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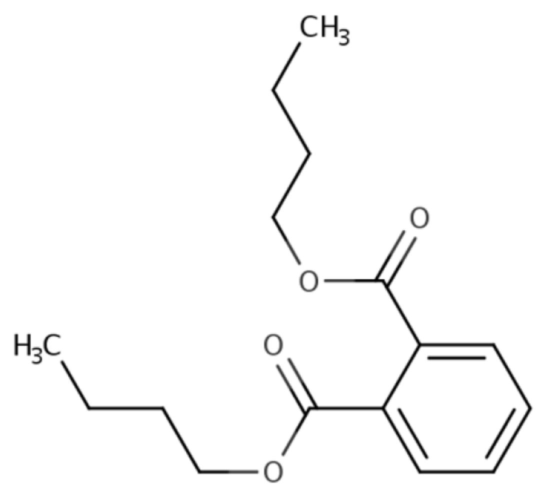
Environmental Protection Agency

Draft Risk Evaluation for Dibutyl Phthalate (DBP)

CASRN 84-74-2



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Docket

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Disclaimer

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EXECUTIVE SUMMARY

Background

EPA has evaluated the health and environmental risks of the chemical dibutyl phthalate (DBP) under the Toxic Substances Control Act (TSCA). In this draft risk evaluation, EPA is preliminarily determining that DBP presents an unreasonable risk of injury to human health based on identified risk to workers from 20 conditions of use (COUs) and risk to consumers from 4 COUs, and that DBP presents an unreasonable risk to the environment from 1 COU. After considering the risks posed under the COUs, EPA did not identify a risk of injury to human health or the environment from the other 19 COUs that would drive the unreasonable risk determination for DBP.

After this draft risk evaluation is informed by public comment and independent, expert peer review, EPA will issue a final risk evaluation that includes its determination as to whether DBP presents unreasonable risk to human health or the environment based on identified risk of injury from COUs.

DBP is primarily used as a plasticizer in polyvinyl chloride (PVC) in consumer, commercial, and industrial applications—although it is also used in adhesives, sealants, paints, coatings, rubbers, and non-PVC plastics, as well as for other applications. Workers may be exposed to DBP when making these products or otherwise using DBP in the workplace (Section 4.1.1). When it is manufactured or used to make products, DBP can be released into water (Section 3.3.1.1) where because of its properties most will end up in the sediment at the bottom of lakes and rivers. If released into the air (Section 3.3.1.2), DBP will attach to dust particles and be deposited on land or into water. Indoors, DBP has the potential over time to be released from products and adhere to dust particles (Section 4.1.2). If it does, people could inhale or ingest dust that contains DBP.

Laboratory animal studies have been conducted to study DBP to determine whether it causes a range of non-cancer and cancer health effects on people. After reviewing the available studies, the Agency concludes that there is robust evidence that DBP causes developmental toxicity (a non-cancer human health hazard; Section 4.2.2). The most sensitive adverse developmental effects include effects on the developing male reproductive system consistent with a disruption of androgen action—known as *phthalate syndrome*—which results from decreased fetal testicular testosterone.

EPA is including DBP for cumulative risk assessment (CRA; Section 4.4) along with five other phthalate chemicals that also cause effects on laboratory animals consistent with phthalate syndrome (U.S. EPA, 2023d). Notably, assessments by Health Canada, U.S. Consumer Product Safety Commission (U.S. CPSC), European Chemicals Agency (ECHA), and the Australian National Industrial Chemicals Notification and Assessment Scheme (NICNAS) have reached similar conclusions regarding the developmental effects of DBP. They have also conducted CRAs of phthalates based on these chemicals' shared ability to cause phthalate syndrome. Furthermore, independent, expert peer reviewers endorsed EPA's proposal to conduct a CRA of phthalates under TSCA during the May 2023 meeting of the Science Advisory Committee on Chemicals (SACC) because humans are co-exposed to multiple toxicologically similar phthalates that cause effects on the developing male reproductive system consistent with a disruption of androgen action and phthalate syndrome. In this draft risk evaluation, the Agency has evaluated cumulative exposure to phthalates using human biomonitoring data. Note that these cumulative phthalate exposures cannot be attributed to specific COUs or other sources. This non-attributable cumulative exposure and risk, representing the national population, was taken into consideration by EPA in its draft risk evaluation for DBP. By taking into account cumulative risk as other authoritative bodies have done, EPA is confident that it is not underestimating the risk of DBP (Section 4.4).

In December 2019, EPA designated DBP as a high-priority substance for TSCA risk evaluation and in August 2020 released the *Final Scope of the Risk Evaluation for Dibutyl Phthalate (1,2-benzenedicarboxylic acid, 1,2-dibutyl ester); CASRN 84-74-2* (U.S. EPA, 2020c). This draft risk evaluation assesses human health risk to workers, including occupational non-users (ONUs); consumers, including bystanders; and the general population exposed to environmental releases. It also assesses risk to the environment. Manufacturers report DBP production volumes through the Chemical Data Reporting (CDR) rule under the associated CAS Registry Number (CASRN) 84-74-2. The production volume for DBP between 2016 and 2019 was between 1 to 10 million pounds (lb) based on the 2020 CDR data (U.S. EPA, 2020b). EPA describes production volumes as a range to protect confidential business information. The Agency has evaluated DBP across its TSCA COUs, ranging from manufacture to disposal.

Past assessments of DBP from other government agencies that addressed a broad range of uses, which may have included TSCA and non-TSCA uses, have concluded that DBP can pose risk to human health based on its concentration in products and the environment. Notably, both the U.S. CPSC's and Health Canada's risk assessments included consideration of exposure from children's products as well as from other sources such as personal care products, diet, consumer products, and the environment. However, these past assessments did not specifically consider exposure to workers. In the United States, Canada, and the European Union, the weight fraction of DBP that can be incorporated into children's toys and child care products is limited by regulation (see Appendix B for an overview of existing national and international regulations on DBP). Limits on worker exposure to DBP exist in the United States, Canada, the European Union, Australia, and elsewhere. Additional international regulatory restrictions and labeling requirements for the use of DBP exist.

In this draft risk evaluation, EPA evaluated risks resulting from exposure to DBP from facilities that manufacture, process, distribute, use or dispose of DBP under industrial and/or commercial COUs subject to TSCA as well as consumer COUs relating to the products resulting from such manufacture and processing. Human or environmental exposure to DBP through uses that are not subject to TSCA (*e.g.,* use in cosmetics, medical devices, food additives) were not specifically evaluated by the Agency in reaching its preliminary determination. This is because these uses are excluded from TSCA's definition of a chemical substance. Thus, conclusions from this evaluation cannot be extrapolated to form conclusions about uses of DBP that are not subject to TSCA and that EPA did not evaluate.

Determining Unreasonable Risk to Human Health

EPA's TSCA existing chemical risk evaluations must determine whether a chemical substance does or does not present unreasonable risk to human health or the environment from its COUs. The unreasonable risk must be informed by the best available science. The Agency, in determining whether DBP presents unreasonable risk to human health, considers risk-related factors as described in its 2024 risk evaluation framework rule. Risk-related factors include but are not limited to the type of health effect under consideration; the reversibility of the health effect being evaluated; exposure-related considerations (*e.g.,* duration, magnitude, frequency of exposure); population exposed (including any potentially exposed or susceptible subpopulations); and EPA's confidence in the information used to inform the hazard and exposure values. If an estimate of risk for a specific scenario exceeds the standard risk benchmarks, then the formal determination of whether those risks significantly contribute to the unreasonable risk of DBP under TSCA must be both case-by-case and context-driven.

EPA evaluated the risks to people from being exposed to DBP at work, indoors, and outdoors. Risks were characterized for occupational and consumer exposures to DBP alone as well as in combination with the measured cumulative phthalate exposure that is experienced by the U.S. population and that cannot be attributed to a specific use. In its human health evaluation, the Agency used a combination of screening level and more refined approaches to assess how people might be exposed to DBP through breathing or ingesting dust or other particulates, as well as through skin contact. EPA has also authored a draft cumulative risk technical support document including DBP and five other phthalate chemicals that all cause the same health effect—phthalate syndrome (U.S. EPA, 2024k). The CRA takes into consideration differences in the ability of each phthalate to cause effects on the developing male reproductive system. Use of this "relative potency" across all the phthalates EPA is reviewing that cause phthalate syndrome provides a more robust risk assessment of DBP as well as a common basis for adding risk across the six phthalates included in the cumulative assessment.

In determining whether DBP presents an unreasonable risk of injury to human health, EPA considered the following potentially exposed and susceptible subpopulations (PESS) in its assessment: females of reproductive age; pregnant women; infants; children and adolescents; people who frequently use consumer products and/or articles containing high concentrations of DBP; people exposed to DBP in the workplace; people in proximity to releasing facilities, including fenceline communities; and Tribes and subsistence fishers whose diets include large amounts of fish. These subpopulations are PESS because some have greater exposure to DBP per body weight (*e.g.*, infants, children, adolescents) while others may experience exposure from multiple sources or higher exposures than others.

EPA weighed the scientific evidence in order to determine confidence levels in underlying data sets and risk estimates for human health (see Section 4.3). For the general population, the Agency has robust confidence the risk estimates calculated were conservative and appropriate for a screening level analysis. For workers, EPA has moderate to robust confidence in the risk estimates calculated for inhalation and dermal exposure scenarios and has robust confidence that dermal exposure scenarios represent a conservative upper bound on exposure. For consumers, the Agency has moderate to robust confidence in the risk estimates calculated for inhalation, ingestion, and dermal exposure scenarios and has robust confidence that dermal exposure scenarios represent a conservative upper bound on exposure.

Determining Unreasonable Risk to The Environment

In determining whether DBP presents an unreasonable risk of injury to the environment, EPA considered the following groups of organisms in its assessment: aquatic vertebrates, aquatic invertebrates, benthic invertebrates, aquatic plants and algae, terrestrial mammals, soil invertebrates, and terrestrial plants. The Agency weighed the scientific evidence in order to determine confidence levels in underlying data sets and risk estimates for the environment (see Section 5.3.4). EPA has slight to robust confidence in its environmental data and risk estimates depending on the source of environmental release information for each COU (see Section 5.3.4).

EPA has preliminarily determined that DBP presents unreasonable risk of injury to the environment based on one COU, Disposal, due to chronic exposure to aquatic vertebrates. These findings are based on wastewater release from treatment plants and is inclusive of wastewater treatment removal of DBP. EPA has robust confidence in the exposure data underlying environmental releases to water for the Disposal COU, as they are based on reported data at plant outfalls from the Discharge Monitoring Report (DMR) database (see Section 3.2). Furthermore, EPA has robust confidence in the hazard data underlying environmental toxicity estimates from DBP exposure in aquatic vertebrates as they are based on high quality toxicity studies (see Section 5.2). EPA has robust overall confidence in the environmental risk characterization for the Disposal COU, and EPA is preliminarily determining that the Disposal COU may contribute significantly to unreasonable risk to the environment for DBP due to chronic exposures to aquatic vertebrates from wastewater discharge.

Summary, Considerations, and Next Steps

EPA has preliminarily determined that the following 24 COUs may significantly contribute to unreasonable risk to human health:

- Manufacturing – domestic manufacturing (dermal and inhalation)
- Manufacturing – importing (dermal and inhalation)
- Processing – processing as a reactant – intermediate in plastic manufacturing (dermal and inhalation)
- Processing – incorporation into formulation, mixture, or reaction product – solvents (which become part of product formulation or mixture) in chemical product and preparation manufacturing; soap, cleaning compound, and toilet preparation manufacturing; adhesive manufacturing; and printing ink manufacturing (dermal and inhalation)
- Processing – incorporation into formulation, mixture, or reaction product – pre-catalyst manufacturing (dermal and inhalation)
- Processing – incorporation into formulation, mixture, or reaction product – plasticizer in paint and coating manufacturing; plastic material and resin manufacturing; rubber manufacturing; soap, cleaning compound, and toilet preparation manufacturing; textiles, apparel, and leather manufacturing; printing ink manufacturing; basic organic chemical manufacturing; and adhesive and sealant manufacturing (dermal)
- Processing – incorporation into article – plasticizer in adhesive and sealant manufacturing; building and construction materials manufacturing; furniture and related product manufacturing; ceramic powders; plastics product manufacturing; and rubber product manufacturing (dermal)
- Processing – repackaging – laboratory chemicals in wholesale and retail trade; plasticizers in wholesale and retail trade; and plastics material and resin manufacturing (dermal and inhalation)
- Industrial use – non-incorporative activities – solvent, including in maleic anhydride manufacturing technology (dermal and inhalation)
- Industrial use – construction, paint, electrical, and metal products – adhesives and sealants (dermal)
- Industrial use – construction, paint, electrical, and metal products – paints and coatings (dermal and inhalation)
- Industrial use – other uses – lubricants and lubricant additives (dermal)
- Commercial use – automotive, fuel, agriculture, outdoor use products – automotive care products (dermal)
- Commercial use – construction, paint, electrical, and metal products – adhesives and sealants (dermal)
- Commercial use – construction, paint, electrical, and metal products – paints and coatings (dermal and inhalation)
- Commercial use – furnishing, cleaning, treatment care products – cleaning and furnishing care products (dermal)
- Commercial use – packaging, paper, plastic, toys, hobby products – ink, toner, and colorant products (dermal and inhalation)
- Commercial use – other uses – laboratory chemicals (dermal)
- Commercial use – other uses – inspection penetrant kit (dermal and inhalation)
- Commercial use – other uses – lubricants and lubricant additives (dermal)
- Consumer use – automotive, fuel, outdoor use products – automotive care products (dermal)
- Consumer use – construction, paint, electrical and metal products – adhesives and sealants (dermal)
- Consumer use – construction, paint, electrical and metal products – paints and coatings (dermal)

- Consumer use – furnishing, cleaning, treatment/care products – cleaning and furnishing care products (dermal)

EPA has preliminarily determined that one COU may significantly contribute to unreasonable risk to the environment:

- Disposal (aquatic vertebrates)

EPA did not preliminarily identify an unreasonable risk of injury to human health and the environment from the following 19 COUs:

- Processing – recycling
- Distribution in commerce
- Industrial use – other uses – automotive articles
- Industrial use – other uses – propellants
- Commercial use – furnishing, cleaning, treatment care products – floor coverings; construction and building materials covering large surface areas including stone, plaster, cement, glass and ceramic articles; fabrics, textiles, and apparel
- Commercial use – furnishing, cleaning, treatment care products – furniture and furnishings
- Commercial use – packaging, paper, plastic, toys, hobby products – packaging (excluding food packaging), including rubber articles; plastic articles (hard); plastic articles (soft); other articles with routine direct contact during normal use, including rubber articles; plastic articles (hard)
- Commercial use – packaging, paper, plastic, toys, hobby products – toys, playground, and sporting equipment
- Commercial use – other uses – automotive articles
- Commercial use – other uses – chemiluminescent light sticks
- Consumer use – furnishing, cleaning, treatment/care products – fabric, textile, and leather products
- Consumer use – furnishing, cleaning, treatment/care products – floor coverings; construction and building materials covering large surface areas including stone, plaster, cement, glass and ceramic articles; fabrics, textiles, and apparel
- Consumer use – packaging, paper, plastic, hobby products – ink, toner, and colorant products
- Consumer use – packaging, paper, plastic, hobby products – packaging (excluding food packaging), including rubber articles; plastic articles (hard); plastic articles (soft); other articles with routine direct contact during normal use, including rubber articles; plastic articles (hard)
- Consumer use – packaging, paper, plastic, hobby products – toys, playground, and sporting equipment
- Consumer use – other uses – automotive articles
- Consumer use – other uses – chemiluminescent light sticks
- Consumer use – other uses – lubricants and lubricant additives
- Consumer use – other uses – novelty articles

This draft risk evaluation has been released for public comment and will undergo independent, expert scientific peer review. EPA seeks public comment on all aspects of this draft risk evaluation. In particular, the Agency seeks comment on whether and how exposure controls and personal protective equipment (PPE; *e.g.*, respirators, gloves) are used for each of the COUs. EPA also seeks information that could be used to replace upper-bound or screening level assumptions, particularly for COUs that may significantly contribute to unreasonable risk for DBP. EPA will issue a final DBP risk evaluation after considering input from the public and peer reviewers. If in the final risk evaluation the Agency determines that DBP presents unreasonable risk to human health or the environment, EPA will initiate regulatory action to the extent necessary so that DBP no longer presents such risk.

1 INTRODUCTION

EPA has evaluated dibutyl phthalate (DBP) pursuant to section 6(b) of the Toxic Substances Control Act (TSCA). DBP is primarily used as a plasticizer in polyvinyl chloride (PVC) in consumer, commercial, and industrial applications—although it is also used in adhesives, sealants, paints, coatings, rubbers, and non-PVC plastics, as well as for other applications. Section 1.1 summarizes the scope of this draft DBP risk evaluation and provides information on production volume, a life cycle diagram (LCD), TSCA conditions of use (COUs), and conceptual models used for DBP. Section 1.3 presents the organization of this draft risk evaluation.

Figure 1-1 describes the major inputs, phases, and outputs/components of the TSCA risk evaluation process, from scoping to releasing the final risk evaluation.

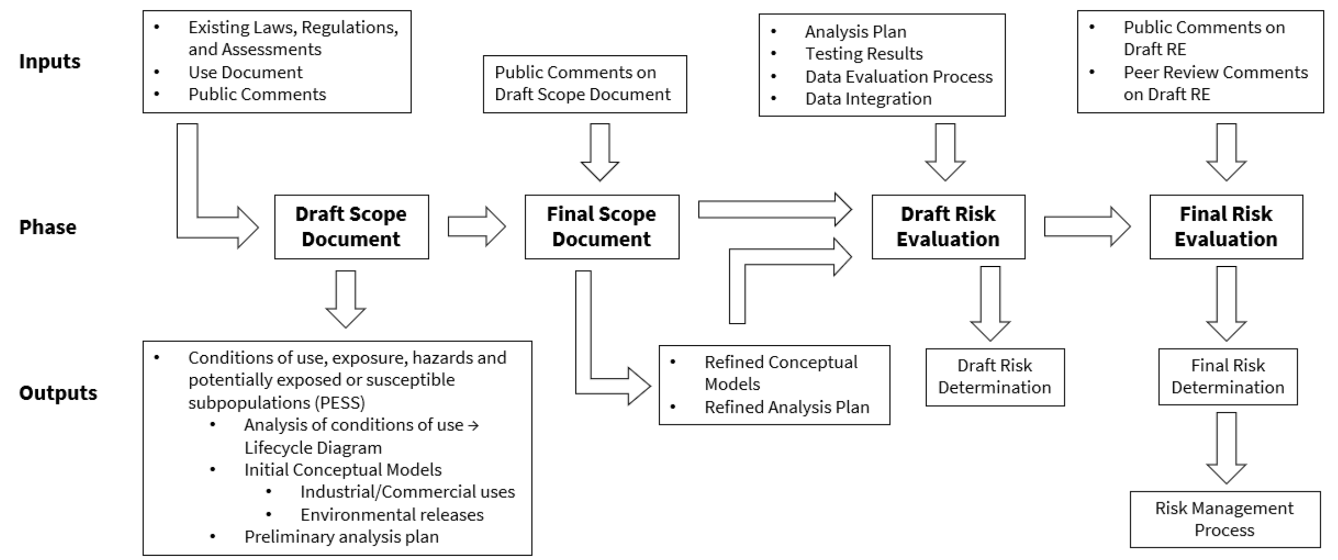


Figure 1-1. TSCA Existing Chemical Risk Evaluation Process

1.1 Scope of the Risk Evaluation

EPA evaluated risk to human and environmental populations for DBP. Specifically for human populations, the Agency evaluated risk to workers including occupational non-users (ONUs) via inhalation routes; risk to workers including ONUs via dermal routes; risk to consumers via inhalation, dermal, and oral routes; and risk to bystanders via the inhalation route. Additionally, EPA incorporated the following potentially exposed and susceptible populations (PESS) into its assessment—females of reproductive age, pregnant women, infants, children and adolescents, people who frequently use consumer products and/or articles containing high-concentrations of DBP, people exposed to DBP in the workplace, and tribes whose diets include large amounts of fish. As described further in Section 4.1.3, EPA assessed risks to the general population, which considered risk from exposure to DBP via oral ingestion of surface water, drinking water, fish, and soil from air to soil deposition. For environmental populations, the Agency evaluated risk to aquatic species via water and sediment as well as risk to terrestrial species via soil and, qualitatively, through trophic transfer.

