3.3.c	Otherwise Use: Ancillary or other use	Z302	Degreaser	U003	Adsorbents and Absorbents	Chemical substances used to retain other substances by accumulation on their surface or by assimilation. Examples of adsorbents include silica gel, activated alumina, and activated carbon. Examples of absorbents include straw oil, alkaline solutions, and kerosene.

TRI Section	TRI Description	TRI Sub-use Code	TRI Sub-use Code Name	2016 CDR Code	2016 CDR Code Name	2016 CDR Functional Use Definition
3.3.c	Otherwise Use: Ancillary or other use	Z302	Degreaser	U029	Solvents (for cleaning or degreasing)	Chemical substances used to dissolve oils, greases, and similar materials from textiles, glassware, metal surfaces, and other articles. Examples include trichloroethylene, perchloroethylene, methylene chloride, liquid carbon dioxide, and n-propyl bromide.
3.3.c	Otherwise Use: Ancillary or other use	Z303	Lubricant	U017	Lubricants and lubricant additives	Chemical substances used to reduce friction, heat, or wear between moving parts or adjacent solid surfaces, or that enhance the lubricity of other substances. Examples of lubricants include mineral oils, silicate and phosphate esters, silicone oil, greases, and solid film lubricants such as graphite and PTFE. Examples of lubricant additives include molybdenum disulphide and tungsten disulphide.
3.3.c	Otherwise Use: Ancillary or other use	Z304	Fuel	U012	Fuels and fuel additives	Chemical substances used to create mechanical or thermal energy through chemical reactions, or which are added to a fuel for the purpose of controlling the rate of reaction or limiting the production of undesirable combustion products, or which provide other benefits such as corrosion inhibition, lubrication, or detergency. Examples of fuels include coal, oil, gasoline, and various grades of diesel fuel. Examples of fuel additives include oxygenated compound such as ethers and alcohols, antioxidants such as phenylenediamines and hindered phenols, corrosion inhibitors such as carboxylic acids, amines, and amine salts, and blending agents such as ethanol.
3.3.c	Otherwise Use: Ancillary or other use	Z305	Flame Retardant	U011	Flame retardants	Chemical substances used on the surface of or incorporated into combustible materials to reduce or eliminate their tendency to ignite when exposed to heat or a flame for a short period of time. Examples include inorganic salts, chlorinated or brominated organic compounds, and organic phosphates/phosphonates.

TRI Section	TRI Description	TRI Sub-use Code	TRI Sub-use Code Name	2016 CDR Code	2016 CDR Code Name	2016 CDR Functional Use Definition
3.3.c	Otherwise Use: Ancillary or other use	Z306	Waste Treatment	U006	Bleaching agents	Chemical substances used to lighten or whiten a substrate through chemical reaction, usually an oxidative process which degrades the color system. Examples generally fall into one of two groups: chlorine containing bleaching agents (*e.g.,* chlorine, hypochlorites, N-chloro compounds and chlorine dioxide); and peroxygen bleaching agents (*e.g.,* hydrogen peroxide, potassium permanganate, and sodium perborate).
3.3.c	Otherwise Use: Ancillary or other use	Z306	Waste Treatment	U018	Odor agents	Chemical substances used to control odors, remove odors, mask odors, or impart odors. Examples include benzenoids, terpenes and terpenoids, musk chemicals, aliphatic aldehydes, aliphatic cyanides, and mercaptans.
3.3.c	Otherwise Use: Ancillary or other use	Z306	Waste Treatment	U019	Oxidizing/reducing agent	Chemical substances used to alter the valence state of another substance by donating or accepting electrons or by the addition or removal of hydrogen to a substance. Examples of oxidizing agents include nitric acid, perchlorates, hexavalent chromium compounds, and peroxydisulfuric acid salts. Examples of reducing agents include hydrazine, sodium thiosulfate, and coke produced from coal.
3.3.c	Otherwise Use: Ancillary or other use	Z306	Waste Treatment	U028	Solid separation agents	Chemical substances used to promote the separation of suspended solids from a liquid. Examples include flotation aids, flocculants, coagulants, dewatering aids, and drainage aids.
3.3.c	Otherwise Use: Ancillary or other use	Z307	Water Treatment	U006	Bleaching agents	Chemical substances used to lighten or whiten a substrate through chemical reaction, usually an oxidative process which degrades the color system. Examples generally fall into one of two groups: chlorine containing bleaching agents (*e.g.,* chlorine, hypochlorites, N-chloro compounds and chlorine dioxide); and, peroxygen bleaching agents (*e.g.,* hydrogen peroxide, potassium permanganate, and sodium perborate).

TRI Section	TRI Description	TRI Sub-use Code	TRI Sub-use Code Name	2016 CDR Code	2016 CDR Code Name	2016 CDR Functional Use Definition
3.3.c	Otherwise Use: Ancillary or other use	Z307	Water Treatment	U018	Odor agents	Chemical substances used to control odors, remove odors, mask odors, or impart odors. Examples include benzenoids, terpenes and terpenoids, musk chemicals, aliphatic aldehydes, aliphatic cyanides, and mercaptans.
3.3.c	Otherwise Use: Ancillary or other use	Z307	Water Treatment	U019	Oxidizing/reducing agent	Chemical substances used to alter the valence state of another substance by donating or accepting electrons or by the addition or removal of hydrogen to a substance. Examples of oxidizing agents include nitric acid, perchlorates, hexavalent chromium compounds, and peroxydisulfuric acid salts. Examples of reducing agents include hydrazine, sodium thiosulfate, and coke produced from coal.
3.3.c	Otherwise Use: Ancillary or other use	Z307	Water Treatment	U028	Solid separation agents	Chemical substances used to promote the separation of suspended solids from a liquid. Examples include flotation aids, flocculants, coagulants, dewatering aids, and drainage aids.
3.3.c	Otherwise Use: Ancillary or other use	Z308	Construction Materials			
3.3.c	Otherwise Use: Ancillary or other use	Z399	Other	U001	Abrasives	Chemical substances used to wear down or polish surfaces by rubbing against the surface. Examples include sandstones, pumice, silex, quartz, silicates, aluminum oxides, and glass.
3.3.c	Otherwise Use: Ancillary or other use	Z399	Other	U013	Functional fluids (closed systems)	Liquid or gaseous chemical substances used for one or more operational properties in a closed system. Examples include: heat transfer agents (*e.g.*, coolants and refrigerants) such as polyalkylene glycols, silicone oils, liquified propane, and carbon dioxide; hydraulic/transmission fluids such as mineral oils, organophosphate esters, silicone, and propylene glycol; and dielectric fluids such as mineral insulating oil and high flash point kerosene. This code does not include fluids used as lubricants.

TRI Section	TRI Description	TRI Sub-use Code	TRI Sub-use Code Name	2016 CDR Code	2016 CDR Code Name	2016 CDR Functional Use Definition
3.3.c	Otherwise Use: Ancillary or other use	Z399	Other	U014	Functional fluids (open systems)	Liquid or gaseous chemical substances used for one or more operational properties in an open system. Examples include antifreezes and de-icing fluids such as ethylene and propylene glycol, sodium formate, potassium acetate, and, sodium acetate. This code also includes substances incorporated into metal working fluids.
3.3.c	Otherwise Use: Ancillary or other use	Z399	Other	U018	Odor agents	Chemical substances used to control odors, remove odors, mask odors, or impart odors. Examples include benzenoids, terpenes and terpenoids, musk chemicals, aliphatic aldehydes, aliphatic cyanides, and mercaptans.
3.3.c	Otherwise Use: Ancillary or other use	Z399	Other	U020	Photosensitive chemicals	Chemical substances used for their ability to alter their physical or chemical structure through absorption of light, resulting in the emission of light, dissociation, discoloration, or other chemical reaction. Examples include sensitizers, fluorescents, photovoltaic agents, ultraviolet absorbers, and ultraviolet stabilizers.
3.3.c	Otherwise Use: Ancillary or other use	Z399	Other	U023	Plating agents and surface treating agents	Chemical substances applied to metal, plastic, or other surfaces to alter physical or chemical properties of the surface. Examples include metal surface treating agents, strippers, etchants, rust and tarnish removers, and descaling agents.

Appendix D EXPOSURE – PRE-SCREENING ANALYSIS

Pre-screening analysis for the ambient air pathway was completed for both 1-BP and MC in this work. The methodology for this analysis is described in Section 2.1.2.1. All inputs used for all exposure scenarios evaluated are included in Supplemental File *SF_FLA_Air Pathway Input Parameters for IIOAC for 1-BP and MC* (Appendix B). Some of the inputs are further discussed below.

The physical parameters of the source type are pre-defined values within IIOAC and are discussed in the IIOAC users guide (U.S. EPA, 2019c). The only source type parameter that can be varied is the area of a fugitive source. For this work, EPA used 100 m^2 as the area of the fugitive source because even with releases reported to TRI, there was no data available on the actual size of the fugitive source.