Consistent with EPA's *Draft Proposed Approach for Cumulative Risk Assessment (CRA) of High-Priority Phthalates and a Manufacturer-Requested Phthalate under the Toxic Substances Control Act* (U.S. EPA, 2023d), EPA has also authored a draft cumulative risk technical support document (TSD) of DBP and five other toxicologically similar phthalates (*i.e.*, diethylhexyl phthalate [DEHP], dicyclohexyl phthalate [DCHP], diisobutyl phthalate [DIBP], butyl benzyl phthalate [BBP], and diisononyl phthalate [DINP]) that are also being evaluated under TSCA based on a common toxicological endpoint (*i.e.*, *phthalate syndrome*, which results from decreased fetal testicular testosterone) (U.S. EPA, 2025x). This TSD is also referred to as the "revised draft CRA TSD" in this draft risk evaluation. The cumulative analysis takes into consideration differences in phthalate potency to cause effects on the developing male reproductive system. Use of relative potency across the phthalates provides a more robust risk assessment of DBP and a common basis for adding risk across the cumulative chemicals. Numerous other regulatory agencies—Health Canada, U.S. Consumer Product Safety Commission (U.S. CPSC), European Chemicals Agency (ECHA), and the Australian National Industrial Chemicals Notification and Assessment Scheme (NICNAS)—have assessed phthalates for cumulative risk. Further, EPA's proposal to conduct a cumulative risk assessment (CRA) of phthalates under TSCA was endorsed by the Science Advisory Committee on Chemicals (SACC) as the best available science because humans are co-exposed to multiple toxicologically similar phthalates that cause effects on the developing male reproductive system consistent with a disruption of androgen action and phthalate syndrome. As described further in Section 4.4, cumulative risk considerations focus on acute duration exposures to the most susceptible subpopulations: female workers and consumers of reproductive age (16–49 years) as well as male infants and male children (3–15 years) exposed to consumer products and articles.

The draft DBP risk evaluation comprises a series of technical support documents. Each technical support document contains sub-assessments that inform adjacent, "downstream" TSDs. A basic diagram showing the layout and relationship of these assessments is provided below in Figure 1-2. High-level summaries of each relevant TSD are presented throughout this draft risk evaluation. Detailed information for each TSD can be found in the corresponding documents, which are listed with citations along with supplemental files in Appendix C.

These TSDs leveraged the data and information sources already identified in the *Final Scope of the Risk Evaluation for Dibutyl Phthalate (1,2-benzenedicarboxylic acid, 1,2-dibutyl ester); CASRN 84-74-2* (also called the "final scope for DBP" or "final scope document") (U.S. EPA, 2020c). OPPT conducted a comprehensive search for "reasonably available information" to identify relevant DBP data for use in the risk evaluation. The approach used to identify specific relevant risk assessment information was discipline-specific and is detailed in the *Draft Systematic Review Protocol for Dibutyl Phthalate (DBP)* (U.S. EPA, 2025w), or as otherwise noted in the relevant TSDs.

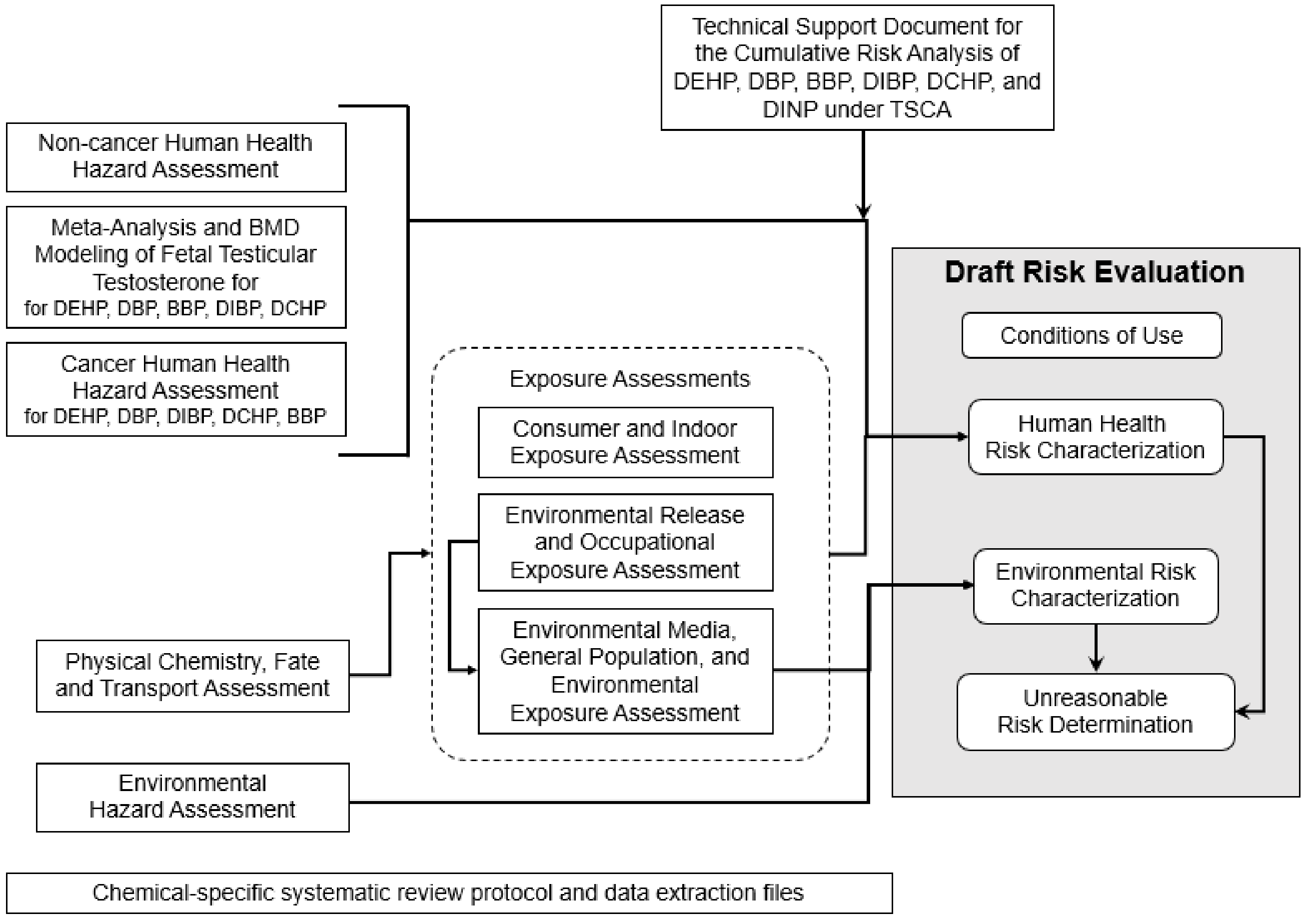


Figure 1-2. Draft Risk Evaluation Document Summary Map

1.1.1 Life Cycle and Production Volume

The LCD shown in Figure 1-3 depicts the COUs that are within the scope of the risk evaluation, during various life cycle stages, including manufacturing, processing, distribution, use (industrial, commercial, consumer), and disposal. The information in the LCD is grouped according to the Chemical Data Reporting (CDR) processing codes and use categories (including functional use codes for industrial uses and product categories for industrial and commercial uses). The CDR Rule under TSCA section 8(a) (see 40 CFR Part 711) requires certain U.S. manufacturers (including importers) to provide EPA with information on the chemicals they manufacture or import into the United States. EPA collects CDR data approximately every four years.

EPA included descriptions of the industrial, commercial, and consumer use categories identified from the 2020 CDR in the LCD (Figure 1-3) (U.S. EPA, 2020b). The descriptions provide a brief overview of the use category; the *Draft Environmental Release and Occupational Exposure Assessment for Dibutyl Phthalate* (U.S. EPA, 2025q) contains more detailed descriptions (*e.g.*, process descriptions, worker activities, process flow diagrams, equipment illustrations) for each manufacturing, processing, use, and disposal category.

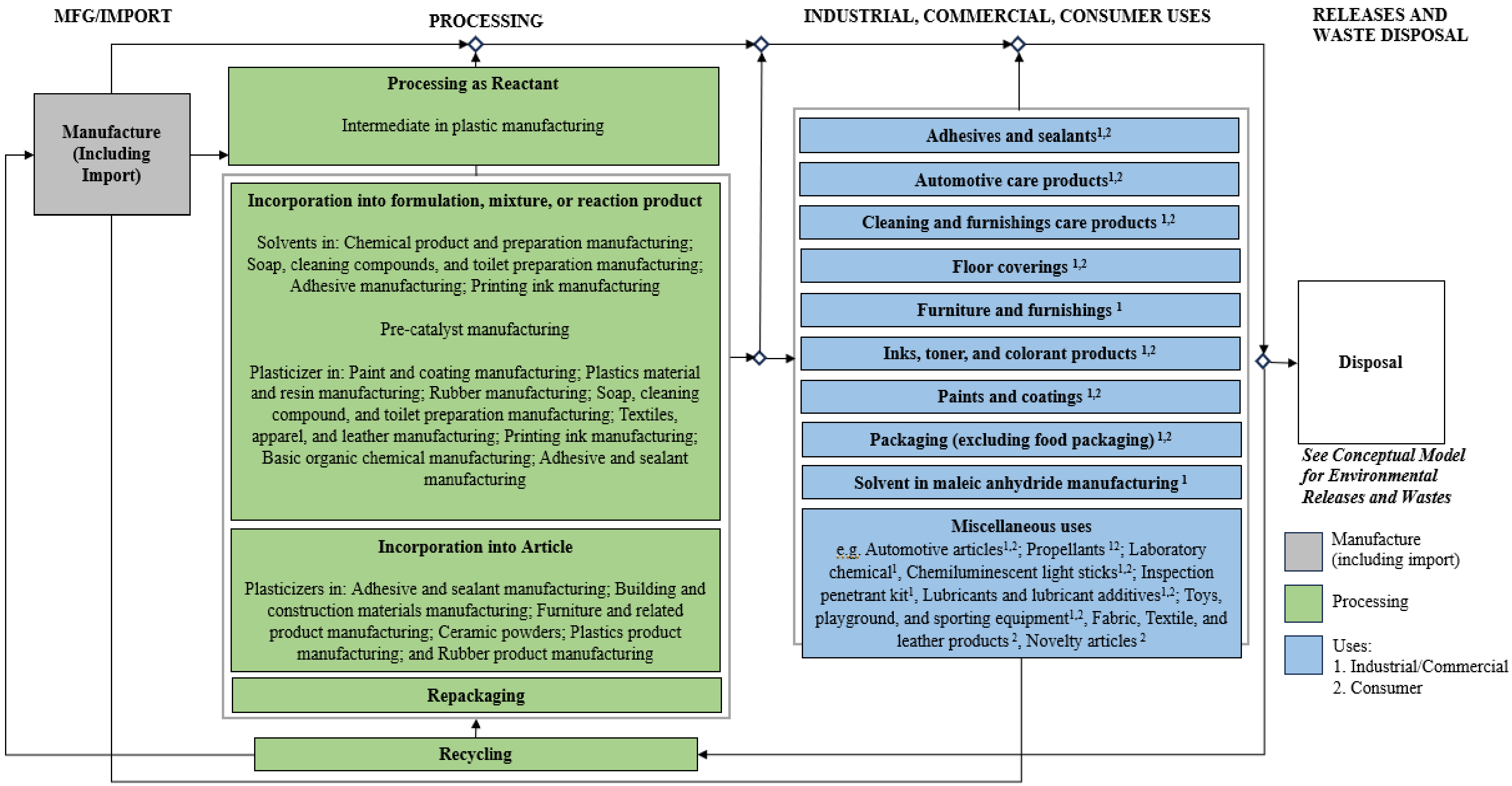


Figure 1-3. DBP Life Cycle Diagram

See Table 1-1 for categories and subcategories of conditions of use. Activities related to distribution (*e.g.*, loading, unloading) will be considered throughout the DBP life cycle, as well as qualitatively through a single distribution scenario.

The production volume for DBP between 2016 and 2019 was between 1 to 10 million pounds (lb) based on the latest 2020 CDR data (U.S. EPA, 2020b). EPA described production volumes as a range to protect production volume data claimed as confidential business information (CBI). For the 2016 and 2020 CDR cycle, collected data included the company name, volume of each chemical manufactured/imported, the number of workers at each site, and information on whether the chemical was used in the commercial, industrial, and/or consumer sector(s).

In the 2020 CDR, one site, Dystar LP in Reidsville, North Carolina, reported a production volume of 51,852 lb for domestic manufacturing of DBP for the 2019 CDR reporting year (U.S. EPA, 2020b). They had previously reported between 0 and 25,021 lb DBP manufactured between 2016 to 2018. Polymer Additives, Inc. in Bridgeport, NJ reported manufacture of DBP but claimed their PV as CBI. An additional three sites (4 sites total) reported their site activities as CBI; EPA assumed that these sites may manufacture DBP. This resulted in a total of five potential DBP manufacturing sites, two sites with known manufacturing activities and three sites with CBI activities.

EPA calculated the production volume for the four sites with CBI production volumes using a uniform distribution set within the national PV range for DBP. EPA calculated the bounds of the range by taking the national aggregate PV range reported in CDR (1–10 million lb) and subtracting out the PVs that belonged to sites with known volumes (both manufacturing and import). Then, for each bound of the PV range, EPA divided the value by the number of sites with CBI PVs for DBP. Based on the known PVs from importers and manufacturers, the total calculated PV associated with the four sites with CBI PVs is 109,546 to 5,252,403 lb/year. Based on this (and after converting lb to kg), EPA set a uniform distribution for the PV for the four sites with CBI PVs with lower bound of 49,689 kg/year, and an upper-bound of 2,382,450 kg/year. For more information regarding DBP's PV for CDR reporters, refer to Section 3.1 of the *Draft Environmental Release and Occupational Exposure Assessment for Dibutyl Phthalate (DBP)* (U.S. EPA, 2025q).

1.2 Conditions of Use Included in the Risk Evaluation

The final scope for DBP (U.S. EPA, 2020c) identified and described the life cycle stages, categories, and subcategories that comprise TSCA COUs that EPA planned to consider in the risk evaluation. All COUs for DBP included in this draft risk evaluation are reflected in the LCD (Figure 1-3) and conceptual models (Section 1.2.1.1). Table 1-1 below presents all COUs for DBP.

In this draft risk evaluation, EPA made updates to the COUs listed in the final scope document (U.S. EPA, 2020c). These updates reflect EPA's improved understanding of the COUs based on further outreach, public comments, and updated industry code names under the CDR for 2020. Updates include (1) additions and clarification of COUs based on new reporting in CDR for 2020 or information received from stakeholders; (2) consolidation of redundant COUs from the processing life stage based on inconsistencies found in CDR reporting for DBP processing and uses, and communications with stakeholders about the use of DBP in industry; and (3) correction of typos or edits for consistency. Appendix C provides a complete list of updates to the COUs between the final scope document and the draft risk evaluation and an explanation of these updates. EPA may further refine the COU descriptions for DBP that are included in the draft risk evaluation when the final risk evaluation for DBP is published, based upon further outreach, peer-review comments, and public comments. Table 1-1 presents the revised COUs that were included and evaluated in this draft risk evaluation for DBP.

Table 1-1. Categories and Subcategories of Use and Corresponding Exposure Scenario in the Risk Evaluation for DBP

Life-Cycle Stage[a]	Category[b]	Subcategory[c]	Reference(s)
Manufacturing	Domestic manufacturing	Domestic manufacturing	(U.S. EPA, 2020a, 2019b)
	Importing	Importing	(U.S. EPA, 2019b)
Processing	Processing as a reactant	Intermediate in plastic manufacturing	(W.R. Grace, 2024)
	Incorporation into formulation, mixture, or reaction product	Solvents (which become part of product formulation or mixture) in chemical product and preparation manufacturing; soap, cleaning compound, and toilet preparation manufacturing; adhesive manufacturing; and printing ink manufacturing	(NLM, 2024; U.S. EPA, 2019b; Kosaric, 2011; Ash and Ash, 2009)
		Pre-catalyst manufacturing	(W.R. Grace, 2024)
		Plasticizer in paint and coating manufacturing; plastic material and resin manufacturing; rubber manufacturing; soap, cleaning compound, and toilet preparation manufacturing; textiles, apparel, and leather manufacturing; printing ink manufacturing; basic organic chemical manufacturing; and adhesive and sealant manufacturing	(NLM, 2024; U.S. EPA, 2020a, 2019b)
	Incorporation into article	Plasticizer in adhesive and sealant manufacturing; building and construction materials manufacturing; furniture and related product manufacturing; ceramic powders; plastics product manufacturing; and rubber product manufacturing	(NLM, 2024; NASA, 2020; U.S. EPA, 2020a; AIA, 2019; U.S. EPA, 2019b; SpecialChem, 2018)
	Repackaging	Laboratory chemicals in wholesale and retail trade; plasticizers in wholesale and retail trade; and plastics material and resin manufacturing	(U.S. EPA, 2020a, 2019b)
	Recycling	Recycling	(U.S. EPA, 2019b)
Distribution in Commerce	Distribution in commerce		
Industrial Use	Non-incorporative activities	Solvent, including in maleic anhydride manufacturing technology	(Huntsman, 2024; U.S. EPA, 2020a, 2019b)

Life-Cycle Stage[a]	Category[b]	Subcategory[c]	Reference(s)
Industrial Use	Construction, Paint, Electrical, and Metal Products	Adhesives and sealants	(NASA, 2020; MEMA, 2019; Sendesi et al., 2017; Whelton et al., 2017; Ford Motor Company, 2015a)
		Paints and coatings	(Carboline, 2021; NASA, 2020)
	Other uses	Automotive articles	(MEMA, 2019)
		Lubricants and lubricant additives	(MEMA, 2019)
		Propellants	(Liang et al., 2021; U.S. EPA, 2020a; AIA, 2019)
Commercial Use	Automotive, fuel, agriculture, outdoor use products	Automotive care products	(U.S. EPA, 2020a)
	Construction, paint, electrical, and metal products	Adhesives and sealants	(U.S. EPA, 2020a; MEMA, 2019; U.S. EPA, 2019b; Sendesi et al., 2017; Whelton et al., 2017)
		Paints and coatings	(NLM, 2024; U.S. EPA, 2020a, 2019b; GoodGuide, 2011; Streitberger et al., 2011)
	Furnishing, cleaning, treatment care products	Cleaning and furnishing care products	(NLM, 2024; U.S. EPA, 2019b; GoodGuide, 2011)
		Floor coverings; construction and building materials covering large surface areas including stone, plaster, cement, glass and ceramic articles; fabrics, textiles, and apparel	(U.S. EPA, 2020a, 2019b; Sendesi et al., 2017; Whelton et al., 2017)
		Furniture and furnishings	(U.S. EPA, 2019b)
	Packaging, paper, plastic, toys, hobby products	Ink, toner, and colorant products	(NLM, 2024; U.S. EPA, 2019b)
		Packaging (excluding food packaging), including rubber articles; plastic articles (hard); plastic articles (soft); other articles with routine direct contact during normal use, including rubber articles; plastic articles (hard)	(NLM, 2024; U.S. EPA, 2020a, 2019b)
		Toys, playground, and sporting equipment	(U.S. EPA, 2019a, f)
	Other uses	Automotive articles	(MEMA, 2019)
		Chemiluminescent light sticks	(U.S. EPA, 2020d)

Life-Cycle Stage[a]	Category[b]	Subcategory[c]	Reference(s)
Commercial Use	Other uses	Laboratory chemicals	(NASA, 2020; U.S. EPA, 2020d, 2019b)
		Inspection penetrant kit	(U.S. EPA, 2020d; AIA, 2019)
		Lubricants and lubricant additives	(NASA, 2020; U.S. EPA, 2020d; MEMA, 2019)
Consumer Use	Automotive, fuel, agriculture, outdoor use products	Automotive care products	(U.S. EPA, 2020a)
	Construction, paint, electrical, and metal products	Adhesives and sealants	(MEMA, 2019; U.S. EPA, 2019b)
		Paints and coatings	(NLM, 2024; U.S. EPA, 2020a, 2019b; GoodGuide, 2011; Streitberger et al., 2011)
	Furnishing, cleaning, treatment care products	Fabric, textile, and leather products	(WSDE, 2023; U.S. EPA, 2020e, 2019b)
		Floor coverings; construction and building materials covering large surface areas including stone, plaster, cement, glass and ceramic articles; fabrics, textiles, and apparel	(U.S. EPA, 2020a, 2019b)
		Cleaning and furnishing care products	(NLM, 2024; U.S. EPA, 2019b; GoodGuide, 2011)
	Packaging, paper, plastic, toys, hobby products	Ink, toner, and colorant products	(U.S. EPA, 2019b)
		Packaging (excluding food packaging), including rubber articles; plastic articles (hard); plastic articles (soft); other articles with routine direct contact during normal use, including rubber articles; plastic articles (hard)	(NLM, 2024; U.S. EPA, 2019b)
		Toys, playground and sporting equipment	(U.S. EPA, 2019a, f)
	Other Uses	Automotive articles	(MEMA, 2019)
		Chemiluminescent light sticks	(U.S. EPA, 2020d)
		Lubricants and lubricant additives	(MEMA, 2019)
		Novelty articles	(Sipe et al., 2023; Stabile, 2013)
Disposal	Disposal	Disposal	(U.S. EPA, 2019b)