Table_Apx D-1. Parameters Used for Point and Fugitive Source Type

Parameter	Stack[a]	Fugitive[b]
Release height (m)	10	3.05
Stack inside diameter (m)	2	N/A
Exit gas velocity (m/s)	5	N/A
Exit gas temperature (K)	300	N/A
Area (m^2)	N/A	100

[a] Length and width were assumed to be 10 meters.
[b] N/A indicates parameter is not applicable for that source type.

Meteorological Stations: IIOAC includes 14 pre-defined climate regions (each with a surface station and upper-air station). As discussed in Section 2.1.2.1, where no TRI data or city location was provided for releases, EPA selected two of the 14 climate regions to represent a central tendency (West North Central) and high-end (South [Coastal]) climate region based on a sensitivity analysis of the average concentration and deposition predictions, using 5 years of meteorological data (2011 through 2015) for all source types. A summary of the average air concentration and particle deposition predictions for all 14 climate regions is provided in Table_Apx D-2.

Table_Apx D-2. Average Air Concentrations and Particle Deposition for 14 IIOAC Climate Regions

Climate Region	Surface Station	Avg. Air Concentration (µg/m^3)	Avg. Particle Deposition (g/m^2)	Air Concentration Rank	Particle Deposition Rank
East North Central	Iowa City, IA	3.71	2.66	3	5
Northeast (Coastal)	Camp Springs, MD	3.48	1.75	7	14
Northeast (Inland)	Pittsburgh, PA	1.85	5.58	14	1
Northwest (Coastal)	Everett, WA	3.60	2.14	4	10
Northwest (Inland)	Idaho Falls, ID	2.88	3.64	12	2

Climate Region	Surface Station	Avg. Air Concentration (µg/m^3)	Avg. Particle Deposition (g/m^2)	Air Concentration Rank	Particle Deposition Rank
South (Inland)	Topeka, KS	3.46	2.09	8	11
South (Coastal)	Lake Charles, LA	4.51	2.19	1	8
Southeast (Coastal)	New River, NC	3.73	2.50	2	6
Southeast (Inland)	Atlanta, GA	3.08	2.36	10	7
Southwest	Grand Junction, CO	3.14	3.24	9	3
West (Coastal)	Point Mugu, CA	3.05	2.03	11	13
West (Inland)	Las Vegas, NV	2.30	2.75	13	4
West North Central	Sioux Falls, SD	3.49	2.16	6	9
Central	Rockford, IL	3.50	2.06	5	12

Release: Release data was extracted from the 2019 TRI data set. EPA extracted the maximum total release reported from all TRI reporting facilities for each chemical. EPA also calculated the arithmetic mean of all reported releases across all TRI reporting facilities for each chemical. These values do not include surrogate facilities or EPA estimated releases but were used to represent the maximum and mean releases for purposes of the pre-screening analysis. These releases are summarized in Table_Apx D-3.

Table_Apx D-3. Maximum and Mean Releases by Chemical for Pre-screening Analysis

Chemical	Number of Days Operating	Maximum Facility Release			Average Facility Release		
		lbs	kg	kg/site-day	lbs	kg	kg/site-day
1-Bromopropane	365	229,135	103,916	285	15,658	7,101	19.46
	260			400			27.31
Methylene Chloride	375	438,116	198,692	544	10,708	4,856	13.30
	260			764			18.68

Exposure Concentrations and Risk Calculations:
All exposure concentrations for 1-BP for all IIOAC model runs for all exposure scenarios are included in Supplemental File *SF_FLA_Air Pathway Pre−Screening Results for 1-BP* (Appendix B). All exposure concentrations for MC for all IIOAC model runs for all exposure scenarios are included in Supplemental File *SF_FLA_Air Pathway Pre−Screening Results for MC* (Appendix B).

IIOAC Model runs provided mean (central tendency) and high-end (defined as the 95th percentile) daily-averaged and annual-averaged outdoor air concentrations in micrograms per cubic meter (µg/m^3) at fenceline (100 meters) and community average (100-1000 meters) distances, for each scenario modeled. Exposure concentrations were converted into ppm using the chemical's molecular weight. The highest daily outdoor air concentrations (in ppm), from all the IIOAC model runs, for fenceline and community average distances, respectively, were used to calculate acute non-cancer risks at various

PODs. The highest annual outdoor air concentrations (in ppm), from all the IIOAC model runs, for fenceline and community average distances, respectively, were used to calculate chronic non-cancer and cancer risks at various PODs. These results are summarized in Table_Apx D-4. For both 1-BP and MC, the highest daily and annual average outdoor air concentrations occurred for the following exposure scenario: Fugitive emissions in a rural setting using the high end meteorological station (South Coastal) with the maximum release and 365 days of operation (24/7).