Life-Cycle Stage[a]	Category[b]	Subcategory[c]	Reference(s)

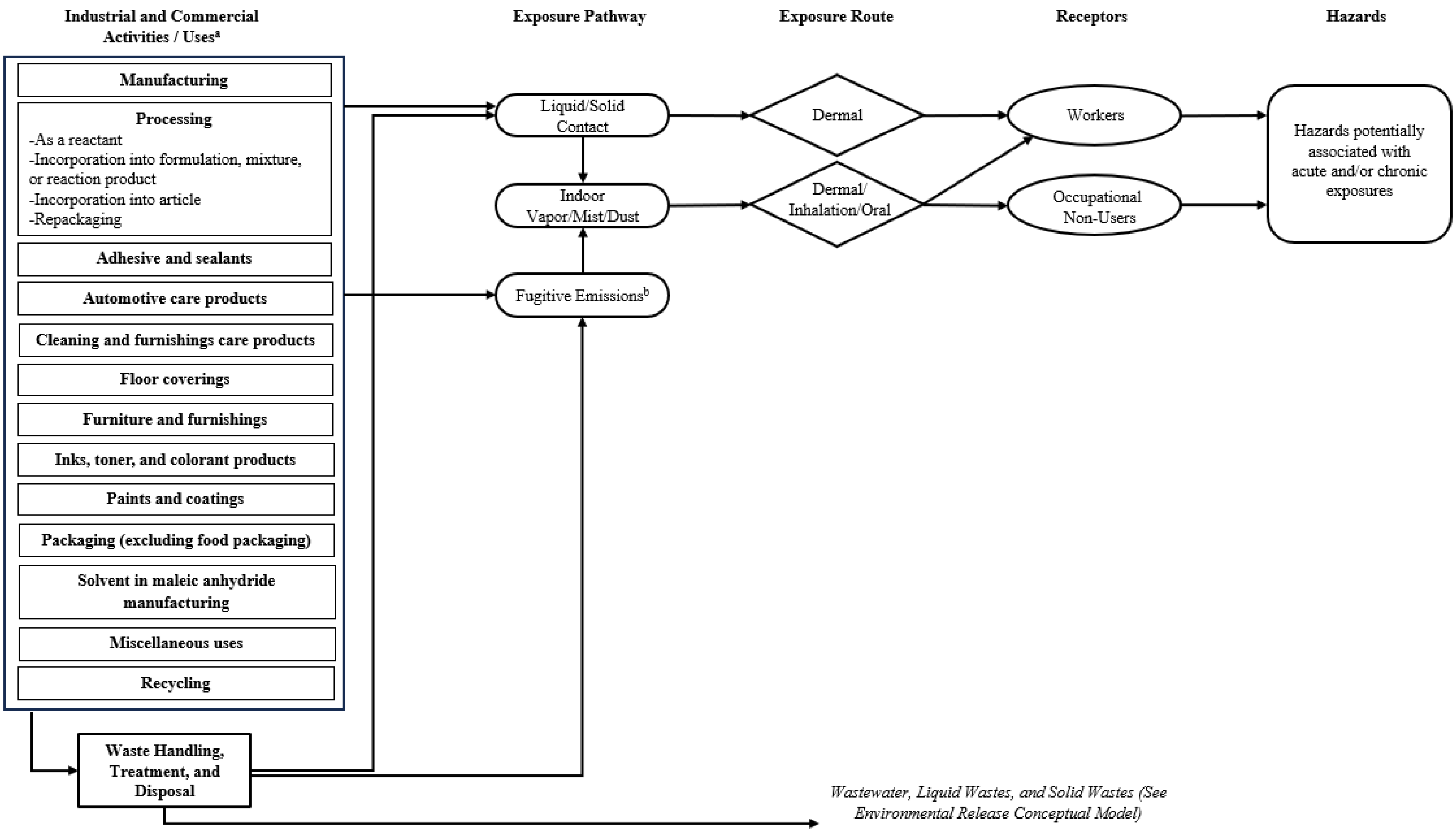
[a] Life Cycle Stage Use Definitions (40 CFR 711.3)
- "Industrial use" means use at a site at which one or more chemicals or mixtures are manufactured (including imported) or processed.
- "Commercial use" means the use of a chemical or a mixture containing a chemical (including as part of an article)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

[b] These categories of conditions of use appear in the Life Cycle Diagram, reflect CDR codes, and broadly represent COUs of DBP in industrial and/or commercial settings.

[c] These subcategories represent more specific activities within the life cycle stage and category of the COUs of DBP.

1.2.1.1 Conceptual Models

The conceptual model in Figure 1-4 presents the exposure pathways, exposure routes, and hazards to human populations from industrial and commercial activities and uses of DBP. There is potential for exposures to workers and/or ONUs via inhalation and via dermal contact. The conceptual model also includes potential ONU dermal exposure to DBP from mists and dusts deposited on surfaces. EPA evaluated activities resulting in exposures associated with distribution in commerce (*e.g.,* loading, unloading) throughout the various life cycle stages and COUs (*e.g.*, manufacturing, processing, industrial use, commercial use, and disposal).

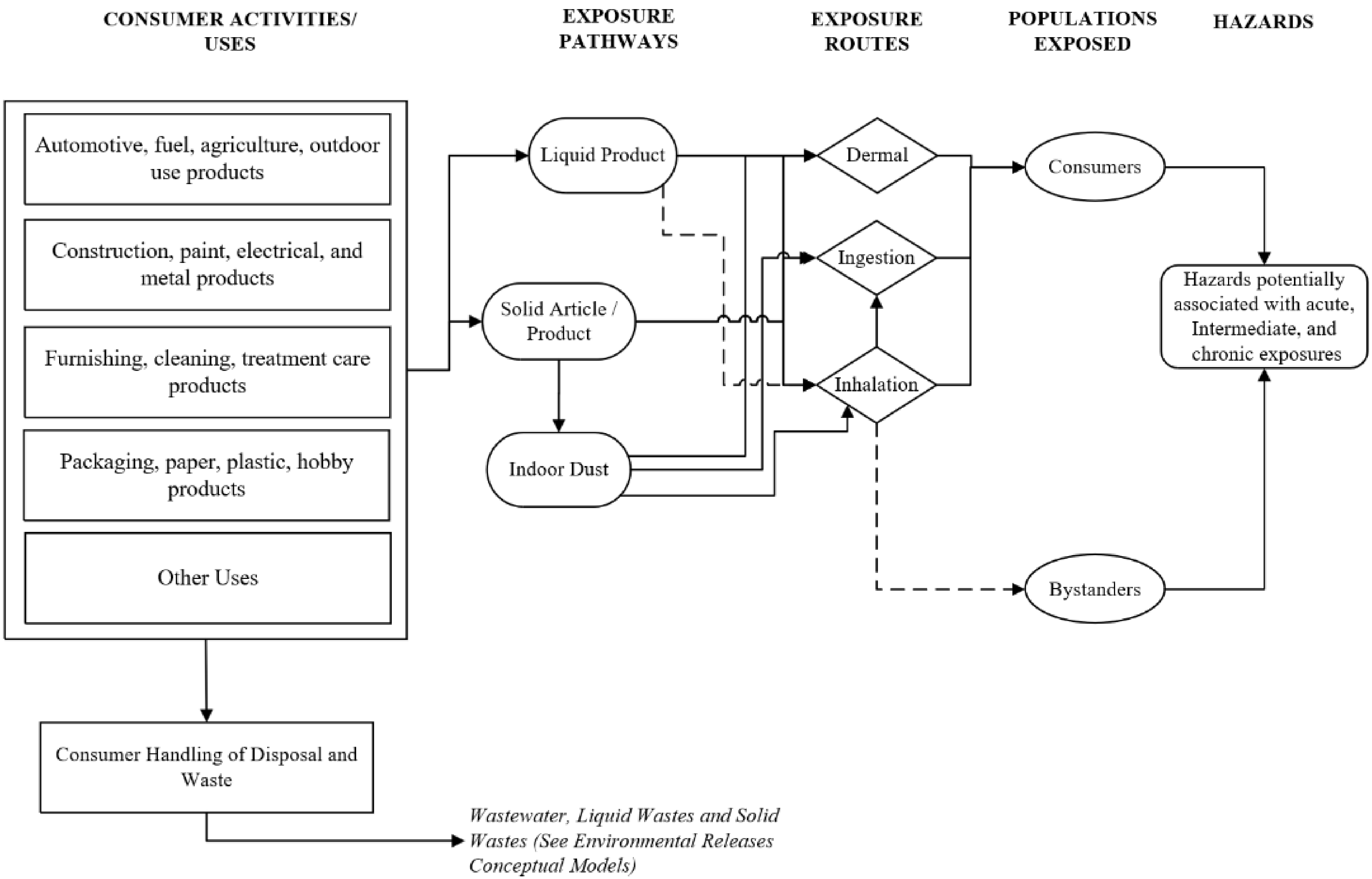


738

739 **Figure 1-4. DBP Conceptual Model for Industrial and Commercial Activities and Uses: Potential Exposure and Hazards**

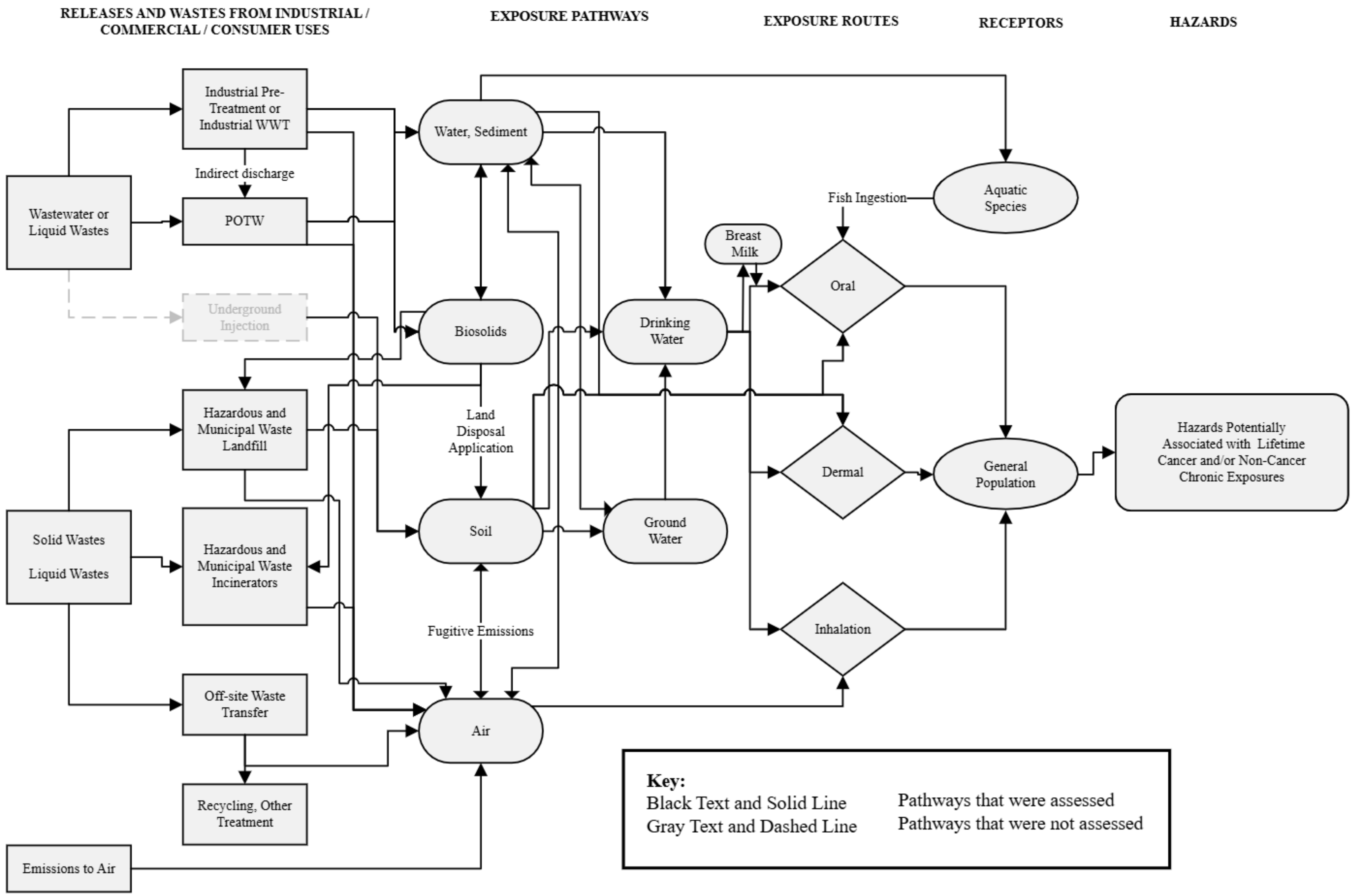
740 [a] Some products are used in both commercial and consumer applications. See Table 1-1 for categories and subcategories of conditions of use.

741 [b] Fugitive air emissions are emissions that are not routed through a stack and include fugitive equipment leaks from valves, pump seals, flanges,
742 compressors, sampling connections and open-ended lines; evaporative losses from surface impoundment and spills; and releases from building ventilation
743 systems.



744

745 **Figure 1-5. DBP Conceptual Model for Consumer Activities and Uses: Potential Exposures and Hazards**
746 The conceptual model presents the exposure pathways, exposure routes, and hazards to human populations from consumer activities and uses of DBP.



747

748 **Figure 1-6. DBP Conceptual Model for Environmental Releases and Wastes: General Population Hazards**

749 The conceptual model presents the exposure pathways, exposure routes, and hazards to human populations from releases and wastes from industrial,
750 commercial, and/or consumer uses of DBP.

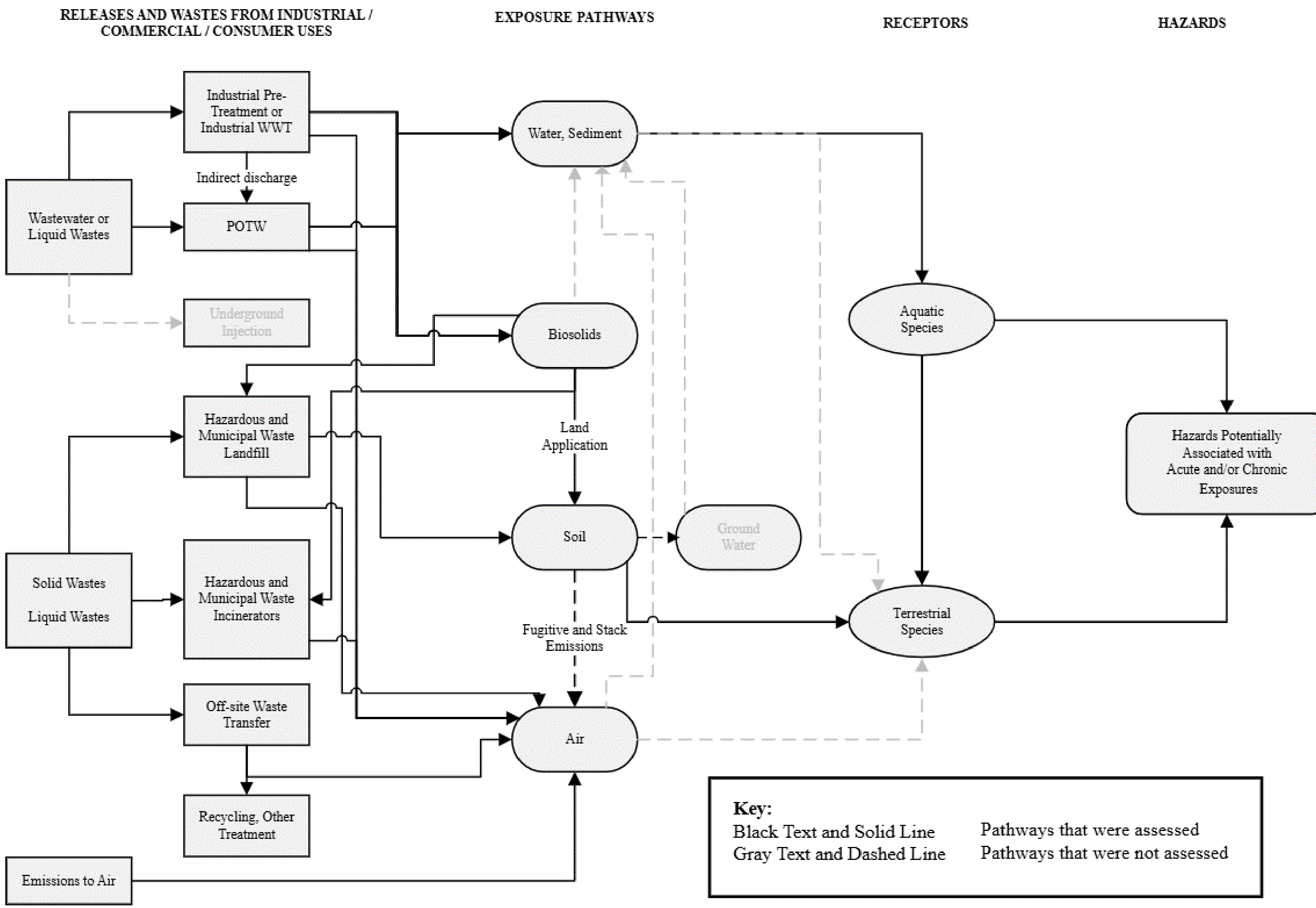


Figure 1-7. DBP Conceptual Model for Environmental Releases and Wastes: Ecological Exposures and Hazards
The conceptual model presents the exposure pathways, exposure routes, and hazards to ecological populations from releases and wastes from industrial, commercial, and/or consumer uses of DBP.

1.2.2 Populations and Durations of Exposure Assessed

Based on the conceptual models presented in Section 1.2.1.1, EPA evaluated risk to environmental and human populations. Environmental risks were evaluated for acute and chronic exposure scenarios for aquatic and terrestrial species, as appropriate. Human health risks were evaluated for acute, intermediate, and chronic exposure scenarios, as applicable based on reasonably available exposure and hazard data, as well as the relevant populations for each. Human populations assessed include the following:

- Workers, including average adults and females of reproductive age;
- ONUs, including average adult workers (individuals of both sexes age 16+ years, including pregnant workers)
- Consumers, including infants (<1 year), toddlers (1–2 years), children (3–5 and 6–10 years), young teens (11–15 years), teenagers (16–20 years), and adults (21+ years);
- Bystanders, including infants (<1 year), toddlers (1–2 years), and children (3–5 and 6–10 years); young teens (11–15 years), teenagers (16–20 years), and adults (21+ years); and
- General population, including infants (<1 year), toddlers (1–5 years), children (6–10 years), youth (11–15 and 16–20 years), and adults (21+ years).

Note that the age groups for consumers, bystanders, and general population are different because each life stage used unique exposure factors (*e.g.*, mouthing, drinking water ingestion, fish consumption rates). These exposure factors are provided in EPA's *Exposure Factors Handbook: 2011 Edition* (U.S. EPA, 2011b).

Consistent with its *Draft Proposed Approach for Cumulative Risk Assessment (CRA) of High-Priority Phthalates and a Manufacturer-Requested Phthalate under the Toxic Substances Control Act* (U.S. EPA, 2023d), EPA is focusing its relative potency factor (RPF) analysis and phthalate CRA on populations most relevant to the common hazard endpoint (*i.e.*, reduced fetal testicular testosterone)—specifically females of reproductive age and male infants and male children. This approach emphasizes a common health effect for sensitive subpopulations; however, additional health endpoints are identified for broader populations and described in the individual non-cancer human health hazard assessments for DBP (U.S. EPA, 2024f), DCHP (U.S. EPA, 2024g), DEHP (U.S. EPA, 2024h), BBP (U.S. EPA, 2024e), DIBP (U.S. EPA, 2024i), and DINP (U.S. EPA, 2024n). Additionally, EPA is focusing its RPF and CRA on acute duration exposures. This is because—as described further in the *Revised Draft Technical Support Document for the CRA of DEHP, DBP, BBP, DIBP, DCHP, and DINP under TSCA* (U.S. EPA, 2025x)—there is evidence that effects on the developing male reproductive system consistent with a disruption of androgen action can result from a single exposure during the critical window of development.