Risk Findings:

Risk Calculations using the highest daily and annual outdoor air concentrations for 1-BP are included in Supplemental File *SF_FLA_Air Pathway Pre−Screening Results for 1-BP* (Appendix B). Risk calculations using the highest daily and annual outdoor air concentrations for MC are included in Supplemental File *SF_FLA_Air Pathway Pre−Screening Analysis Results for MC* (Appendix B).

Based on the data provided in Table_Apx D-4, acute and chronic non-cancer risks were found at the fenceline distance of 100 meters for 1-BP for the high-end and central tendency exposure concentrations. Additionally, cancer risks were found at both fenceline and community average distances for 1-BP for both the high-end and central tendency exposure concentrations. Neither acute nor chronic non-cancer risks were found for MC. Cancer risk was found at the fenceline distance of 100 meters for MC for the high-end exposure concentration only.

Based on the data provided in Table_Apx D-4, acute and chronic non-cancer risks were found at the fenceline distance of 100 meters for 1-BP for the high-end exposure concentration only. Additionally, cancer risks were found at both fenceline and community average distances for both the high-end and central tendency exposure concentrations. Non-cancer risks were not found for MC although cancer risks were found at the fenceline distance of 100 meters for the high-end exposure concentration only. Based on the results above, we found risks for each of the two chemicals evaluated (1-BP and MC), and therefore EPA has initiated a full screening level analysis.

Table_Apx D-4. Exposure Concentrations and Risk Calculations

Chemical	IIOAC Outputs (Statistics)	Concentration (ppm)				Risks (Inhalation)					
		Fenceline		Community Average		Non-cancer [a b c d]				Cancer [e f]	
						Acute		Chronic			
		Daily	Annual	Daily	Annual	Fenceline	Community Average	Fenceline	Community Average	Fenceline	Community Average
1-BP	HE	9.71E−02	9.71E−02	1.13E−02	1.13E−02	62	531	62	531	5.83E−04	6.78E−05
	CT	8.90E−02	8.90E−02	1.01E−01	1.01E−01	67	597	67	597	5.34E−04	6.03E−05
MC	HE	2.68E−06	2.68E−01	3.12E−02	3.12E−02	648	5569	64	551	1.56E−06	1.81E−07
	CT	6.56E−03	6.56E−03	7.64E−04	7.64E−04	26,507	227,786	2,620	2,2517	3.81E−08	4.43E−09

[a] Used Benchmark MOE of 100 for acute and chronic risks for 1-BP

[b] Used Benchmark MOE of 30 and 10 for acute and chronic risks, respectively, for MC

[c] Used End Points (Post-Implantation Loss (F0)) of 6 (per ppm) for acute and chronic risks for 1-BP

[d] Used End Points of 174 (Decreased Visual Performance) and 17.2 (Vacuolization and Cell Foci) (per ppm) for acute and chronic risks, respectively, for MC

[e] Used Benchmark MOE of 1.00E−06 for cancer risk

[f] Used End Points 5.00E−03 (liver) for 1-BP and 5.80E−06 (lung and liver tumors) for MC

Appendix E 1-BP, MC, AND NMP RISK EVALUATION COU TO OES MAPPING

Table_Apx E-1, Table_Apx E-2, and Table_Apx E-3 contain a mapping of the conditions of use (COU) to occupational exposure scenarios (OES) from the 1-BP, MC, and NMP Risk Evaluations, respectively (U.S. EPA, 2020b, c, d). EPA used the OES from the Risk Evaluations, as they are summarized in these tables, for the release estimates in Sections 3.1.3, 3.2.3, and 3.3.3.

Table_Apx E-1. 1-BP Risk Evaluation Conditions of Use to OES Mapping

Conditions of Use from the 1-BP Risk Evaluation[a]			Occupational Exposure Scenario (OES) from the 1-BP Risk Evaluation[a]
Life Cycle Stage	**Category**	**Subcategory**	
Manufacture	Domestic manufacture	Domestic manufacture	Manufacture
	Import	Import	Import
Processing	Processing as a reactant	Intermediate in all other basic inorganic chemical manufacturing, all other basic organic chemical manufacturing, and pesticide, fertilizer and other agricultural chemical manufacturing	Processing as a Reactant
	Processing – incorporating into formulation, mixture or reaction product	Solvents for cleaning or degreasing in manufacturing of: • all other chemical product and preparation • computer and electronic product • electrical equipment, appliance and component • soap, cleaning compound and toilet preparation • services	Processing – Incorporation into Formulation, Mixture, or Reaction Product
	Processing – incorporating into articles	Solvents (which become part of product formulation or mixture) in construction	Processing – Incorporation into Articles
Processing	Repackaging	Solvent for cleaning or degreasing in all other basic organic chemical	Repackaging
	Recycling	Recycling	Disposal and Recycling
Distribution in commerce	Distribution	Distribution	Not assessed as a separate operation; exposures/releases from distribution are