1.2.2.1 Potentially Exposed and Susceptible Subpopulations

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

This draft risk evaluation considers PESS throughout the human health risk assessment (Section 4), including throughout the exposure assessment, hazard identification, and dose-response analysis supporting this assessment. EPA incorporated the following PESS into its assessment: females of reproductive age, pregnant women, infants, children and adolescents, people who frequently use consumer products and/or articles containing high concentrations of DBP, people exposed to DBP in the workplace, and tribes whose diets include large amounts of fish. These subpopulations are PESS because some have greater exposure to DBP per body weight (*e.g.*, infants, children, adolescents) or due to age-specific behaviors (*e.g.*, mouthing of toys, wires, and erasers by infants and children assessed in the consumer exposure scenarios), while some experience aggregate or sentinel exposures. EPA also evaluated non-attributable exposures and cumulative risk to phthalates (*i.e.*, DEHP, DBP, BBP, DIBP, and DINP) using biomonitoring data from National Health and Nutrition Examination Survey (NHANES). This non-attributable cumulative risk from exposure to DEHP, DBP, BBP, DIBP, and DINP was taken into consideration as part of EPA's cumulative risk calculations for DBP, presented below in Section 4.4 and around exposures to DBP from both occupational and consumer COUs/occupational exposure scenarios (OESs).

Section 4.3.5 summarizes how PESS were incorporated into the draft risk evaluation through consideration of potentially increased exposures and/or potentially increased biological susceptibility and summarizes additional sources of uncertainty related to consideration of PESS.

1.3 Organization of the Risk Evaluation

This draft risk evaluation for DBP includes five additional major sections, and several appendices, as described below:

- Section 2 summarizes basic physical and chemical characteristics as well as the fate and transport of DBP.
- Section 3 includes an overview of releases and concentrations of DBP in the environment.
- Section 4 presents the human health risk assessment, including the exposure, hazard, and risk characterization based on the COUs. It includes a discussion of PESS based on both greater exposure and/or susceptibility as well as a description of aggregate and sentinel exposures. Section 4 also discusses assumptions and uncertainties and how they potentially impact the strength of the evidence of draft risk evaluation. Finally, Section 4 presents cumulative risk estimates from exposure to BBP, DEHP, DBP, DIBP, DCHP, and DINP (Section 4.4), as well as a comparison of the individual BBP risk assessment and the draft CRA (Section 4.5)
- Section 5 provides a discussion and analysis of the environmental risk assessment, including the environmental exposure, hazard, and risk characterization based on the COUs for DBP. It also discusses assumptions and uncertainties and how they potentially impact the strength of the evidence of draft risk evaluation.
- Section 6 presents EPA's proposed determination of whether DBP presents an unreasonable risk to human health or the environment under the assessed COUs.
- Appendix A provides a list of key abbreviations and acronyms used throughout this draft risk evaluation.
- Appendix B provides a brief summary of the federal, state, and international regulatory history of DBP.
- Appendix C incudes a list and citations for all TSDs and supplemental files included in the draft risk evaluation for DBP.

- Appendix D provides a summary of updates made to COUs for DBP from the final scope document to this draft risk evaluation.
- Appendix E provides descriptions of the DBP COUs evaluated by EPA.
- Appendix F provides the draft occupational exposure value for DBP that was derived by EPA.

2 CHEMISTRY AND FATE AND TRANSPORT OF DBP

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

Sections 2.1 and 2.2 summarize the physical and chemical properties, and environmental fate and transport of DBP, respectively. See the *Draft Chemistry, Fate, and Transport Assessment for Dibutyl Phthalate (DBP)* (U.S. EPA, 2024j).

2.1 Summary of Physical and Chemical Properties

EPA gathered and evaluated physical and chemical property data and information according to the process described in the *Draft Systematic Review Protocol for Dibutyl Phthalate (DBP)* (U.S. EPA, 2025w). EPA considered both measured and estimated physical and chemical property data/information as described in the *Draft Physical Chemistry, Fate, and Transport Assessment for Dibutyl Phthalate (DBP)* (U.S. EPA, 2024j). The selected values are summarized in Table 2-1, as applicable. Information on the full, extracted dataset is available in the *Draft Data Quality Evaluation and Data Extraction Information for Physical and Chemical Properties for Dibutyl Phthalate (DBP)* (U.S. EPA, 2025k).

Table 2-1. Physical and Chemical Properties of DBP

Property	Selected Value(s)	Reference(s)	Overall Data Quality Rating
Molecular formula	$C_{16}H_{22}O_4$	–	–
Molecular weight	278.35 g/mol	–	–
Physical form	Oily liquid	O'Neil (2013)	High
Melting point	−35 °C	Rumble (2018)	High
Boiling point	340 °C	O'Neil (2013)	High
Density	1.0465 g/cm^3	Rumble (2018)	High
Vapor pressure	2.01E−05 mm Hg	U.S. EPA (2019c)	High
Vapor density	9.58	NLM (2024)	High
Water solubility	11.2 mg/L	Howard et al. (1985)	High
Organic carbon:water (Log K_{OC})	3.69 (average of 7 values ranging between 3.14–3.94)	Xiang et al. (2019); Russell and Mcduffie (1986)	High
Octanol:water partition coefficient (log K_{OW})	4.5	NLM (2024)	High
Octanol:air partition coefficient (log K_{OA})	8.63 (EPI Suite™)	U.S. EPA (2017)	High

Property	Selected Value(s)	Reference(s)	Overall Data Quality Rating
Air:water partition coefficient (log K_{AW})	–4.131 (EPI Suite™)	U.S. EPA (2017)	High
Henry's Law constant	1.81E–06 atm·m^3/mol at 25 °C	NLM (2024)	High
Flash point	157 °C	NLM (2024)	High
Autoflammability	402 °C	NLM (2024)	High
Viscosity	20.3 cP	NLM (2024)	High

2.2 Summary of Environmental Fate and Transport

Reasonably available environmental fate data—including biotic and abiotic biodegradation rates, removal during wastewater treatment, volatilization from water sources, and organic carbon:water partition coefficient (log K_{OC})—are parameters used in the current risk evaluation. In assessing the environmental fate and transport of DBP, EPA considered the full range of results from the available highest quality data sources obtained during systematic review. Information on the full extracted dataset is available in the *Draft Data Quality Evaluation and Data Extraction Information for Environmental Fate and Transport for Dibutyl Phthalate (DBP)* (U.S. EPA, 2025i). Other fate estimates were based on modeling results from EPI Suite™ (U.S. EPA, 2012b), a predictive tool for physical and chemical properties and environmental fate estimation. Information regarding the model inputs is available in the *Draft Physical Chemistry and Fate and Transport Assessment for Dibutyl Phthalate (DBP)* (U.S. EPA, 2024j).

EPA evaluated the reasonably available information to characterize the environmental fate and transport of DBP, the key points of the fate assessment for DBP (U.S. EPA, 2024j) are summarized below and listed in Table 2-2.

Given the consistent results from numerous high-quality studies, there is robust evidence of the following:

- DBP not expected to undergo significant direct photolysis but will undergo indirect photodegradation by reacting with hydroxyl radicals in the atmosphere with a half-life of 1.13 to 1.15 days.
- DBP will partition to organic carbon and particulate matter in air.
- DBP will not hydrolyze under standard environmental conditions, but its hydrolysis rate increases with increased pH and temperature in deep-landfill environments.
- DBP will biodegrade in aerobic surface water, soil, and wastewater treatment processes.
- DBP will not biodegrade under anoxic conditions and may have high persistence in anaerobic soils and sediment.
- DBP will be removed with wastewater treatment and will sorb significantly to sludge, with a small fraction being present in wastewater treatment plant (WWTP) effluent.
- DBP has low bioaccumulation potential.
- DBP may be persistent in surface water and sediment proximal to continuous points of release.
- DBP is expected to transform to monobutyl phthalate (MBP), butanol, and phthalic acid in the environment.

As a result of limited studies identified, there is moderate confidence that DBP

- Will be removed in conventional drinking water treatment systems both in the treatment process and via reduction by chlorination and chlorination byproducts in post-treatment storage and drinking water conveyance with a removal efficiency of 31 to 64.5 percent (Kong et al., 2017; Shan et al., 2016).

Findings that were found to have a robust weight of evidence supporting them had one or more high-quality studies that were largely in agreement with each other. Findings that were said to have a moderate weight of evidence were based on a mix of high- and medium-quality studies that were largely in agreement but varied in sample size and consistency of findings.

Table 2-2. Summary of Environmental Fate Information for DBP*[a]*

Parameter	Value	Reference(s)	Overall Data Quality Rating
Aerobic primary biodegradation in water	68.3–100% in 7–28 days	NITE (2019); SRC (1983); Tabak et al. (1981)	High
Aerobic biodegradation in sediment	$t_{1/2}$ = 2.9 days in natural river sediment collected from the Zhonggang, Keya, Erren, Gaoping, Donggang, and Danshui Rivers, Taiwan	Yuan et al. (2002)	High
Anaerobic biodegradation in sediment	$t_{1/2}$ = 14.4 days in natural river sediment collected from the Zhonggang, Keya, Erren, Gaoping, Donggang, and Danshui Rivers in Taiwan	Yuan et al. (2002)	High
Aerobic biodegradation in soil	88.1–97.2% after 200 days in Chalmers slit loam, Plainfield sand, and Fincastle silt loam soils	Inman et al. (1984)	High
Hydrolysis	$t_{1/2}$ = approximately 22 years at pH 7 and 25 °C; $K_H = 1.0 \pm 0.05E{-}02\ M^{-1}\ sec^{-1}$ at pH 10–12 and 30 °C	ATSDR (1999); Wolfe et al. (1980)	High
Photolysis	Direct: Expected to be susceptible to direct photolysis by sunlight; contains chromophores that absorb at wavelengths >290 nm Indirect: $t_{1/2}$ = 1.13 days (·OH rate constant of 9.47E−12 OH/cm^3) and 1.15 days (·OH rate constant of 9.28E−12 OH/cm^3); (estimated based on a 12-hour day with 1.5E06 ·OH/cm^3)	Lei et al. (2018); Peterson and Staples (2003)	High
Environmental degradation half-lives	1.15 days (air) 10 days (water) 20 days (soil)	Lei et al. (2018); SRC (1983)	High

Parameter	Value	Reference(s)	Overall Data Quality Rating
(selected values for modeling)	90 days (sediment)		
Wastewater treatment plant (WWTP) removal	65–98%	U.S. EPA (1982)	High
Aquatic bioconcentration factor (BCF)	2.9 ± 0.1 and 30.6 ± 3.4 in brown shrimp (*Penaeus aztecus*) at 100 and 500 ppb, respectively; 11.7 in sheepshead minnow (*Cyprinodon variegate)* at 100 ppb; 21.1 ± 9.3 and 41.6 ± 5.1 in American oyster (*Crassostrea virginica*) at 100 and 500 ppb, respectively	Wofford et al. (1981)	High
Aquatic bioaccumulation factor (BAF)	100, 316, 251 and 1,259 L/kg dry weight (dw) in bluegill, bass, skygager, and crucian carp, respectively.	Lee et al. (2019)	High
Aquatic Trophic Magnification Factor (TMF)	0.70 (Experimental; 18 marine species)	Mackintosh et al. (2004)	High
Plant Concentration Factor (PCF)	0.26–4.78 (Fruit and vegetables)	Sun et al. (2015)	High
Terr. Biota-sediment accumulation factor (BSAF)	0.242–0.460 (*Eisenia fetida*)	Ji and Deng (2016); Hu et al. (2005)	High
[a] Additional information on value selection can be found in the *Draft Physical Chemistry, Fate, and Transport Assessment for Dibutyl Phthalate (DBP)* (U.S. EPA, 2024j).			

916

3 RELEASES AND CONCENTRATIONS OF DBP IN THE ENVIRONMENT

EPA estimated environmental releases and concentrations of DBP. Section 3.1 describes the approach and methodology for estimating releases; Section 3.2 presents estimates of environmental releases; and Section 3.3 presents the approach and methodology for estimating environmental concentrations as well as a summary of concentrations of DBP in the environment.

3.1 Approach and Methodology

This section provides an overview of the approach and methodology for assessing releases to the environment from industrial, commercial, and consumer uses. Specifically, Sections 3.1.1 through 3.1.3 describe the approach and methodology for estimating releases to the environment from industrial and commercial uses.

3.1.1 Manufacturing, Processing, Industrial and Commercial

This subsection describes the grouping of manufacturing, processing, industrial and commercial COUs into OESs as well as the use of DBP within each OES. Specifically, Section 3.1.1.1 provides a crosswalk of COUs to OESs and 3.1.1.2 provides descriptions for the use of DBP within each OES.

3.1.1.1 Crosswalk of Conditions of Use to Occupational Exposure Scenarios

EPA categorized the COUs listed in Table 1-1 into OESs. Table 3-1 provides a crosswalk between the COUs and OESs whereas Table 3-2 provides the reverse: a crosswalk of OESs to COUs. Each OES is developed based on a set of occupational activities and conditions such that similar occupational exposures and environmental releases are expected from the use(s) covered under that OES. For each OES, EPA provided occupational exposure and environmental release results, which are expected to be representative of the entire population of workers and sites for the given OES in the United States. In some cases, EPA defined only a single OES for multiple COUs, while in other cases the Agency developed multiple OESs for a single COU. EPA made this determination by considering variability in release and use conditions and whether the variability required discrete scenarios or could be captured as a distribution of exposures. The *Draft Environmental Release and Occupational Exposure Assessment for Dibutyl Phthalate (DBP)* (U.S. EPA, 2025q) provides further information on specific OESs.

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

COU			OES[d]
Life Cycle Stage[a]	**Category[b]**	**Subcategory[c]**	
Manufacturing	Domestic manufacturing	Domestic manufacturing	Manufacturing
	Importing	Importing	Import and repackaging
Processing	Repackaging	Laboratory chemicals in wholesale and retail trade; plasticizers in wholesale and retail trade; and plastics material and resin manufacturing	Import and repackaging
	Processing as a reactant	Intermediate in plastic manufacturing	Incorporation into formulations, mixtures, or reaction product

COU			OES[d]
Life Cycle Stage[a]	**Category[b]**	**Subcategory[c]**	
Processing	Incorporation into formulation, mixture, or reaction product	Solvents (which become part of product formulation or mixture) in chemical product and preparation manufacturing; soap, cleaning compound, and toilet preparation manufacturing; adhesive manufacturing; and printing ink manufacturing	Incorporation into formulations, mixtures, or reaction product
		Plasticizer in paint and coating manufacturing; plastic material and resin manufacturing; rubber manufacturing; soap, cleaning compound, and toilet preparation manufacturing; textiles, apparel, and leather manufacturing; printing ink manufacturing; basic organic chemical manufacturing; and adhesive and sealant manufacturing	Incorporation into formulations, mixtures, or reaction product; PVC plastics compounding; Non-PVC material manufacturing
		Pre-catalyst manufacturing	Incorporation into formulations, mixtures, or reaction product
	Incorporation into articles	Plasticizer in adhesive and sealant manufacturing; building and construction materials manufacturing; furniture and related product manufacturing; ceramic powders; plastics product manufacturing; and rubber product manufacturing	PVC plastics converting; Non-PVC material manufacturing;
	Recycling	Recycling	Recycling
Distribution in Commerce	Distribution in commerce		Distribution in commerce
Industrial Use	Non-incorporative activities	Solvent, including in maleic anhydride manufacturing technology	Industrial process solvent use
	Construction, paint, electrical, and metal products	Adhesives and sealants	Application of adhesives and sealants
		Paints and coatings	Application of paints and coatings
	Other uses	Automotive articles	Fabrication or use of final product or articles
		Lubricants and lubricant additives	Use of lubricants and functional fluids
		Propellants	Fabrication or use of final product or articles

COU			OES[d]
Life Cycle Stage[a]	**Category[b]**	**Subcategory[c]**	
Commercial Use	Automotive, fuel, agriculture, outdoor use products	Automotive care products	Use of lubricants and functional fluids
	Construction, paint, electrical, and metal products	Adhesives and sealants	Application of adhesives and sealants
		Paints and coatings	Application of paints and coatings
	Furnishing, cleaning, treatment care products	Cleaning and furnishing care products	Use of lubricants and functional fluids
		Floor coverings; construction and building materials covering large surface areas including stone, plaster, cement, glass and ceramic articles; fabrics, textiles, and apparel;	Fabrication or use of final product or articles
		Furniture and furnishings	
	Packaging, paper, plastic, toys, hobby products	Ink, toner, and colorant products	Application of paints and coatings
		Packaging (excluding food packaging), including rubber articles; plastic articles (hard); plastic articles (soft); other articles with routine direct contact during normal use, including rubber articles; plastic articles (hard)	Fabrication or use of final product or articles
		Toys, playground, and sporting equipment	Fabrication or use of final product or articles
	Other uses	Laboratory chemicals	Use of laboratory chemicals
		Automotive articles	Fabrication or use of final product or articles
		Chemiluminescent light sticks	Fabrication or use of final product or articles
		Inspection penetrant kit	Use of penetrants and inspection fluids
		Lubricants and lubricant additives	Use of lubricants and functional fluids
Disposal	Disposal	Disposal	Waste handling, treatment, and disposal

[a] Life Cycle Stage Use Definitions (40 CFR 711.3)
- "Industrial use" means use at a site at which one or more chemicals or mixtures are manufactured (including imported) or processed.
- "Commercial use" means the use of a chemical or a mixture containing a chemical (including as part of an article) in a commercial enterprise providing saleable goods or services.
- "Consumer use" means the use of a chemical or a mixture containing a chemical (including as part of an article, such as furniture or clothing) when sold to or made available to consumers for their use.

COU			OES[d]
Life Cycle Stage[a]	Category[b]	Subcategory[c]	

– Although EPA has identified both industrial and commercial uses here for purposes of distinguishing scenarios in this document, the Agency interprets the authority over "any manner or method of commercial use" under TSCA section 6(a)(5) to reach both.

[b] These categories of COU appear in the life cycle diagram, reflect CDR codes, and broadly represent COUs of DBP in industrial and/or commercial settings.

[c] These subcategories represent more specific activities within the life cycle stage and category of the COU of DBP.

[d] An OES is based on a set of facts, assumptions, and inferences that describe how releases and exposures take place within an occupational COU. The occurrence of releases/exposures may be similar across multiple conditions of use (multiple COUs mapped to single OES), or there may be several ways in which releases/exposures take place for a given condition of use (single COU mapped to multiple OESs).

Table 3-2. Crosswalk of Assessed Occupational Exposure Scenarios to Conditions of Use

OES[a]	COU		
	Life Cycle Stage[b]	Category[c]	Subcategory[d]
Manufacturing	Manufacturing	Domestic manufacturing	Domestic manufacturing
Import and repackaging	Manufacturing	Importing	Importing
	Processing	Repackaging	Laboratory chemicals in wholesale and retail trade; plasticizers in wholesale and retail trade; and plastics material and resin manufacturing
Incorporation into formulations, mixtures, or reaction product	Processing	Processing as a reactant	Intermediate in plastic manufacturing
	Processing	Incorporation into formulation, mixture, or reaction product	Solvents (which become part of product formulation or mixture) in chemical product and preparation manufacturing; soap, cleaning compound, and toilet preparation manufacturing; adhesive manufacturing; and printing ink manufacturing
	Processing	Incorporation into formulation, mixture, or reaction product	Plasticizer in paint and coating manufacturing; soap, cleaning compound, and toilet preparation manufacturing; textiles, apparel, and leather manufacturing; printing ink manufacturing; basic organic chemical manufacturing; and adhesive and sealant manufacturing
	Processing	Incorporation into formulation, mixture, or reaction product	Pre-catalyst manufacturing
PVC plastics compounding	Processing	Incorporation into formulation, mixture, or reaction product	Plasticizer in plastic material and resin manufacturing
PVC plastics converting	Processing	Incorporation into articles	Plasticizer in adhesive and sealant manufacturing; building and construction materials manufacturing; furniture and related

OES[a]	COU		
	Life Cycle Stage[b]	Category[c]	Subcategory[d]
			product manufacturing; ceramic powders; plastics product manufacturing
Non-PVC materials manufacturing	Processing	Incorporation into formulation, mixture, or reaction product	Plasticizer in plastic material and resin manufacturing; rubber manufacturing
	Processing	Incorporation into articles	Plasticizer in adhesive and sealant manufacturing; building and construction materials manufacturing; furniture and related product manufacturing; ceramic powders; plastics product manufacturing; and rubber product manufacturing
Application of adhesives and sealants	Commercial Use	Construction, paint, electrical, and metal products	Application of adhesives and sealants
	Industrial Use	Construction, paint, electrical, and metal products	Application of adhesives and sealants
Application of paints and coatings	Commercial Use	Packaging, paper, plastic, toys, hobby products	Ink, toner, and colorant products
	Commercial Use	Construction, paint, electrical, and metal products	Paints and coatings
	Industrial Use	Construction, paint, electrical, and metal products	Paints and coatings
Industrial process solvent use	Industrial Use	Non- incorporative activities	Solvent, including in maleic anhydride manufacturing technology
Use of laboratory chemicals (solid)	Commercial Use	Other uses	Laboratory chemicals
Use of laboratory chemicals (liquid)	Commercial Use	Other uses	Laboratory chemicals
Use of lubricants and functional fluids	Commercial Use	Other uses	Lubricants and lubricant additives
	Industrial Use	Other uses	Lubricants and lubricant additives
	Commercial Use	Automotive, fuel, agriculture, outdoor use products	Automotive care products
	Commercial Use	Furnishing, cleaning, treatment care products	Cleaning and furnishing care products
Use of penetrants and inspection fluids	Commercial Use	Other uses	Inspection penetrant kit

OES[a]	COU		
	Life Cycle Stage[b]	**Category[c]**	**Subcategory[d]**
Fabrication or use of final product or articles	Commercial Use	Furnishing, cleaning, treatment care products	Floor coverings; construction and building materials covering large surface areas including stone, plaster, cement, glass and ceramic articles; fabrics, textiles, and apparel
	Commercial Use	Furnishing, cleaning, treatment care products	Furniture and furnishings
	Commercial Use	Other uses	Automotive articles
	Commercial Use	Other uses	Chemiluminescent light sticks
	Industrial Use	Other uses	Automotive articles
	Industrial Use	Other uses	Propellants
	Commercial Use	Packaging, paper, plastic, toys, hobby products	Packaging (excluding food packaging), including rubber articles; plastic articles (hard); plastic articles (soft); other articles with routine direct contact during normal use, including rubber articles; plastic articles (hard)
	Commercial Use	Packaging, paper, plastic, toys, hobby products	Toys, playground, and sporting equipment
Recycling	Processing	Recycling	Recycling
Waste handling, treatment, and disposal	Disposal	Disposal	Disposal

[a] An OES is based on a set of facts, assumptions, and inferences that describe how releases and exposures take place within an occupational condition of use. The occurrence of releases/exposures may be similar across multiple conditions of use (multiple COUs mapped to single OES), or there may be several ways in which releases/exposures take place for a given condition of use (single COU mapped to multiple OESs).
[b] Life Cycle Stage Use Definitions (40 CFR 711.3)
- "Industrial use" means use at a site at which one or more chemicals or mixtures are manufactured (including imported) or processed.
- "Commercial use" means the use of a chemical or a mixture containing a chemical (including as part of an article) in a commercial enterprise providing saleable goods or services.
- "Consumer use" means the use of a chemical or a mixture containing a chemical (including as part of an article, such as furniture or clothing) when sold to or made available to consumers for their use.
- Although EPA has identified both industrial and commercial uses here for purposes of distinguishing scenarios in this document, the Agency interprets the authority over "any manner or method of commercial use" under TSCA Section 6(a)(5) to reach both.

[c] These categories of conditions of use appear in the Life Cycle Diagram, reflect CDR codes, and broadly represent conditions of use of DPB in industrial and/or commercial settings.
[d] These subcategories represent more specific activities within the life cycle stage and category of the conditions of use of DBP.

3.1.1.2 Description of DBP Use for Each OES

After EPA characterized the OESs for the occupational exposure assessment of DBP, the occupational uses of DBP for all OESs were summarized. Brief summaries of the uses of DBP for all OESs are presented in Table 3-3.

Table 3-3. Description of the Function of DBP for Each OES

OES	Role/Function of DBP
Manufacturing	DBP is typically produced through the esterification of the carboxyl groups phthalic anhydride with n-butyl alcohol in the presence of sulfuric acid as a catalyst.
Import and repackaging	DBP is imported domestically for use and/or may be repackaged before shipment to formulation sites.
Incorporation into formulation, mixture, or reaction product	DBP is used primarily as a plasticizer in the formulation of paints and coatings. DBP is also incorporated into other products such as adhesives, sealants, inks, toners, and colorant products.
PVC plastics compounding	DBP is used in PVC plastics to increase flexibility.
PVC plastics converting	DBP is used in PVC plastics to increase flexibility.
Non-PVC materials compounding and converting	DBP is used in non-PVC polymers, such as resins, and as an intermediate in rubber product manufacturing.
Application of adhesives and sealants	DBP is used as an additive in adhesives and sealants for industrial and commercial use.
Application of paints and coatings	DBP is used in paint and coating products for industrial and commercial use.
Industrial process solvent use	DBP is used as a solvent for industrial use, primarily for the formulation of maleic anhydride.
Use of laboratory chemicals	DBP is a laboratory chemical used for laboratory analyses in liquid and solid forms.
Use of lubricants and functional fluids	DBP is used as a functional fluid for processes in printing and related support activities and is also used as a lubricant such as textile fiber lubricant in industrial processes.
Use of penetrants and inspection fluids	DBP is used in inspection penetrant kits for commercial use.
Fabrication of final product from articles	DBP is found in a wide array of different final articles not found in other OES including building and construction materials, flooring materials, furniture, and furnishings.
Recycling	Some PVC plastics that contain DBP may be recycled either in-house or at PVC recycling facilities to manufacture new PVC material.
Waste handling, treatment, and disposal	Upon fabrication or use of DBP-containing products, residual chemicals are disposed and released to air, wastewater, or disposal facilities.
Distribution in commerce	Distribution in commerce consists of the transportation associated with the moving of DBP-containing products and/or articles between sites manufacturing, processing, and use COUs, or the transportation of DBP containing wastes to recycling sites or for final disposal.

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

The number of release days associated with the releases is included in the release tables for different OES in section 3 of the *Draft Environmental Release and Occupational Exposure Assessment for Dibutyl Phthalate (DBP)* (U.S. EPA, 2025q). Unless EPA identified conflicting information, EPA assumed that the number of release days per year for a given release source equals the number of operating days at the facility. EPA used information from National Emissions Inventory (NEI), generic scenarios (GSs), emission scenario documents (ESDs), and other literature sources obtained through systematic review to assess the number of operating days for releases. When monte carlo modeling was performed to estimate releases, a discrete value or a range of input for the number of release days was input to the monte carlo simulation. The model generated the 50th and 95th percentiles of operating days which was associated with the central tendency and high-end estimates of releases respectively. The number of release days used in the assessment is expected to be reasonable since EPA used information directly reported by facilities or information from sources which through EPA's systematic review process.

3.1.3 Daily Release Estimation

For each OES, EPA estimated releases to each media of release using Toxics Release Inventory (TRI) data (2017–2022), Discharge Monitoring Report (DMR) data (2017–2022), and NEI data (2017–2020) or modeling as shown in Figure 3-1. Where available, EPA used NEI, GSs, or ESDs to estimate number of release days, which EPA used to convert between annual release estimates and daily release estimates. EPA used 2020 CDR, TRI, DMR, NEI, and Monte Carlo modeling data to estimate the number of sites using DBP within an OES. The *Draft Environmental Release and Occupational Exposure Assessment for Dibutyl Phthalate (DBP)* (U.S. EPA, 2025q) describes EPA's approach and methodology for estimating daily releases and provides detailed facility level results for each OES.

For each OES, EPA estimated DBP releases per facility to each release media applicable to that OES. For DBP, EPA assessed releases to water, air, or land (*i.e.,* disposal to land).

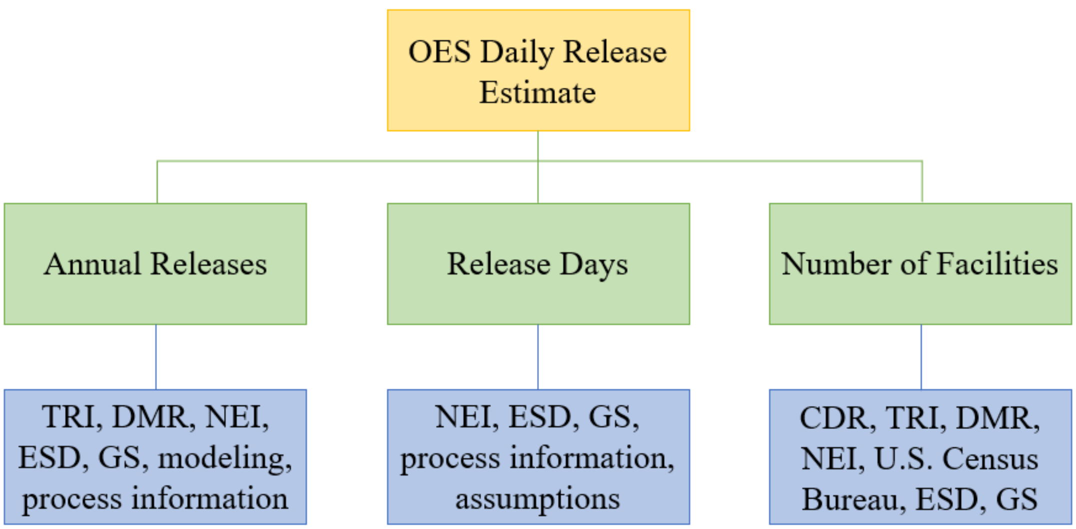


Figure 3-1. Overview of EPA's Approach to Estimate Daily Releases for Each OES
TRI = Toxics Release Inventory; DMR = Discharge Monitoring Report; NEI = National Emissions Inventory; CDR = Chemical Data Reporting; ESD = Emission Scenario Document; GS = Generic Scenario

3.1.4 Consumer Down-the-Drain and Landfills

EPA evaluated down-the-drain releases of DBP for consumer COUs qualitatively. Although EPA acknowledges that there may be DBP releases to the environment via the cleaning and disposal of adhesives, sealants, paints, coatings, cleaners, waxes, and polishes, the Agency did not quantitatively assess down-the-drain and disposal scenarios of consumer products due to limited information from monitoring data or modeling tools. EPA instead conducted a qualitative screening level assessment using physical and chemical properties. See the *Draft Consumer and Indoor Dust Exposure Assessment for Dibutyl Phthalate (DBP)* (U.S. EPA, 2025c) for further details.

Adhesives, sealants, paints, coatings, cleaners, waxes, and polishes can be disposed down-the-drain while users wash their hands, brushes, sponges, and other product applying tools. In addition, these products can be disposed of when users no longer have use for them or have reached the product shelf life and taken to landfills. All other solid products and articles listed in Table 4-5 of the *Draft Consumer and Indoor Dust Exposure Assessment for Dibutyl Phthalate (DBP)* (U.S. EPA, 2025c) can be removed and disposed in landfills, or other waste handling locations that properly manage the disposal of products like adhesives, sealants, paints, lacquers, and coatings. Section 3.2 in the *Draft Environmental Media and General Population and Environmental Exposure for Dibutyl Phthalate (DBP)* (U.S. EPA, 2025p) summarizes DBP monitoring data identified for landfills. Briefly, no studies were identified which reported the concentration of DBP in landfills or in the surrounding areas in the U.S., but DBP was identified in sludge in wastewater plants in China, Canada, and the U.S. DBP is expected to have a high affinity to particulate (log K_{OC} = 3.14–3.94) and organic media (log K_{OW} = 4.5), which would limit leaching to groundwater. Because of its high hydrophobicity and high affinity for soil sorption, it is unlikely that DBP will migrate from landfills via groundwater infiltration.

3.2 Summary of Environmental Releases

3.2.1 Manufacturing, Processing, Industrial and Commercial

EPA combined its estimates for annual releases, release days, number of facilities, and hours of release per day to estimate a range of daily releases for each OES. Table 3-4 presents a summary of these ranges across facilities. See the *Draft Environmental Release and Occupational Exposure Assessment for Dibutyl Phthalate (DBP)* (U.S. EPA, 2025q) for additional detail on deriving the overall confidence score for each OES. EPA was not able to estimate site-specific releases for the final use of products or articles OES. Disposal sites handling post-consumer, end-use DBP were not quantifiable due to the wide and dispersed use of DBP in PVC and other products. Pre-consumer waste handling, treatment, and disposal are assumed to be captured in upstream OES.

1019 **Table 3-4. Summary of EPA's Annual and Daily Release Estimates for Each OES**

OES	Type of Discharge,[a] Air Emission,[b] or Transfer for Disposal[c]	Estimated Annual Release (kg/site-year) [d]		Estimated Daily Release (kg/site-day) [e]		Number of Facilities[f]	Source(s)
		Central Tendency[g]	High-End	Central Tendency[g]	High-End		
Manufacturing	Stack air	0.24	0.24	7.8E–04	7.8E–04	1-Dystar LP, Reidsville, NC	CDR, peer-reviewed literature (GS/ESD)
	Fugitive air	9.9E–04	1.7E–03	3.3E–06	5.5E–06		
	Wastewater, incineration, or landfill	558	585	1.9	2.0		
	Stack air	3.0	5.7	1.0E–02	1.9E–02	4	Environmental release modeling
	Fugitive air	7.8E–04	1.6E–03	2.6E–06	5.4E–06		
	Wastewater, incineration, or landfill	6,942	1.3E04	23	43		
Import and repackaging	Stack air	0	0	0	0	4	NEI
	Stack air	0	227	0	0.87	10	TRI
	Fugitive air	35	113	9.5E–02	0.31	4	NEI
	Fugitive air	0	227	0	0.87	10	TRI
	Wastewater	227	227	0.87	0.87	5	TRI/DMR
	Land	5,994	3.7E04	16	103	2	TRI
Incorporation into mixture, formulation, or reaction product	Stack air	0	8.4	0	3.4E–02	32	NEI
	Stack air	0	311	0	1.2	18	TRI
	Fugitive air	4.6	51	1.1E–02	0.18	32	NEI
	Fugitive air	0	238	0	0.95	18	TRI
	Wastewater	227	227	0.91	0.91	11	TRI/DMR
	Land	510	1.0E04	2.0	40	3	TRI

OES	Type of Discharge,[a] Air Emission,[b] or Transfer for Disposal[c]	Estimated Annual Release (kg/site-year)[d]		Estimated Daily Release (kg/site-day)[e]		Number of Facilities[f]	Source(s)
		Central Tendency[g]	High-End	Central Tendency[g]	High-End		
PVC plastic compounding	Stack air	N/A	N/A	N/A	N/A	1	NEI (one site provided fugitive air emissions but stated that stack air releases were not applicable)
	Stack air	10	13	4.2E–02	8.0E–02	1	TRI
	Fugitive air	6.7	6.7	1.9E–02	1.9E–02	1	NEI
	Fugitive air	1.4	1.4	5.5E–03	5.5E–03	1	TRI
	Wastewater	0.28	43	1.1E–03	0.12	14	DMR
	Land	2.7	566	9.5E–03	2.0	3	Surrogate data – Non-PVC material manufacturing
PVC plastics converting	Stack air	53	58	0.21	0.23	7	NEI
	Stack air	0	0	0	0	1	TRI
	Fugitive air	3.5E–02	1.8	6.8E–05	6.6E–03	7	NEI
	Fugitive air	0.45	0.45	1.8E–03	1.8E–03	1	TRI
	Wastewater	0.28	43	1.1E–03	0.12	14	Surrogate data – PVC plastics compounding.
	Land	2.7	566	9.5E–03	2.0	3	Surrogate data – Non-PVC material manufacturing
Non-PVC material manufacturing (compounding and converting)	Stack air	9.0E–02	177	7.8E–05	0.61	49	NEI
	Stack air	4.3	34	1.7E–02	0.26	4	TRI
	Fugitive air	1.4	117	5.2E–03	0.44	49	NEI
	Fugitive air	0.24	59	9.5E–04	0.45	4	TRI
	Wastewater	4.5E–03	4.5E–03	1.8E–05	1.8E–05	1	TRI
	Land	2.7	566	9.5E–03	2.0	3	TRI

OES	Type of Discharge,[a] Air Emission,[b] or Transfer for Disposal[c]	Estimated Annual Release (kg/site-year) [d]		Estimated Daily Release (kg/site-day) [e]		Number of Facilities[f]	Source(s)
		Central Tendency[g]	High-End	Central Tendency[g]	High-End		
Application of adhesives and sealants[h]	Stack air	4.4E–06	99	1.7E–08	0.39	164	NEI
	Stack air	0	0	0	0	1	TRI
	Fugitive air	1.2	97	4.9E–03	0.39	164	NEI
	Fugitive air	0	0	0	0	1	TRI
	Incineration or landfill	291	1,357	1.4	7.1	94–973 generic sites	Modeled environmental release
	Wastewater, incineration, or landfill	209	860	0.97	4.5		
Application of paints and coatings (no spray control)[h]	Stack air	4.4E–06	99	1.7E–08	0.39	164	NEI
	Stack air	0	0	0	0	1	TRI
	Fugitive air	1.2	97	4.9E–03	0.39	164	NEI
	Fugitive air	0	0	0	0	1	TRI
	Wastewater	0	0	0	0	219–2,624 generic sites	Modeled environmental release
	Incineration or landfill	92	368	0.36	1.4		
	Wastewater, incineration or landfill	72	206	0.28	0.80		
	Unknown (air, wastewater, incineration, or landfill)	1,957	8,655	7.6	34		
Application of paints and coatings (spray control) [h]	Stack air	4.4E–06	99	1.7E–08	0.39	164	NEI
	Stack air	0	0	0	0	1	TRI
	Fugitive air	1.2	97	4.9E–03	0.39	164	NEI
	Fugitive air	0	0	0	0	1	TRI
	Wastewater	0	0	0	0	219–2,660 generic sites	Modeled environmental release
	Incineration or landfill	1,858	8,170	7.2	32		
	Wastewater, incineration or landfill	72	206	0.28	0.80		
	Unknown (air, wastewater, incineration, or landfill)	0	0	0	0		

OES	Type of Discharge,[a] Air Emission,[b] or Transfer for Disposal[c]	Estimated Annual Release (kg/site-year) [d]		Estimated Daily Release (kg/site-day) [e]		Number of Facilities[f]	Source(s)
		Central Tendency[g]	High-End	Central Tendency[g]	High-End		
Industrial process solvent use	Stack air	96	192	0.38	0.77	2	NEI
	Stack air	74	122	0.66	1.1	1	TRI
	Fugitive air	181	182	0.72	0.73	2	NEI
	Fugitive air	180	180	0.72	1.6	1	TRI
	Wastewater	No data identified for this OES; EPA assumed no releases to water for this use				N/A	N/A
	Land	510	1.0E04	2.0	40	3	Surrogate data – Incorporation into formulation, mixture, or reaction product.
Use of laboratory chemicals (liquid)	Fugitive air	1.4	2.7	3.8E–03	7.5E–03	2	NEI
	Stack air	N/A	N/A	N/A	N/A	2	NEI
	Wastewater, incineration, or landfill	17	80	4.8E–02	0.22	5,587–36,873 generic sites	Modeled environmental release
Use of laboratory chemicals (solid)	Fugitive air	1.4	2.7	3.8E–03	7.5E–03	2	NEI
	Stack air	N/A	N/A	N/A	N/A	2	NEI
	Wastewater, incineration, or landfill	4.3	19	1.2E–02	5.2E–02	31,477–36,873 generic sites	Modeled environmental release
	Unknown (air, wastewater, incineration, or landfill)	1.5E–02	0.11	4.0E–05	2.9E–04		
	Incineration or landfill	1.9E–02	0.13	5.3E–05	3.5E–04		
Use of lubricants and functional fluids	Landfill	6.4	35	3.0	13	3,337–39,808 generic sites	Modeled environmental release
	Wastewater	15	74	6.8	26		
	Recycling	0.22	1.7	0.11	0.62		
	Fuel blending (incineration)	5.0	37	2.3	14		

OES	Type of Discharge,[a] Air Emission,[b] or Transfer for Disposal[c]	Estimated Annual Release (kg/site-year) [d]		Estimated Daily Release (kg/site-day) [e]		Number of Facilities[f]	Source(s)
		Central Tendency[g]	High-End	Central Tendency[g]	High-End		
Use of penetrants and inspection fluids (non-aerosol)	Fugitive air	1.6E–05	3.0E–05	6.4E–08	1.2E–07	14,538–20,770 generic sites	Modeled environmental release
	Wastewater, incineration, or landfill	6.7	8.7	2.7E–02	3.5E–02		
Use of penetrants and inspection fluids (aerosol)	Fugitive air	0.99	1.3	4.0E–03	5.2E–03	14,541–20,767 generic sites	
	Wastewater, incineration, or landfill	5.7	7.4	2.3E–02	3.0E–02		
Fabrication and final use of products or articles	No data was available to estimate releases for this OES and there were no suitable surrogate release data or models. This release is described qualitatively.						
Recycling	Stack air	9.0E–02	177	7.8E–05	0.61	49	Surrogate data – Non-PVC material manufacturing
	Stack air	4.3	34	1.7E–02	0.26	4	
	Fugitive air	1.4	117	5.2E–03	0.44	49	
	Fugitive air	0.24	59	9.5E–04	0.45	4	
	Wastewater	0.28	43	1.1E–03	0.12	14	Surrogate data – PVC plastics compounding
	Land	2.7	566	9.5E-03	2.0	3	Surrogate data – Non-PVC material manufacturing
Waste handling, treatment, and disposal	Stack air	0	105	0	0.37	147	NEI
	Stack air	0	190	0	1.5	20	TRI
	Fugitive air	6.4E-05	19	2.0E-07	5.8E-02	147	NEI
	Fugitive air	0	2.8	0	2.2E-02	20	TRI
	Wastewater	1.1	78	3.9E-03	0.27	70	TRI/DMR
	Land	4,762	7.1E04	17	247	12	TRI

[a] Direct discharge to surface water; indirect discharge to non-POTW; indirect discharge to POTW
[b] Emissions via fugitive air; stack air; or treatment via incineration
[c] Transfer to surface impoundment, land application, or landfills
[d] For modeled results, the presented central tendency and high-end are the 50th and 95th percentile values of the modeled distribution. For programmatic data, the presented central tendency is calculated from the median reported release amounts and high-end from the reported maximum release amounts. The specific

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

central tendency and high-end values presented depends on the number of sites with programmatic data. For databases with six or more reporting facilities, EPA estimated central tendency and high-end releases using the 50th and 95th percentile values, respectively. For three to five facilities, EPA estimated the central tendency and high-end releases using the 50th percentile and maximum values, respectively. For two sites, EPA presented the midpoint and the maximum value. Finally, EPA presented sites with only one data point as-is from the programmatic database.