Conditions of Use from the 1-BP Risk Evaluation[a]			Occupational Exposure Scenario (OES) from the 1-BP Risk Evaluation[a]
Life Cycle Stage	**Category**	**Subcategory**	
			considered within each condition of use.
Industrial/ commercial use	Solvent (for cleaning or degreasing)	Batch vapor degreaser (*e.g.*, open-top, closed-loop)	Batch Vapor Degreaser (Open-Top) Batch Vapor Degreaser (Closed-Loop)
		In-line vapor degreaser (*e.g.*, conveyorized, web cleaner)	In-line Vapor Degreaser
		Cold cleaner	Cold Cleaner
		Aerosol spray degreaser/cleaner	Aerosol Spray Degreaser/Cleaner
	Adhesives and sealants	Adhesive chemicals - spray adhesive for foam cushion manufacturing and other uses	Adhesive Chemicals (Spray Adhesives)
Industrial/ commercial use Industrial/ commercial use	Cleaning and furniture care products	Dry cleaning solvent	Dry Cleaning
		Spot cleaner, stain remover	Spot Cleaner, Stain Remover
		Liquid cleaner (*e.g.*, coin and scissor cleaner)	Other Uses
		Liquid spray/aerosol cleaner	Other Uses
	Other uses	Arts, crafts and hobby materials – adhesive accelerant	Other Uses
		Automotive care products – engine degreaser, brake cleaner	Aerosol Spray Degreaser/Cleaner
		Anti-adhesive agents – mold cleaning and release product	Other Uses
		Building/construction materials not covered elsewhere – insulation	THERMAX Installation
		Electronic and electronic products and metal products	Other Uses
		Functional fluids (closed systems) – refrigerant	Other Uses
		Functional fluids (open system) – cutting oils	Other Uses
		Other – asphalt extraction	Other Uses

Conditions of Use from the 1-BP Risk Evaluation[a]				Occupational Exposure Scenario (OES) from the 1-BP Risk Evaluation[a]
Life Cycle Stage	Category		Subcategory	
		Other – laboratory chemicals	Other Uses	
		Temperature indicator – coatings	Other Uses	
Disposal (Manufacturing, Processing, Use)	Disposal		Municipal waste incinerator	Disposal, Recycling
			Off-site waste transfer	
[a] This table is based on Table 2-2 of the 2020 1-Bromopane Risk Evaluation (U.S. EPA, 2020b).				

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Table_Apx E-2. MC Risk Evaluation Conditions of Use to OES Mapping

Conditions of Use from the MC Risk Evaluation[a]			Occupational Exposure Scenario (OES) from the MC Risk Evaluation Category[a]
Life Cycle Stage	**Category**	**Life Cycle Stage**	
Manufacturing	Domestic manufacturing	Manufacturing	Manufacturing
	Import	Import	Repackaging
Processing	Processing as a reactant	Intermediate in industrial gas manufacturing (*e.g.*, manufacture of fluorinated gases used as refrigerants)	Processing as a Reactant
		Intermediate for pesticide, fertilizer, and other agricultural chemical manufacturing	
		CBI function for petrochemical manufacturing	
		Intermediate for other chemicals	
	Incorporated into formulation, mixture, or reaction product	Solvents (for cleaning or degreasing), including manufacturing of: • All other basic organic chemical • Soap, cleaning compound and toilet preparation	Processing – Incorporation into Formulation, Mixture, or Reaction Product
		Solvents (which become part of product formulation or mixture), including manufacturing of: • All other chemical product and preparation • Paints and coatings	