[e] Where available, EPA used peer-reviewed literature (*e.g.*, GSs or ESDs to provide a basis to estimate the number of release days of dibutyl phthalate within a COU).

[f] Where available, EPA used the 2020 CDR (U.S. EPA, 2020b), NEI (U.S. EPA, 2023a), DMR (U.S. EPA, 2024a), and TRI databases (U.S. EPA, 2024o), 2020 U.S. County Business Practices (U.S. Census Bureau, 2022), and Monte Carlo models to estimate the number of sites that use DBP for each condition of use. Some modeled OES calculated the number of facilities/sites, presented as 50th and 95th percentiles. Other modeled OES set the number of facilities deterministically, presented as one value.

[g] The central tendency values for NEI air were calculated using the median of the reported releases at each site.

[h] Data for the Application of adhesives and sealants OES and Application of paints and coatings OES were assessed together as the release estimate details provided by the database sources were insufficient to characterize between the two OESs. Data presented are expected to be representative for both OESs.

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

For each OES, EPA considered the assessment approach, the quality of the data and models, and the uncertainties in the assessment results to determine a level of confidence for the environmental release estimates. Table 3-5 provides EPA's weight of scientific evidence rating for each OES.

EPA integrated numerous evidence streams across systematic review sources to develop environmental release estimates for DBP. The Agency made a judgment on the weight of scientific evidence supporting the release estimates based on the strengths, limitations, and uncertainties associated with the release estimates. EPA described this judgment using the following confidence descriptors: robust, moderate, slight, or indeterminate.

In determining the strength of the overall weight of scientific evidence, EPA considered factors that increase or decrease the strength of the evidence supporting the release estimate (whether measured or estimated), including quality of the data/information, relevance of the data to the release scenario (including considerations of temporal and spatial relevance), and the use of surrogate data when appropriate. In general, higher rated studies (as determined through data evaluation) increase the weight of scientific evidence when compared to lower rated studies, and EPA gave preference to chemical- and scenario-specific data over surrogate data (*e.g.*, data from a similar chemical or scenario). For example, a conclusion of moderate weight of scientific evidence is appropriate where there is measured release data from a limited number of sources, such that there is a limited number of data points that may not cover most or all the sites within the OES. A conclusion of slight weight of scientific evidence is appropriate where there is limited information that does not sufficiently cover all sites within the COU, and the assumptions and uncertainties are not fully known or documented. See EPA's *Draft Systematic Review Protocol Supporting TSCA Risk Evaluations for Chemical Substances, Version 1.0: A Generic TSCA Systematic Review Protocol with Chemical-Specific Methodologies* (also called the "Draft Systematic Review Protocol") (U.S. EPA, 2021a) for additional information on weight of scientific evidence conclusions.

Table 3-5 summarizes EPA's overall weight of scientific evidence conclusions for its release estimates for each OES. NEI obtained a high data quality rating and TRI and DMR obtained a medium quality rating from EPA's systematic review process. In general, modeled data had data quality ratings of medium. As a result, for releases that used GSs/ESDs, the weight of scientific conclusion was moderate when used in tandem with Monte Carlo modeling.

1055 **Table 3-5. Summary of Overall Confidence in Environmental Release Estimates by OES**

OES	Weight of Scientific Evidence Conclusion in Release Estimates
Manufacturing	EPA found limited chemical specific data for the Manufacturing OES and assessed environmental releases using models and model parameters derived from CDR, the 2023 Methodology for Estimating Environmental Releases from Sampling Wastes (U.S. EPA, 2023f), and sources identified through systematic review (including surrogate—DINP and DIDP—industry-supplied data). EPA used EPA/OPPT models combined with Monte Carlo modeling to estimate releases to the environment, with media of release assessed using appropriate default input parameters from EPA/OPPT models and industry-supplied data. EPA believes a strength of the Monte Carlo modeling approach is that variation in model input values allow for estimation of a range of potential release values that are more likely to capture actual releases than a discrete value. Additionally, Monte Carlo modeling uses a large number of data points (simulation runs) and considers the full distributions of input parameters. EPA used facility-specific DBP manufacturing volumes for all facilities that reported this information to CDR. For facilities that did not report DBP manufacturing volumes to CDR, operating parameters were derived using data from a current U.S. manufacturing site for DIDP and DINP that is assumed to operate using similar operating parameters as DBP manufacturing. This information was used to provide more accurate estimates than the generic values provided by the EPA/OPPT models. These strengths increase the weight of evidence. The primary limitation of EPA's approach is the uncertainty in the representativeness of release estimates toward the true distribution of potential releases. In addition, 1 DBP manufacturing site and 2 manufacturing and/or import sites claimed their DBP production volume as CBI for the purpose of CDR reporting; therefore, DBP throughput estimates for these sites are based on the national aggregate PV and reported import volumes from other sites. Additional limitations include uncertainties in the representativeness of the surrogate industry-provided operating parameters from DIDP and DINP and the generic EPA/OPPT models used to calculate environmental releases for DBP manufacturing sites. These limitations decrease the weight of evidence. As discussed above, the strength of the analysis includes using Monte Carlo modeling, which can use a range as an input, increases confidence in the analysis. However, several uncertainties discussed above, such as using surrogate parameters, reduced the confidence of the analysis. Therefore, EPA concluded that the weight of scientific evidence for this assessment is moderate, considering the strengths and limitations of the reasonably available data.
Import and repackaging	Air releases are assessed using reported releases from 2017–2022 TRI (U.S. EPA, 2024o), and 2017 and 2020 NEI (U.S. EPA, 2023a, 2019e). NEI captures additional sources that are not included in TRI due to reporting thresholds. Factors that decrease the overall confidence for this OES include the uncertainty in the accuracy of reported releases, and the limitations in representativeness to all sites because TRI and NEI may not capture all relevant sites. The air releases assessment is based on 10 reporting sites in NEI and 4 reporting sites in TRI. Based on the NAICS and SIC codes used to map data from the reporting databases (CDR, DMR, etc.), there may be 14 additional repackaging sites that we do not have reported releases for this media in this assessment. Land releases are assessed using reported releases from 2017–2022 TRI. The primary limitation is that the land releases assessment is based on 2 reporting sites (2 sites only reported air releases), and EPA did not have additional sources to estimate land releases from this OES. Based on the NAICS and SIC codes used to map data from the reporting databases (CDR, DMR, NEI, etc.), there may be 26 additional repackaging sites that do not have reported releases for this media in this assessment.

OES	Weight of Scientific Evidence Conclusion in Release Estimates
	Water releases are assessed using reported releases from 2017–2022 TRI and DMR. The primary strength of TRI data is that TRI compiles the best readily available release data for all reporting facilities. The primary limitation is that the water release assessment is based on 1 reporting site under DMR and 4 reporting sites in TRI (2 sites only reported air releases), and EPA did not have additional sources to estimate water releases from this OES. Based on the NAICS and SIC codes used to map data from the reporting databases (CDR, NEI, etc.), there may be 23 additional repackaging sites that do not have reported releases for this media in this assessment. As discussed above, the strength of the analysis includes using industry reported release data to various EPA databases. However, several uncertainties discussed above, such as not capturing all release sources, slightly reduced the confidence of the analysis. Therefore, EPA concluded that the weight of scientific evidence for this assessment is moderate to robust, considering the strengths and limitations of reasonably available data.
Incorporation into formulations, mixtures, or reaction products	Air releases are assessed using reported releases from 2017–2022 TRI (U.S. EPA, 2024o), and 2017 and 2020 NEI (U.S. EPA, 2023a, 2019e). The primary strength of TRI data is that TRI compiles the data reported directly by facilities that manufacture, process, and/or use DBP. NEI captures additional sources that are not included in TRI due to reporting thresholds. Factors that decrease the overall confidence for this OES include the uncertainty in the accuracy of reported releases, and the limitations in representativeness to all sites because TRI and NEI may not capture all relevant sites. The air releases assessment is based on 32 reporting sites under NEI and 18 reporting sites in TRI (2 sites reported under both TRI and NEI). Based on the NAICS and SIC codes used to map data from the reporting databases (CDR, DMR, etc.), there may be 2 additional incorporation into formulation, mixture, or reaction product sites that do not have reported releases for this media in this assessment. The relatively large number of reporting sites is a strength for these release estimates as they add variability to the assessment and as a result are more likely to be representative of the industry as a whole. Land releases are assessed using reported releases from 2017–2022 TRI. The primary limitation is that the land releases assessment is based on three reporting sites, and EPA did not have additional sources to estimate land releases from this OES. Based on the NAICS and SIC codes used to map data from the reporting databases (CDR, DMR, NEI, etc.), there may be 47 additional incorporation into formulation, mixture, or reaction product sites that do not have reported releases for this media in this assessment. Water releases are assessed using reported releases from 2017–2022 TRI. Factors that decrease the overall confidence for this OES include the uncertainty in the accuracy of reported releases, the limitations in representativeness to all sites because TRI may not capture all relevant sites, and EPA did not have additional sources to estimate water releases from this OES. The water releases assessment is based on 11 reporting sites in TRI. Based on the NAICS and SIC codes used to map data from the reporting databases (CDR, NEI, etc.), there may be 39 additional incorporation into formulation, mixture, or reaction product sites that do not have reported releases for this media in this assessment. As discussed above, the strength of the analysis includes using industry reported release data to various EPA databases. However, several uncertainties discussed above, such as not capturing all release sources, slightly reduced the confidence of the analysis.

OES	Weight of Scientific Evidence Conclusion in Release Estimates
	Therefore, EPA concluded that the weight of scientific evidence for this assessment is moderate to robust, considering the strengths and limitations of reasonably available data.
PVC plastics compounding	Air releases are assessed using reported releases from 2017–2022 TRI (U.S. EPA, 2024o), and 2017 and 2020 NEI (U.S. EPA, 2023a, 2019e). The primary strength of TRI data is that TRI compiles the data reported directly by facilities that manufacture, process, and/or use DBP. NEI captures additional sources that are not included in TRI due to reporting thresholds. Factors that decrease the overall confidence for this OES include the uncertainty in the accuracy of reported releases, and the limitations in representativeness to all sites because TRI and NEI may not capture all relevant sites. The air releases assessment is based on 1 reporting site under NEI and 1 reporting site in TRI. Based on the NAICS and SIC codes used to map data from the reporting databases (CDR, DMR, etc.), there may be 15 additional PVC plastics compounding sites that do not have reported releases for this media in this assessment. TRI reporters identified for this OES reported 0 releases for land; however, it is uncertain if that is representative for PVC compounding sites as a whole. Because of this, EPA assessed land releases using surrogate data from sites that were identified under the OES for non-PVC materials manufacturing. Releases were estimated using reported releases from 2017–2022 TRI. The primary limitation is that the land releases assessment is based on 3 reporting sites, and EPA did not have additional sources to estimate land releases from this OES. Water releases are assessed using reported releases from to DMR (U.S. EPA, 2024a). The primary strength of DMR data is that it may capture additional sources that are not included in TRI due to reporting thresholds. A factor that decreases the overall confidence for this OES include the uncertainty in the accuracy of reported releases. The water releases assessment is based on 14 reporting sites. Based on the NAICS and SIC codes used to map data from the reporting databases (CDR, NEI, etc.), there may be 3 PVC plastics compounding sites that do not have reported releases for this media in this assessment. As discussed above, the strength of the analysis includes using industry reported release data to various EPA databases. However, several uncertainties discussed above, such as not capturing all release sources, slightly reduced the confidence of the analysis. Therefore, EPA concluded that the weight of scientific evidence for this assessment is moderate to robust, considering the strengths and limitations of reasonably available data.
PVC plastics converting	Air releases are assessed using reported releases from 2017–2022 TRI (U.S. EPA, 2024o), and 2017 and 2020 NEI (U.S. EPA, 2023a, 2019e). The primary strength of TRI data is that TRI compiles the data reported directly by facilities that manufacture, process, and/or use DBP. NEI captures additional sources that are not included in TRI due to reporting thresholds. Factors that decrease the overall confidence for this OES include the uncertainty in the accuracy of reported releases, and the limitations in representativeness to all sites because TRI and NEI may not capture all relevant sites. The air releases assessment is based on 7 reporting sites under NEI and 1 reporting site in TRI. Based on the NAICS and SIC codes used to map data from the reporting databases (CDR, DMR, etc.), there may be 2 additional PVC plastics converting sites that do not have reported releases for this media in this assessment. EPA did not identify land release data from TRI reporters for this OES. These releases were assessed using surrogate data from sites that were identified under the OES for non-PVC materials manufacturing due to expected similarities in the processes that occur at the

OES	Weight of Scientific Evidence Conclusion in Release Estimates
	sites. Releases were estimated using reported releases from 2017–2022 TRI. The primary limitation is that the land releases assessment is based on 3 reporting sites, and EPA did not have additional sources to estimate land releases from this OES. EPA did not identify water release data from TRI and DMR reporters for this OES. These releases are assessed using surrogate data from sites that were identified under the OES for PVC plastics compounding due to expected similarities in the processes that occur at the sites. Water releases are assessed using reported releases from to DMR (U.S. EPA, 2024a). The primary strength of DMR data is that it may capture additional sources that are not included in TRI due to reporting thresholds. A factor that decreases the overall confidence for this OES include the uncertainty in the accuracy of reported releases. The water releases assessment is based on 14 reporting sites. As discussed above, the strength of the analysis includes using industry reported release data to various EPA databases. However, several uncertainties discussed above, such as not capturing all release sources, slightly reduced the confidence of the analysis. Therefore, EPA concluded that the weight of scientific evidence for this assessment is moderate to robust, considering the strengths and limitations of reasonably available data.
Non-PVC material manufacturing	Air releases are assessed using reported releases from 2017–2022 TRI (U.S. EPA, 2024o), and 2017 and 2020 NEI (U.S. EPA, 2023a, 2019e). NEI captures additional sources that are not included in TRI due to reporting thresholds. Factors that decrease the overall confidence for this OES include the uncertainty in the accuracy of reported releases, and the limitations in representativeness to all sites because TRI and NEI may not capture all relevant sites. The air releases assessment is based on 49 reporting sites under NEI and 4 reporting sites in TRI (one site reported under both TRI and NEI). The relatively large number of reporting sites is a strength for these release estimates as they add variability to the assessment and as a result are more likely to be representative of the industry as a whole. Land releases are assessed using reported releases from 2017–2022 TRI. The primary limitation is that the land releases assessment is based on 3 reporting sites, and EPA did not have additional sources to estimate land releases from this OES. Based on the NAICS and SIC codes used to map data from the reporting databases (CDR, DMR, NEI, etc.), there may be 49 additional non PVC-material manufacturing sites that do not have reported releases for this media in this assessment. Water releases are assessed using reported releases from 2017–2022 TRI. The primary strength of TRI data is that TRI compiles the best readily available release data for all reporting facilities. Factors that decrease the overall confidence for this OES include the uncertainty in the accuracy of reported releases, the limitations in representativeness to all sites because TRI may not capture all relevant sites, and EPA did not have additional sources to estimate water releases from this OES. The water releases assessment is based on 1 reporting site in TRI. Based on the NAICS and SIC codes used to map data from the reporting databases (CDR, NEI, etc.), there may be 51 additional sites that do not have reported releases for this media in this assessment. As discussed above, the strength of the analysis includes using industry reported release data to various EPA databases. However, several uncertainties discussed above, such as not capturing all release sources, slightly reduced the confidence of the analysis.

OES	Weight of Scientific Evidence Conclusion in Release Estimates
	Therefore, EPA concluded that the weight of scientific evidence for this assessment is moderate to robust, considering the strengths and limitations of reasonably available data.
Application of adhesives and sealants	Air releases are assessed using reported releases from 2017 and 2020 NEI (U.S. EPA, 2023a, 2019e). NEI captures additional sources that are not included in TRI due to reporting thresholds. Another factor that increases the strength of the data is that air release data was provided by 166 reporting sites, which adds variability to the assessment. Factors that decrease the overall confidence for this OES include the uncertainty in the accuracy of reported releases, the fact that the type of end-use product is uncertain between adhesives/sealants and paint/coatings, and the limitations in representativeness to all sites because NEI may not capture all relevant sites. EPA was unable to identify chemical and site-specific releases to land and water and assessed these releases using the ESD on the Use of Adhesives (OECD, 2015). EPA used EPA/OPPT models combined with Monte Carlo modeling to estimate releases to the environment and media of release using appropriate default input parameters from the ESD and EPA/OPPT models. The Agency believes a strength of the Monte Carlo modeling approach is that variation in model input values allow for estimation of a range of potential release values that are more likely to capture actual releases than a discrete value. Monte Carlo modeling also considers a large number of data points (simulation runs) and the full distributions of input parameters. Additionally, EPA used DBP-specific data on concentration and application methods for different DBP-containing adhesives and sealant products in the analysis. These data provide more accurate estimates than the generic values provided by the ESD. These strengths increase the weight of evidence. The primary limitation of EPA's approach to land and water releases is the uncertainty in the representativeness of estimated release values toward the true distribution of potential releases at all sites in this OES. Specifically, the generic default values in the ESD may not represent releases from real-world sites that incorporate DBP into adhesives and sealants. Based on the number of formulated products identified, the overall production volume of DBP for this OES was estimated by assuming that the portion of DBP with uncertain end-use will be split between adhesives/sealants and paint/coating products. EPA lacks data on DBP-specific facility use volume and number of use sites; therefore, the Agency based facility throughput estimates and number of sites on industry-specific default facility throughputs from the ESD, DBP product concentrations, and the overall production volume range from CDR data which has a reporting threshold of 25,000 lb. These limitations decrease the weight of evidence. As discussed above, the strength of the analysis includes using industry reported release data to various EPA databases. However, several uncertainties discussed above, such as not capturing all release sources, slightly reduced the confidence of the analysis. Therefore, EPA concluded that the weight of scientific evidence for this assessment is moderate to robust, considering the strengths and limitations of reasonably available data.
Application of paints and coatings	Air releases are assessed using reported releases from 2017 and 2020 NEI (U.S. EPA, 2023a, 2019e). NEI captures additional sources that are not included in TRI due to reporting thresholds. Another factor that increases the strength of the data is that air release data was provided by 166 reporting sites, which adds variability to the assessment. Factors that decrease the overall confidence for this OES include the uncertainty in the accuracy of reported releases, the fact that the type of end-use product is uncertain between adhesives/sealants and paint/coatings, and the limitations in representativeness to all sites because NEI may not capture all relevant sites.