Conditions of Use from the MC Risk Evaluation[a]			Occupational Exposure Scenario (OES) from the MC Risk Evaluation Category[a]
Life Cycle Stage	**Category**	**Life Cycle Stage**	
Processing		Propellants and blowing agents for all other chemical product and preparation manufacturing	Processing – Incorporation into Formulation, Mixture, or Reaction Product
		Propellants and blowing agents for plastics product manufacturing	
		Paint additives and coating additives not described by other codes for CBI industrial sector	
		Laboratory chemicals for all other chemical product and preparation manufacturing	
		Laboratory chemicals for CBI industrial sectors	
		Processing aid, not otherwise listed for petrochemical manufacturing	
		Adhesive and sealant chemicals in adhesive manufacturing	
		Unknown function for oil and gas drilling, extraction, and support activities	
	Repackaging	Solvents (which become part of product formulation or mixture) for all other chemical product and preparation manufacturing	Repackaging
		CBI functions for all other chemical product	

Conditions of Use from the MC Risk Evaluation[a]			Occupational Exposure Scenario (OES) from the MC Risk Evaluation Category[a]
Life Cycle Stage	**Category**	**Life Cycle Stage**	
		and preparation manufacturing	
	Recycling	Recycling	Waste Handling, Disposal, Treatment, and Recycling
Distribution in commerce	Distribution	Distribution	Repackaging
Industrial, commercial and consumer uses	Solvents (for cleaning or degreasing)	Batch vapor degreaser (*e.g.*, open-top, closed-loop)	Batch Open-Top Vapor Degreasing
		In-line vapor degreaser (*e.g.*, conveyorized, web cleaner)	Conveyorized Vapor Degreasing
		Cold cleaner	Cold Cleaning
		Aerosol spray degreaser/cleaner	Commercial Aerosol Products (Aerosol Degreasing, Aerosol Lubricants, Automotive Care Products)
	Adhesives and sealants Paints and coatings including paint and coating removers	Single component glues and adhesives and sealants and caulks	Adhesives and Sealants
		Paints and coatings use	Paints and Coatings
		Adhesive/caulk removers	Adhesive and Caulk Removers
		Paints and coating removers, including furniture refinishers	Paint Remover
Industrial, commercial and consumer uses Industrial, commercial and consumer uses	Metal products not covered elsewhere	Degreasers – aerosol and non-aerosol degreasers and cleaners *e.g.*, coil cleaners	Commercial Aerosol Products (Aerosol Degreasing, Aerosol Lubricants, Automotive Care Products) Miscellaneous Non-aerosol Industrial and Commercial Uses
	Fabric, textile, and leather products not covered elsewhere	Textile finishing and impregnating/ surface treatment products *e.g.*, water repellant	Fabric Finishing
	Automotive care products	Function fluids for air conditioners: refrigerant, treatment, leak sealer	Miscellaneous Non-aerosol Industrial and Commercial Uses

Conditions of Use from the MC Risk Evaluation[a]			Occupational Exposure Scenario (OES) from the MC Risk Evaluation Category[a]
Life Cycle Stage	Category	Life Cycle Stage	
Industrial, commercial and consumer uses Industrial, commercial and consumer uses		Interior car care – spot remover	Commercial Aerosol Products (Aerosol Degreasing, Aerosol Lubricants, Automotive Care Products)
	Automotive care products	Degreasers: gasket remover, transmission cleaners, carburetor cleaner, brake quieter/cleaner	Commercial Aerosol Products (Aerosol Degreasing, Aerosol Lubricants, Automotive Care Products)
	Apparel and footwear care products	Post-market waxes and polishes applied to footwear *e.g.*, shoe polish	Commercial Aerosol Products (Aerosol Degreasing, Aerosol Lubricants, Automotive Care Products)
	Laundry and dishwashing products	Spot remover for apparel and textiles	Spot Cleaning
	Lubricants and greases	Liquid and spray lubricants and greases	Commercial Aerosol Products (Aerosol Degreasing, Aerosol Lubricants, Automotive Care Products) Miscellaneous Non-aerosol Industrial and Commercial Uses
		Degreasers – aerosol and non-aerosol degreasers and cleaners	
	Building/ construction materials not covered elsewhere	Cold pipe insulation	Commercial Aerosol Products (Aerosol Degreasing, Aerosol Lubricants, Automotive Care Products)
	Solvents (which become part of product formulation or mixture)	All other chemical product and preparation manufacturing	Processing – Incorporation into Formulation, Mixture, or Reaction Product
	Processing aid not otherwise listed	In multiple manufacturing sectors	Cellulose Triacetate Film Production
	Propellants and blowing agents	Flexible polyurethane foam manufacturing	Flexible Polyurethane Foam Manufacturing
	Arts, crafts, and hobby materials	Crafting glue and cement/concrete	Adhesives and Sealants