OES	Weight of Scientific Evidence Conclusion in Release Estimates
	EPA was unable to identify chemical and site-specific releases to land and water and assessed these releases using the ESD on the Application of Radiation Curable Coatings, Inks and Adhesives and the GS on Coating Application via Spray Painting in the Automotive Refinishing Industry (OECD, 2011a, b). EPA used EPA/OPPT models combined with Monte Carlo modeling to estimate releases to the environment. EPA assessed media of release using appropriate default input parameters from the ESD, GS, and EPA/OPPT models and a default assumption that all paints and coatings are applied via spray application. EPA believes a strength of the Monte Carlo modeling approach is that variation in model input values allow for estimation of a range of potential release values that are more likely to capture actual releases than a discrete value. Monte Carlo modeling also considers a large number of data points (simulation runs) and the full distributions of input parameters. Additionally, EPA used DBP-specific data on concentration for different DBP-containing paints and coatings in the analysis. These data provide more accurate estimates than the generic values provided by the GS and ESD. These strengths increase the weight of evidence. The primary limitation of EPA's approach to land and water releases is the uncertainty in the representativeness of estimated release values toward the true distribution of potential releases at all sites in this OES. Specifically, the generic default values in the GS and ESD may not represent releases from real-world sites that incorporate DBP into paints and coatings. Additionally, EPA assumes spray applications of the coatings, which may not be representative of other coating application methods. In addition, the Agency lacks data on DBP-specific facility use volume and number of use sites; therefore, EPA based throughput estimates on values from ESD, GS, and CDR data which has a reporting threshold of 25,000 lb and an annual DBP production volume range. Finally, EPA estimated the overall production volume of DBP for this OES by assuming that the portion of DBP with uncertain end-use will be split between adhesives/sealants and paint/coating products. These limitations decrease the weight of evidence. As discussed above, the strength of the analysis includes using industry reported release data to NEI and using Monte Carlo modeling that can use range as an input. However, several uncertainties discussed above, such as the unavailability of reported releases for land and water, slightly reduced the confidence of the analysis. Therefore, EPA concluded that the weight of scientific evidence for this assessment is moderate to robust, considering of the strengths and limitations of reasonably available data.
Industrial process solvent use	Air releases are assessed using reported releases from 2017–2022 TRI (U.S. EPA, 2024o), and 2017 and 2020 NEI (U.S. EPA, 2023a, 2019e). NEI captures additional sources that are not included in TRI due to reporting thresholds. Factors that decrease the overall confidence for this OES include the uncertainty in the accuracy of reported releases, and the limitations in representativeness to all sites because TRI and NEI may not capture all relevant sites. The air releases assessment is based on 2 reporting sites under NEI and 1 reporting site in TRI (site reported under both TRI and NEI). Based on the NAICS and SIC codes used to map data from the reporting databases (CDR, DMR, etc.), there may be 1 additional industrial process solvent use site that is not accounted for in this assessment. EPA was unable to identify land release data from TRI reporters for this OES. These releases were assessed using surrogate data from sites that were identified under the OES for incorporation into formulation, mixtures, or reaction products due to expected similarities in the processes that occur at the sites. Land releases were estimated using reported releases from 2017–2022 TRI. The primary limitation is that the land releases assessment is based on 3 reporting sites, and EPA did not have additional sources to estimate land releases from this OES.

OES	Weight of Scientific Evidence Conclusion in Release Estimates
	EPA was unable to identify water release data from TRI and DMR reporters for this OES; however, based on the specifics of DBP's use in the process, the Agency does not expect water releases for this OES. This is based on process information provided by Huntsman Corporation, which was rated high in systematic review (Huntsman, 2015). As discussed above, the strength of the analysis includes using industry reported release data to various EPA databases. However, several uncertainties discussed above, such as not capturing all release sources or using surrogate reported releases, slightly reduced the confidence of the analysis. Therefore, EPA concluded that the weight of scientific evidence for this assessment is moderate to robust, considering of the strengths and limitations of reasonably available data.
Use of laboratory chemicals	Air releases are assessed using reported releases from 2017 and 2020 NEI (U.S. EPA, 2023a, 2019e). NEI captures additional sources that are not included in TRI due to reporting thresholds. NEI data was collected from 2 reporting sites. Factors that decrease the overall confidence for this OES include the uncertainty in the accuracy of reported releases, and the limitations in representativeness to all sites because NEI may not capture all relevant sites. EPA were unable to identify chemical and site-specific releases to land and water and assessed these releases using the Draft GS on the Use of laboratory chemicals (U.S. EPA, 2023h). EPA used EPA/OPPT models combined with Monte Carlo modeling to estimate releases to the environment, and media of release using appropriate default input parameters from the GS and EPA/OPPT models for solid and liquid DBP materials. EPA believes a strength of the Monte Carlo modeling approach is that variation in model input values allow for estimation of a range of potential release values that are more likely to capture actual releases than a discrete value. Monte Carlo modeling also considers a large number of data points (simulation runs) and the full distributions of input parameters. EPA used SDSs from identified laboratory DBP products to inform product concentration and material states. These strengths increase the weight of evidence. EPA believes the primary limitation of the land and water release assessments to be the uncertainty in the representativeness of values toward the true distribution of potential releases. In addition, the Agency lacks data on DBP-specific laboratory chemical throughput and number of laboratories; therefore, EPA based the number of laboratories and throughput estimates on stock solution throughputs from the Draft GS on the Use of Laboratory Chemicals and on CDR Reporting Thresholds. Additionally, because no entries in CDR indicate a laboratory use and there were no other sources to estimate the volume of DBP used in this OES, EPA developed a high-end bounding estimate based on the CDR reporting threshold of 25,000 lb or 5% of total product volume for a given use, which by definition is expected to over-estimate the average release case. These limitations decrease the weight of evidence. As discussed above, the strength of the analysis includes using industry reported release data to NEI and using Monte Carlo modeling that can use range as an input. However, several uncertainties discussed above, such as the unavailability of reported releases for land and water, slightly reduced the confidence of the analysis. Therefore, EPA concluded that the weight of scientific evidence for this assessment is moderate to robust, considering of the strengths and limitations of reasonably available data.
Use of lubricants and functional fluids	EPA found limited chemical-specific data for the Use of lubricants and functional fluids OES and assessed releases to the environment using the ESD on the Lubricant and Lubricant Additives. EPA used EPA/OPPT models combined with Monte Carlo modeling to estimate releases to the environment and media of release using appropriate default input parameters from the ESD and

OES	Weight of Scientific Evidence Conclusion in Release Estimates
	EPA/OPPT models. The Agency believes the strength of the Monte Carlo modeling approach is that variation in model input values and a range of potential release values are more likely to capture actual releases than discrete values. Monte Carlo modeling also considers a large number of data points (simulation runs) and the full distributions of input parameters. EPA did not identify a lubricant or functional fluid product that contained DBP but identified 1 DINP-containing functional fluid for use in Monte Carlo analysis for the risk evaluation for that chemical. Therefore, EPA used products containing DINP as surrogate for concentration and use data in the analysis. This data provides more accurate estimates than the generic values provided by the ESD. The primary limitation of EPA's approach is the uncertainty in the representativeness of estimated release values toward the true distribution of potential releases at all sites in this OES. Specifically, the generic default values in the ESD may not represent releases from real-world sites using DBP-containing lubricants and functional fluids. In addition, EPA lacks information on the specific facility use rate of DBP-containing products and number of use sites; therefore, EPA estimated the number of sites and throughputs based on CDR, which has a reporting threshold of 25,000 lb (*i.e.*, not all potential sites represented), and an annual DBP production volume range that spans an order of magnitude. The respective share of DBP use for each OES presented in the EU Risk Assessment Report may differ from actual conditions adding some uncertainty to estimated releases. Furthermore, EPA lacks chemical-specific information on concentrations of DBP in lubricants and functional fluids and primarily relied on surrogate data. Actual concentrations may differ adding some uncertainty to estimated releases. As discussed above, the strength of the analysis includes using Monte Carlo modeling, which can use a range as an input, increases confidence in the analysis. However, several uncertainties discussed above, such as the lack of availability of reported releases, reduced the confidence of the analysis. Therefore, EPA concluded that the weight of scientific evidence for this assessment is moderate, considering the strengths and limitations of the reasonably available data.
Use of penetrants and inspection fluids	EPA found limited chemical specific data for the Use of penetrants and inspection fluids OES and assessed releases to the environment using the ESD on the Use of Metalworking Fluids (OECD, 2011c). EPA used EPA/OPPT models combined with Monte Carlo modeling to estimate releases to the environment, media of release using appropriate default input parameters from the ESD, and EPA/OPPT models. The Agency believes the strength of the Monte Carlo modeling approach is that variation in model input values and a range of potential release values are more likely to capture actual releases than discrete values. Monte Carlo modeling also consider a large number of data points (simulation runs) and the full distributions of input parameters. EPA assessed an aerosol and non-aerosol application method based on surrogate DINP-specific penetrant data that also provided DINP concentration. The safety and product data sheets that EPA used to obtain these values provide more accurate estimates than the generic values provided by the ESD. The primary limitation of EPA's approach is the uncertainty in the representativeness of estimated release values toward the true distribution of potential releases at all sites in this OES. Specifically, the generic default values in the ESD and the surrogate material parameters may not be representative of releases from real-world sites that use DBP-containing inspection fluids and penetrants. Additionally, because no entries in CDR indicate this OES use case and there were no other sources to estimate the volume of DBP used in this OES, EPA developed a high-end bounding estimate based on CDR reporting threshold, which by definition is expected to overestimate the average release case.

OES	Weight of Scientific Evidence Conclusion in Release Estimates
	As discussed above, the strength of the analysis includes using Monte Carlo modeling, which can use a range as an input, increases confidence in the analysis. However, several uncertainties discussed above, such as the lack of availability of reported releases, reduced the confidence of the analysis. Therefore, EPA concluded that the weight of scientific evidence for this assessment is moderate, considering the strengths and limitations of the reasonably available data.
Fabrication or use of final product or articles	No data were available to estimate releases for this OES and there were no suitable surrogate release data or models. This release is described qualitatively.
Recycling	EPA found limited chemical specific data for the Recycling OES. EPA assessed releases to the environment from recycling activities using the Revised Draft GS for the Use of Additives in Plastic Compounding (U.S. EPA, 2021e) as surrogate for the recycling process. EPA/OPPT models were combined with Monte Carlo modeling to estimate releases to the environment. EPA believes the strength of the Monte Carlo modeling approach is that variation in model input values and a range of potential release values are more likely to capture actual releases than discrete values. Monte Carlo modeling also considers a large number of data points (simulation runs) and the full distributions of input parameters. EPA referenced the Quantification and evaluation of plastic waste in the United States (Milbrandt et al., 2022), to estimate the rate of PVC recycling in the United States. EPA estimated the DBP PVC market share (based on the surrogate market shares from DINP and DIDP) to define an approximate recycling volume of PVC containing DBP. These strengths increase the weight of evidence. The primary limitation of EPA's approach is the uncertainty in the representativeness of estimated release values toward the true distribution of potential releases at all sites in this OES. Specifically, the generic default values and release points in the GS represent all types of plastic compounding sites and may not represent sites that recycle PVC products containing DBP. In addition, EPA lacks DBP-specific PVC recycling rates and facility production volume data; therefore, EPA based throughput estimates on PVC plastics compounding data and U.S. PVC recycling rates, which are not specific to DBP and may not accurately reflect current U.S. recycling volume. DBP may also be present in non-PVC plastics that are recycled; however, EPA was unable to identify information on these recycling practices. These limitations decrease the weight of evidence. As discussed above, the strength of the analysis includes using Monte Carlo modeling, which can use a range as an input, increases confidence in the analysis. However, several uncertainties discussed above, such as the lack of availability of reported releases, reduced the confidence of the analysis. Therefore, EPA concluded that the weight of scientific evidence for this assessment is moderate, considering the strengths and limitations of the reasonably available data.
Waste handling, treatment, and disposal	***General Waste Handling, Treatment, and Disposal*** Air releases for non-POTW sites are assessed using reported releases from 2017–2022 TRI, and 2017 and 2020 NEI. NEI captures additional sources that are not included in TRI due to reporting thresholds. Factors that decrease the confidence for this OES include the uncertainty in the accuracy of reported releases, and the limitations in representativeness to all sites because TRI and NEI may not capture all relevant sites. The air release assessment is based on 147 sites under NEI and 20 sites in TRI (with 9 sites reporting under

OES	Weight of Scientific Evidence Conclusion in Release Estimates
	both NEI and TRI). Based on other reporting databases (CDR, DMR, etc), there are 12 additional non-POTW sites that do not have reported releases for this media in this assessment. Land releases for non-POTW are assessed using reported releases from 2017–2022 TRI. The primary limitation is that the land releases assessment is based on 12 reporting sites, and EPA did not have additional sources to estimate land releases from this OES. Based on the reporting databases (CDR, DMR, NEI, etc.), there are 214 additional waste handling, treatment, and disposal sites that do not have reported releases for this media in this assessment. Water releases for non-POTW sites are assessed using reported releases from 2017 to 2022 TRI and DMR. The primary strength of TRI data is that TRI compiles the best readily available release data for all reporting facilities. For non-POTW sites, the primary limitation is that the water release assessment is based on 13 reporting sites under DMR and one reporting site in TRI, and EPA did not have additional sources to estimate water releases from this OES. Based on other reporting databases (CDR, NEI, etc), there are 156 additional sites that do not have reported releases for this media in this assessment. As discussed above, the strength of the analysis includes using industry reported release data to various EPA databases. However, several uncertainties discussed above, such as not capturing all release sources, slightly reduced the confidence of the analysis. Therefore, EPA concluded that the weight of scientific evidence for this assessment is moderate to robust, considering the strengths and limitations of reasonably available data. ***Waste Handling, Treatment, and Disposal (POTW and Remediation)*** Water releases for POTW and remediation sites are assessed using reported releases from 2017–2022 DMR, which has a high overall data quality determination from the systematic review process. A strength of using DMR data and the Pollutant Loading Tool used to pull the DMR data is that the tool calculates an annual pollutant load by integrating monitoring period release reports provided to the EPA and extrapolating over the course of the year. However, this approach assumes average quantities, concentrations, and hydrologic flows for a given period are representative of other times of the year. A total of 57 POTW/remediation sites reported releases of DBP to DMR. Based on this information, for POTW releases, EPA has concluded that the weight of scientific evidence for this assessment is moderate to robust, considering the strengths and limitations of reasonably available data.

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3.2.3 Strengths, Limitations, Assumptions, and Key Sources of Uncertainty for the Environmental Release Assessment

Strengths

EPA compiled release information using reported releases from the 2017 through 2022 TRI (U.S. EPA, 2024o), 2017 through 2022 DMR (U.S. EPA, 2024a), and 2017 through 2020 NEI (U.S. EPA, 2023a, 2019e). NEI obtained a high data quality rating and TRI and DMR obtained a medium quality rating from EPA's systematic review process. Furthermore, TRI-reporting facilities are required to submit their "best available data" to EPA for TRI reporting purposes. Some facilities are required to measure or monitor emission or other waste management quantities due to regulations unrelated to the TRI Program (*e.g.*, permitting requirements), or due to company policies. These existing, reasonably available data are often used by facilities for TRI reporting purposes, as they represent the best available data (*e.g.*, stack releases can be directly measured by stack testing using EPA reference methods providing a directly measured emission rate which can then be used to calculate annual emissions). DMR-reporting facilities are required to monitor, measure, and report effluent at regular intervals, thus generating many site-specific water release datapoints. Though NEI does not require stack testing or continuous emissions monitoring and reporting agencies may use different emission estimation methods, reasonable estimates may be obtained through mass-balance calculations, the use of emission factors, and engineering calculations.

Limitations

Facilities are only required to report to TRI if the facility has 10 or more full-time employees, is included in an applicable NAICS code, and manufactures, processes, or uses the chemical in quantities greater than a certain threshold (25,000 lb for manufacturers and processors and 10,000 lb for users). For NEI, the Air Emissions Reporting Requirements (AERR) only requires Criteria Air Pollutants (CAP) data reporting, Hazardous Air Pollutants (HAP) data reporting is voluntary. As a result, EPA augments SLT-provided HAP data with other information to better estimate point, nonpoint, and mobile source HAP emissions. For point sources, HAP augmentation is performed on each emissions source using the WebFIRE database or data from TRI. DMR data are submitted by NPDES permit holders to states or directly to the EPA according to the monitoring requirements of the facility's permit. States are only required to load major discharger data into DMR and may or may not load minor discharger data. The definition of major vs. minor discharger is set by each state and could be based on discharge volume or facility size. Due to these limitations across programs, some sites may release DBP but are not included in TRI, NEI, or DMR. It is uncertain, the extent to which, sites not captured in these databases release DBP into the environment or whether releases from sites not in the databases are to water, air, or landfill.

Manufacturers and importers of DBP submit CDR data to EPA if they meet reporting threshold requirements. Sites are only required to report production data to CDR if their yearly production volume exceeds 25,000 lb. Sites can claim their production volume as CBI, further limiting the production volume information in CDR. As a result, some sites that produce or use DBP may not be included in the CDR dataset and the total production volume for a given OES may be underestimated. The extent to which sites that are not captured in the CDR release DBP into the environment is unknown. The media of release for these sites is also unknown.

Assumptions and Uncertainties

There is some uncertainty in the DMR data pulled using the ECHO Pollutant Loading Tool Advanced Search option. For facilities that reported having zero pollutant loads to DMR, the EZ Search Load

Module uses a combination of setting non-detects equal to zero and as one-half the detection limit to calculate the annual pollutant loadings. This method could cause overestimation or underestimation of annual and daily pollutant loads. A strength of using DMR data and the Pollutant Loading Tool is that the tool calculates an annual pollutant load by integrating monitoring period release reports provided to the EPA and extrapolating over the course of the year. However, this approach assumes average quantities, concentrations, and hydrologic flows for a given period are representative of other times of the year.

When monitoring or direct measurement data are not reasonably available or are known to be non-representative for TRI reporting purposes, the TRI regulations require that facilities determine release and other waste management quantities of TRI-listed chemicals by making reasonable estimates. There is additional uncertainty in daily release estimates for air emissions. Facilities reporting to TRI report annual air emissions while NEI reports annual air emissions and the estimated number of release days. To assess daily air emissions for TRI, EPA used relevant data from relevant ESDs or GSs to estimate the expected number of release days.

CDR information on the downstream processing and use of DBP at facilities is also limited; therefore, there is some uncertainty as to the production volume attributed to a given OES. For OES with limited CDR data, EPA developed potential production volume ranges given reported CDR data, known reporting thresholds, and the national aggregate production volume of 1,000,000 to 10,000,000 lb for DBP in 2019. To handle an OES without programmatic data, EPA used the potential production volume ranges as uniform distributions in Monte Carlo modeling when assessing releases for each OES. Due to the wide range of potential production volumes attributable to certain OES, the overall releases may be over or underestimated. DBP releases at each site may vary from day to day, such that on any given day the actual daily release rate may be higher or lower than the estimated average daily release rate.

The EPA has further identified the following additional uncertainties that contribute to the overall uncertainty in the environmental release assessment:

- **Use of Census Bureau for Number of Facilities:** In some cases, EPA estimated the maximum number of facilities for a given OES using data from the U.S. Census. In such cases, the Agency determined the maximum number of sites for use in Monte Carlo modeling from industry data from the U.S. Census Bureau, County and Business Patterns dataset (U.S. BLS, 2023).
- **Uncertainties Associated with Facility Throughputs:** EPA estimated facility throughputs of DBP or DBP-containing products using various methods, including using generic industry data presented in the relevant GS or ESD or by calculation based on estimated number of facilities and overall production volume of DBP from CDR for the given OES. In either case, the values used for facility throughputs may encompass a wide range of possible values. Due to these uncertainties, the facility throughputs may be under or overestimated.
- **Uncertainties Associated with Number of Release Days Estimate:** For most OESs, EPA estimated the number of release days using programmatic data where available, or from GSs, ESDs, or SpERC factsheets when no programmatic data were found. In such cases, EPA used applicable sources to estimate a range of release days over the course of an operating year. Due to uncertainty in DBP-specific facility operations, release days may be under or overestimated.
- **Uncertainties Associated with DBP-Containing Product Concentrations:** In most cases, the number of identified products for a given OES were limited. In such cases, EPA estimated a range of possible DBP concentrations for products in the OES. However, the extent to which

these products represent all DBP-containing products within the OES is uncertain. For OESs with little-to-no reasonably available product data, EPA estimated DBP concentrations from GSs or ESDs. Due to these uncertainties, the average product concentrations may be under or overestimated.

3.3 Summary of Concentrations of DBP in the Environment

Based on the environmental release assessment summarized in Section 3.2 and presented in EPA's *Draft Environmental Release and Occupational Exposure Assessment for Dibutyl Phthalate (DBP)* (U.S. EPA, 2025q), DBP is expected to be released to the environment via air, water, biosolids, and disposal to landfills. Environmental media concentrations were quantified in ambient air, soil from ambient air deposition, surface water, and sediment. Additional analysis of surface water used as drinking water was conducted for the Human Health Risk Assessment (Section 4). Given limited available information on DBP in soil and groundwater from releases to biosolids and landfills, along with the availability of high-quality physical and chemical and fate data (Section 2), concentrations of DBP in soil and groundwater from releases to biosolids and landfills were not quantified (discussed further below. Air releases of DBP from fugitive and stack emissions with deposition to soil were estimated using the Integrated Indoor/Outdoor Air Calculator (IIOAC) Model, as described in Section 8.1.3 of the *Draft Environmental Media, General Population, and Environmental Exposure Assessment for Dibutyl Phthalate (DBP)* (U.S. EPA, 2025p).