Conditions of Use from the MC Risk Evaluation[a]			Occupational Exposure Scenario (OES) from the MC Risk Evaluation Category[a]
Life Cycle Stage	**Category**	**Life Cycle Stage**	
	Other Uses	Laboratory chemicals – all other chemical product and preparation manufacturing	Laboratory Use
		Electrical equipment, appliance, and component manufacturing	Miscellaneous Non-aerosol Industrial and Commercial Uses
		Plastic and rubber products	Plastic Product Manufacturing
		Anti-adhesive agent – anti-spatter welding aerosol	Commercial Aerosol Products (Aerosol Degreasing, Aerosol Lubricants, Automotive Care Products)
		Oil and gas drilling, extraction, and support activities	Miscellaneous Non-aerosol Industrial and Commercial Uses
		Toys, playground, and sporting equipment – including novelty articles (toys, gifts, etc.)	Miscellaneous Non-aerosol Industrial and Commercial Uses
		Carbon remover, lithographic printing cleaner, wood floor cleaner, brush cleaner	Lithographic Printing Plate Cleaning
Disposal	Disposal	Industrial pre-treatment	Waste Handling, Disposal, Treatment, and Recycling
		Industrial wastewater treatment	
		Publicly owned treatment works (POTW)	
		Underground injection	
		Municipal landfill	
		Hazardous landfill	
		Other land disposal	
		Municipal waste incinerator	

Conditions of Use from the MC Risk Evaluation[a]			Occupational Exposure Scenario (OES) from the MC Risk Evaluation Category[a]
Life Cycle Stage	**Category**	**Life Cycle Stage**	
		Hazardous waste incinerator	
		Off-site waste transfer	

[a] This table is based on Table 2-22 of the 2020 Methylene Chloride Risk Evaluation (U.S. EPA, 2020c).

1 **Table_Apx E-3. NMP Risk Evaluation Conditions of Use to OES Mapping**

Conditions of Use from the NMP Risk Evaluation[a]			Occupational Exposure Scenario (OES) from the NMP Risk Evaluation Category[a]
Life Cycle Stage	**Category**	**Subcategory**	
Manufacturing	Domestic Manufacture	Domestic Manufacture	Manufacturing
	Import	Import	Repackaging
Processing	Processing as a reactant or intermediate	Intermediate in Plastic Material and Resin Manufacturing	Chemical Processing, Excluding Formulation
		Other Non-incorporative Processing	
	Incorporated into formulation, mixture, or reaction product	Adhesives and sealant chemicals in Adhesive Manufacturing	Incorporation into Formulation, Mixture, or Reaction Product
		Anti-adhesive agents in Printing and Related Support Activities	Incorporation into Formulation, Mixture, or Reaction Product
		Paint additives and coating additives not described by other codes in Paint and Coating Manufacturing; and Print Ink Manufacturing	Incorporation into Formulation, Mixture, or Reaction Product
		Processing aids not otherwise listed in Plastic Material and Resin Manufacturing	Incorporation into Formulation, Mixture, or Reaction Product
		Solvents (for cleaning or degreasing) in Non-metallic Mineral Product Manufacturing; Machinery Manufacturing; Plastic Material and Resin Manufacturing; Primary Metal Manufacturing; Soap, Cleaning Compound and Toilet Preparation Manufacturing; Transportation Equipment Manufacturing; All Other Chemical Product and Preparation Manufacturing; Printing and Related Support Activities; Services; Wholesale and Retail Trade	Incorporation into Formulation, Mixture, or Reaction Product
		Surface active agents in Soap, Cleaning Compound and Toilet Preparation Manufacturing	Incorporation into Formulation, Mixture, or Reaction Product
		Plating agents and surface treating agents in Fabricated Metal Product Manufacturing	Incorporation into Formulation, Mixture, or Reaction Product

Conditions of Use from the NMP Risk Evaluation[a]			Occupational Exposure Scenario (OES) from the NMP Risk Evaluation Category[a]
Life Cycle Stage	**Category**	**Subcategory**	
Processing		Solvents (which become part of product formulation or mixture) in Electrical Equipment, Appliance and Component Manufacturing; Other Manufacturing; Paint and Coating Manufacturing; Print Ink Manufacturing; Soap, Cleaning Compound and Toilet Preparation Manufacturing; Transportation Equipment Manufacturing; All Other Chemical Product and Preparation Manufacturing; Printing and Related Support Activities; Wholesale and Retail Trade	Incorporation into Formulation, Mixture, or Reaction Product
		Other uses in Oil and Gas Drilling, Extraction and Support Activities; Plastic Material and Resin Manufacturing; Services	Incorporation into Formulation, Mixture, or Reaction Product
	Incorporation into articles	Lubricants and lubricant additives in Machinery Manufacturing	Metal Finishing
		Paint additives and coating additives not described by other codes in Transportation Equipment Manufacturing	Application of Paints, Coatings, Adhesives, and Sealants
		Solvents (which become part of product formulation or mixture), including in Textiles, Apparel and Leather Manufacturing	Incorporation into Formulation, Mixture, or Reaction Product
		Other, including in Plastic Product Manufacturing	Chemical Processing, Excluding Formulation
	Repackaging	Wholesale and Retail Trade	Repackaging
	Recycling	Recycling	Recycling and Disposal
Distribution in Commerce	Distribution	Distribution in Commerce	Repackaging
	Paints and coatings	Paint and coating removers	Removal of Paints, Coatings, Adhesives, and Sealants
		Adhesive removers	Removal of Paints, Coatings, Adhesives, and Sealants

Conditions of Use from the NMP Risk Evaluation[a]			Occupational Exposure Scenario (OES) from the NMP Risk Evaluation Category[a]
Life Cycle Stage	**Category**	**Subcategory**	
Industrial/ Commercial Use		Lacquers, stains, varnishes, primers and floor finishes	Application of Paints, Coatings, Adhesives, and Sealants
		Powder coatings (surface preparation)	Application of Paints, Coatings, Adhesives, and Sealants
	Paint additives and coating additives not described by other codes	Use in Computer and Electronic Product Manufacturing in Electronic Parts Manufacturing	Other Electronics Manufacturing
		Use in Computer and Electronic Product Manufacturing for Use in Semiconductor Manufacturing	Semiconductor Manufacturing
		Use in Construction, Fabricated Metal Product Manufacturing, Machinery Manufacturing, Other Manufacturing, Paint and Coating Manufacturing, Primary Metal Manufacturing, Transportation Equipment Manufacturing, Wholesale and Retail Trade	Application of Paints, Coatings, Adhesives, and Sealants
	Solvents (for cleaning or degreasing)	Use in Electrical Equipment, Appliance and Component Manufacturing	Other Electronics Manufacturing
		Use in Electrical Equipment, Appliance and Component Manufacturing for Use in Semiconductor Manufacturing	Semiconductor Manufacturing
	Ink, toner, and colorant products	Printer ink	Printing and Writing
		Inks in writing equipment	Printing and Writing
	Processing aids, specific to petroleum production	Petrochemical Manufacturing	Chemical Processing, Excluding Formulation
	Other uses	Other uses in Oil and Gas Drilling, Extraction and Support Activities	Chemical Processing, Excluding Formulation
		Functional Fluids (closed systems)	Chemical Processing, Excluding Formulation
	Adhesives and sealants	Adhesives and sealant chemicals including binding agents	Application of Paints, Coatings, Adhesives, and Sealants

Conditions of Use from the NMP Risk Evaluation[a]			Occupational Exposure Scenario (OES) from the NMP Risk Evaluation Category[a]
Life Cycle Stage	**Category**	**Subcategory**	
Industrial/ Commercial Use		Single component glues and adhesives, including lubricant adhesives	Application of Paints, Coatings, Adhesives, and Sealants
		Two-component glues and adhesives, including some resins	Application of Paints, Coatings, Adhesives, and Sealants
	Other uses	Soldering materials	Soldering
		Anti-freeze and de-icing products	Commercial Automotive Serving
		Automotive care products	Commercial Automotive Serving
		Lubricants and greases	Commercial Automotive Serving
		Metal products not covered elsewhere	Metal Finishing
		Lubricant and lubricant additives, including hydrophilic coatings	Metal Finishing
		Laboratory chemicals	Laboratory Use
		Lithium ion battery manufacturing	Lithium Ion Cell Manufacturing c
		Cleaning and furniture care products, including wood cleaners, gasket removers	Cleaning
		Fertilizer and other agricultural chemical manufacturing – processing aids and solvents	Fertilizer Application
Disposal	Disposal	Industrial pre-treatment	Recycling and Disposal
		Industrial wastewater treatment	Recycling and Disposal
		Publicly owned treatment works (POTW)	Recycling and Disposal
		Underground injection	Recycling and Disposal
		Landfill (municipal, hazardous, or other land disposal)	Recycling and Disposal
		Emissions to air	Recycling and Disposal
		Incinerators (municipal and hazardous waste)	Recycling and Disposal

[a] This table is based on Table 2-2 of the 2020 n-Methylpyrrolidone Risk Evaluation (U.S. EPA, 2020d).