EPA relied on its fate assessment to determine which environmental pathways to consider for its screening level analysis of environmental exposure and general population exposure. Details on the environmental partitioning and media assessment can be found in *Draft Chemistry, Fate, and Transport Assessment for Dibutyl Phthalate (DBP)* (U.S. EPA, 2024j). Briefly, based on DBP's fate parameters and behavior (*e.g.*, Henry's Law constant, log K_{OC}, water solubility, fugacity modeling), EPA anticipates DBP to be predominantly in water and soil, though DBP may also exist in air and sediments. Therefore, EPA quantitatively assessed concentrations of DBP in surface water, sediment, ambient air, and soil from air to soil deposition. Soil concentrations of DBP from land application of biosolids were not quantitatively assessed due to limited available information as well as the expectation that DBP is to have limited persistence potential and mobility in soils receiving biosolids. Thus, they present limited exposure potential. In contrast, EPA has greater confidence in quantifying DBP concentrations in soil resulting from air to soil deposition since it is direct deposition into soil rather than mobility from air to soil (as with biosolids). Therefore, EPA quantified air to soil deposition with a screening level approach for the purpose of the environmental exposure assessment.

Further detail on the screening level assessment of each environmental pathway can be found in the *Draft Environmental Media, General Population, and Environmental Exposure Assessment for Dibutyl Phthalate (DBP)* (U.S. EPA, 2025p). EPA began its environmental and general population exposure assessment with a screening level approach using the highest modeled environmental media concentrations for the environmental pathways expected to be of greatest concern. The highest environmental media concentrations were estimated using the release estimates for an OES associated with a COU that, paired with conservative assumptions of environmental conditions, resulted in the greatest modeled concentration of DBP in a given environmental medium type. Therefore, EPA did not estimate environmental concentrations of DBP resulting from all OESs presented in Table 3-1. Details on the use of screening level analyses in exposure assessment can be found in EPA's *Guidelines for Human Exposure Assessment* (U.S. EPA, 2019d).

For the water pathway, different hydrological flow rates were used for the different screening level exposure scenarios. The 30Q5[1] flows (lowest 30-day average flow that occurs in a 5-year period) are used to estimate acute, incidental human exposure through swimming or recreational contact. The harmonic mean[2] flows provide a more conservative estimate as compared to annual average flows and are therefore preferred for assessing potential chronic human exposure via drinking water. The harmonic mean is also used for estimating human exposure through fish ingestion because it takes time for chemical concentrations to accumulate in fish. Lastly, for aquatic or ecological exposure, a 7Q10[3] flow (lowest 7-day average flow that occurs in a 10-year period) is used to estimate exceedances of concentrations of concern for aquatic life (U.S. EPA, 2007b).

For the screening level assessment, the OES(s) resulting in the highest environmental concentration of DBP to be used for subsequent exposure screening varied by environmental media, as shown in Table 3-6. Releases to surface water were sorted by comparing daily release estimates with receiving water body flow rates to determine the order of release concentrations prior to modeling. Manufacturing yielded the highest water concentration using a 7Q10 flow, a 30Q5 flow, and harmonic mean flow. The combined release estimates from the Waste handling, treatment, and disposal (stack; corresponding to the Disposal COU) and Application of paints, coatings, adhesives, and sealants (fugitive; corresponding to the Industrial/commercial use; Construction, paint, electrical, and metal products; and Adhesives and sealants/paints and coatings COUs) OESs yielded the highest ambient air concentration. The summary table also indicates whether the high-end estimate was used for environmental or general population exposure assessment as well as which flow statistics were selected to screen for risks to human or environmental health. For the screening level analysis, if the high-end environmental media concentrations did not result in potential environmental or human health risk, no further OESs were assessed, and no further refinements were pursued. For the surface water and ambient air pathways, only the OESs resulting in the highest estimated water column or ambient air concentrations were carried forward to the human health risk assessment (*i.e.*, Manufacturing for water; Waste handling, treatment, and disposal [stack]; Application of paints, coatings, adhesives, and sealants; and Application of paints, coatings, adhesives, and sealants [fugitive] for ambient air). For aquatic ecological exposure, the OES resulting in the highest estimated water column or sediment concentrations (Manufacturing) was used as the starting point to determine the reference concentration for the screening assessment; see Sections 5.1 and 5.3.1 for details of how the ecological screening assessment was performed.

[1] 30Q5 is defined as 30 consecutive days of lowest flow over a 5-year period. These flows are used to determine acute human exposures via drinking water (U.S. EPA, 2007b).
[2] Harmonic mean is defined as the inverse mean of reciprocal daily arithmetic mean flow values. These flows represent a long-term average and are used to generate estimates of chronic human exposures via drinking water and fish ingestion.
[3] 7Q10 is defined as 7 consecutive days of lowest flow over a 10-year period. These flows are used to calculate estimates of chronic surface water concentrations to compare with the COCs for aquatic life.

Table 3-6. Summary of High-End DBP Concentrations in Various Environmental Media from Environmental Releases

OES [a]	Release Media	Environmental Media	DBP Concentration	Environmental or General Population
Manufacturing	Water	Total water column (7Q10) [b], P50 flow [c]	1,160 µg/L (286-day average)	Environmental
		P75 flow	67.80 µg/L (286-day average)	
		P90 flow	4.00 µg/L (286-day average)	
Manufacturing	Sediment	Benthic sediment (7Q10), P50 flow	27 mg/kg (7-day average)	Environmental
		P75 flow	1.57 mg/kg (7-day average)	
		P90 flow	0.093 mg/kg (7-day average)	
Fugitive: application of paints, coatings, adhesives, and sealants stack: waste handling, treatment, and disposal	Air deposition to soil	Annual deposition rate to soil	0.00178 mg/kg/yr (365-day release)	Environmental and General Population
Manufacturing	Water	Total water column (30Q5) [d], P50 flow [c]	885 µg/L	General Population
		P75 flow	46.6 µg/L	
		P90 flow	3.0 µg/L	
Waste handling, treatment, and disposal	Water	Surface water (30Q5) [d]	14.5 µg/L	General Population
		Surface water (harmonic mean) [e]	14.5 µg/L	
Waste handling, treatment, and disposal (stack)	Ambient air	Daily-averaged total (fugitive and stack, 100 m)	17.26 µg/m^3	General Population
Application of paints, coatings, adhesives, and sealants Application of paints, coatings, adhesives, and sealants (fugitive)		Annual-averaged total (fugitive and stack, 100 m)	11.82 µg/m^3	General Population

[a] Table 3-1 provides the crosswalk of OES to COUs.
[b] 7Q10 is the 7 consecutive days of lowest flow over a 10-year period.
[c] The P50, P75, and P90 flows refer to the 50th, 75th, and 90th percentiles of the distribution of water body flow rates in generic release scenarios; see Appendix B of the *Draft Environmental Media, General Population, and Environmental Exposure Assessment for Dibutyl Phthalate (DBP)* (U.S. EPA, 2025p).
[d] 30Q5 is defined as 30 consecutive days of lowest flow over a 5-year period.
[e] Harmonic mean is defined as the inverse mean of reciprocal daily arithmetic mean flow values. These flows represent a long-term average.

3.3.1 Weight of Scientific Evidence Conclusions

Detailed discussion of the strengths, limitations, and sources of uncertainty for presented environmental media concentrations leading to a weight of scientific evidence conclusion can be found in the *Draft Environmental Media, General Population, and Environmental Exposure Assessment for Dibutyl Phthalate (DBP)* (U.S. EPA, 2025p). However, the weight of scientific evidence conclusion is summarized below for the modeled concentrations for surface water and ambient air.

For the screening level assessment, EPA used the release estimates presented in Table 3-4 to model DBP concentrations in different environmental media. The Agency assessed additional variables when considering the weight of scientific evidence for its estimation of environmental media concentrations. Some additional considerations include the use of an additional model (Point Source Calculator of the Variable Volume Water Model [VVWM-PSC], IIOAC, etc.) using the release as an input, the applicability of the release data to the environmental media being considered, likelihood of an occurrence of a release to the specific environmental compartment, and available monitoring data.

3.3.1.1 Surface Water

For the screening level human health assessment, EPA utilized releases associated with the Manufacturing OES as it resulted in the highest surface water concentrations. EPA determined the surface water concentration associated with this OES represented a conservative high-end exposure scenario (approximately 20× higher than concentrations indicated by monitoring data) and was appropriate to use in its screening level assessment to assess all other OESs and their associated COUs.

EPA utilized daily release information as an input to the Variable Volume Water Model with Point Source Calculator Tool (VVWM-PSC) Model to estimate surface water concentrations for use in general population and environmental exposure assessments. As mentioned in Section 3.2, the Agency estimated a range for daily releases for each OES when possible. EPA was not able to estimate site-specific releases for the Final use of products or articles OES. Disposal sites handling post-consumer, end-use DBP were not quantifiable due to the wide and dispersed use of DBP in PVC and other products. Pre-consumer waste handling, treatment, and disposal are assumed to be captured in upstream OES. Several OESs had releases estimated using programmatic data. EPA compiled programmatic release information using reported releases from TRI, DMR, and NEI. NEI obtained a high-quality rating whereas TRI and DMR obtained a medium-quality rating from EPA's systematic review process, as discussed in Table 3-5. One limitation was that the extent to which sites not captured in these databases release DBP into the environment is uncertain. Additionally, not all OESs are represented in these databases.

For OESs that did not have reported release data, releases were estimated using GSs/ESDs. For releases that use GSs/ESDs, EPA concluded the weight of scientific conclusion was moderate. Five OESs (Manufacturing, Application of adhesives and sealants, Application of paints and coatings, Use of laboratory chemicals, and Use of penetrants and inspection fluids) had modeled releases from generic scenarios for multimedia discharges to combinations of multiple of the following: water, wastewater (POTW), incineration, landfill, and air. For these generic scenario OESs, there was insufficient information to determine the fraction of the release going to each of the reported media types, including to surface water. For these OESs, surface water, pore water, and sediment concentrations of DBP were estimated using VVWM-PSC, assuming a conservative scenario in which all of the multimedia releases were to surface water. Based on comparison with reported scenarios for DBP wastewater release, EPA has less confidence in the unlikely combination of high-end releases of DBP to the lowest-flow generic condition (P50) water bodies. Where EPA had sufficient data to produce estimates of releases to surface water from generic scenarios (such as with the Use of lubricants and functional fluids OES), EPA estimated release concentrations, but these estimates had greater uncertainty in the modeled exposure results relative to those releases for which EPA obtained programmatic release data.

Table 3-7 below identifies the data available for use in modeling surface water concentrations for each OES and EPA's confidence in the estimated surface water concentrations used for exposure assessment. For the screening level general population assessment, the Agency identified the OES (Manufacturing) that resulted in the highest surface water concentrations to assess exposure (Table 3-6). EPA prioritized use of programmatic data with actual release data from reporting facilities where overall confidence in the estimates would be higher. For estimating surface water concentrations from releases, the Agency prioritized the use of TRI annual release reports over DMR monitoring data, reviewing DMR period data as supporting information for the releases reported to TRI. Releases from facilities reporting via TRI Form A, which represents undefined releases to unspecified media types, less than 500 lb per year, were not directly modeled. Because of this, and for the purpose of the tiered approach taken for the general population analysis, environmental concentrations from potential releases to surface water from facilities reporting via TRI Form A were expected to be lower than the high-end concentrations applied for screening.

For facilities reporting releases to TRI and DMR, relevant flow data from the associated receiving water body were collected by querying multiple EPA databases and permit IDs under the National Pollutant Discharge Elimination System (NPDES). The flow data include self-reported hydrologic reach codes on NPDES permits and the best available flow estimates from EPA and U.S. Geological Survey (USGS) databases. Other model inputs were derived from reasonably available literature collected and evaluated through EPA's systematic review process for TSCA risk evaluations. All monitoring and experimental data included in this analysis were from articles rated medium or high quality from this process.

The weight of scientific evidence conclusions regarding confidence in the release estimates from facilities and the associated receiving water body and hydrologic flow information described in the preceding paragraphs, for the estimated surface water concentrations associated with each OES and water release data type are presented in Table 3-7. EPA proceeded with the use of TRI data for modeling surface water concentrations as a screening step for exposure pathways requiring screening level refinement beyond the first tier employing release estimates from the Manufacturing OES. EPA identified the Waste handling, treatment, and disposal OES as appropriate as it resulted in a high-end surface water concentration based on reporting data for actual facilities. Additionally, release concentrations were estimated at the point of release in the receiving water body, as a conservative assumption to evaluate the upper-end of potential exposure concentrations for a given release. Overall, EPA has robust confidence that the high-end estimated surface water concentration modeled using the Manufacturing OES is appropriate to use in its high-end, screening level assessment to assess all OESs and their associated COUs—including those with releases that were unable to be quantified—if no risk is found beyond the benchmark. Releases from all other OESs and their associated COUs (including OESs and COUs with releases that could not be quantified and those with releases modeled from generic scenarios) are expected to result in lower environmental concentrations in surface water. Where risks in subsequent analyses are found in excess of the appropriate benchmark, further analysis of other OES is conducted. General population and environmental risk estimates from surface water can be found in Sections 4.3.4 and 5.3.2, respectively.

1322 **Table 3-7. Summary of Weight of Scientific Evidence Associated with Each OES**

OES[a]	Water Release Data Type(s)	WOSE Surface Water Concentrations
Manufacturing[b]	Generic Scenario (multimedia)	No facilities reported releases for this OES, so EPA modeled releases using generic scenarios. Because EPA was unable to determine the fraction of multimedia releases to surface water, the Agency estimated a conservative scenario assuming that all multimedia releases went to surface water. EPA has slight confidence in the precision of the high-end of these estimates and resulting determinations of risk, due to compounding conservative assumptions creating an unlikely release scenario. However, the Agency has moderate to robust confidence in these estimates representing a theoretical upper-bound of potential release concentrations, which can effectively be applied in a screening exercise to screen for risk.
Import and repackaging	TRI, DMR	All reported releases to TRI within this OES were via Form A. Due to EPA's high confidence that such releases to surface water, if present, would not exceed the high-end releases applied for screening, no quantitative estimate of surface water release concentrations was conducted for this OES for TRI releases. One facility reporting to DMR listed DBP monitoring but reported no discharge in the last decade.
Incorporation into formulation, mixture, or reaction product	TRI	All reported releases to TRI within this OES were via Form A. Due to EPA's high confidence that such releases to surface water, if present, would not exceed the high-end releases applied for screening, no quantitative estimate of surface water release concentrations was conducted for this OES.
PVC plastics compounding	TRI, DMR	EPA conducted modeling using the PSC tool to estimate surface water and sediment concentrations of DBP. PSC inputs include physical and chemical properties of DBP which received a high confidence rating and a reported DBP release from TRI which received a moderate to robust rating. Based on this information, EPA concluded that the weight of scientific evidence for this assessment is moderate to robust.
Non-PVC material compounding	TRI, DMR	EPA conducted modeling using the SC tool to estimate surface water and sediment concentrations of DBP. PSC inputs include physical and chemical properties of DBP, which received a high confidence rating and a reported DBP release from TRI, which received a moderate to robust rating. Based on this information, EPA concluded that the weight of scientific evidence for this assessment is moderate to robust.
Incorporation into adhesives and sealants	Generic Scenario (multimedia)	No facilities reported releases for this OES, so EPA modeled releases using generic scenarios. Because the Agency was unable to determine the fraction of multimedia releases to surface water, EPA estimated a conservative scenario assuming that all multimedia releases went to surface water. EPA has slight confidence in the precision of the high-end of these estimates and resulting determinations of risk, due to compounding conservative assumptions creating an unlikely release scenario. However, EPA has moderate to robust confidence in these estimates representing a theoretical upper-bound of potential release

OES[a]	Water Release Data Type(s)	WOSE Surface Water Concentrations
		concentrations, which can effectively be applied in a screening exercise to screen out risk.
PVC plastics converting (surrogate release data from PVC plastics compounding)	TRI	EPA conducted modeling using the PSC tool to estimate surface water and sediment concentrations of DBP. PSC inputs include physical and chemical properties of DBP, which received a high confidence rating and reported DBP releases from TRI, which received a moderate to robust rating. Based on this information, EPA concluded that the weight of scientific evidence for this assessment is moderate.
Non-PVC material converting	TRI	EPA conducted modeling using the PSC tool to estimate surface water and sediment concentrations of DBP. PSC inputs include physical and chemical properties of DBP, which received a high confidence rating and reported DBP releases from TRI, which received a moderate to robust rating. Based on this information, EPA concluded that the weight of scientific evidence for this assessment is moderate to robust.
Recycling (surrogate release data from PVC plastics compounding)	DMR	EPA conducted modeling using the PSC tool to estimate surface water and sediment concentrations of DBP. PSC inputs include physical and chemical properties of DBP, which received a high confidence rating and reported DBP releases from TRI, which received a moderate to robust rating. Based on this information, EPA concluded that the weight of scientific evidence for this assessment is moderate.
Industrial process solvent use	No water releases	EPA was unable to identify water release data from TRI and DMR reporters for this OES; however, based on the specifics of DBP's use in the process, EPA does not expect water releases for this OES.
Application of adhesives and sealants	Generic Scenario (multimedia)	No facilities reported releases for this OES, so EPA modeled releases using generic scenarios. Because the Agency was unable to determine the fraction of multimedia releases to surface water, EPA estimated a conservative scenario assuming that all multimedia releases went to surface water. EPA has slight confidence in the precision of the high-end of these estimates and resulting determinations of risk, due to compounding conservative assumptions creating an unlikely release scenario. However, EPA has moderate to robust confidence in these estimates representing a theoretical upper bound of potential release concentrations, which can effectively be applied in a screening exercise to screen out risk.
Application of paints and coatings	Generic Scenario (multimedia)	No facilities reported releases for this OES, so EPA modeled releases using generic scenarios. Because EPA was unable to determine the fraction of multimedia releases to surface water, EPA estimated a conservative scenario assuming that all multimedia releases went to surface water. EPA has slight confidence in the precision of the high-end of these estimates and resulting determinations of risk, due to compounding conservative assumptions creating an unlikely release scenario. However, EPA has moderate to robust confidence in these estimates representing a theoretical upper bound of potential release concentrations, which can effectively be applied in a screening exercise to screen out risk.

OES[a]	Water Release Data Type(s)	WOSE Surface Water Concentrations
Use of laboratory chemicals	Generic Scenario (multimedia)	No facilities reported releases for this OES, so EPA modeled releases using generic scenarios. Because the Agency was unable to model releases to just surface water, EPA concluded that there was insufficient precision in release data to calculate a surface water concentration based on the release data.
Use of lubricants and functional fluids	Generic Scenario (water-specific)	No facilities reported releases for this OES, so EPA modeled releases using generic scenarios. Sufficient release data were available to model a surface water-specific release, and the resulting range of estimated concentrations were below the high-end releases applied for general population screening.
Use of penetrants and inspection fluids	Generic Scenario (water-specific)	No facilities reported releases for this OES, so EPA modeled releases using generic scenarios. Sufficient release data were available to model a surface water-specific release, and the resulting range of estimated concentrations were below the high-end releases applied for general population screening.
Waste handling, treatment, and disposal	TRI, DMR	EPA conducted modeling using the PSC tool to estimate surface water and sediment concentrations of DBP. PSC inputs include physical and chemical properties of DBP, which received a high confidence rating and reported DBP releases from TRI, which received a moderate to robust rating. Based on this information, EPA concluded that the weight of scientific evidence for this assessment is moderate to robust.

DMR = Discharge Monitoring Report; OES = occupational exposure scenario; PSC = point source calculator (tool); TRI = Toxics Release Inventory
[a] Table 3-1 provides a crosswalk of industrial and commercial COUs to OES.
[b] The Manufacturing OES is highlighted as this scenario was used for screening level assessments.

3.3.1.2 Ambient Air and Air to Soil Deposition

EPA used the IIOAC Model, previously peer-reviewed methodology for fenceline communities (U.S. EPA, 2022b), and integrated recommendations from that and other peer reviews to evaluate exposures and deposition rates via the ambient air pathway for this assessment. The IIOAC Model was developed based on a series of pre-run scenarios within American Meteorological Society/EPA Regulatory Model (AERMOD; the Agency's regulatory model), which gives EPA greater confidence in the IIOAC Model results. However, since results from IIOAC are based on the pre-run AERMOD scenarios, IIOAC modeling is limited to the parameters (*e.g.*, stack parameters, meteorological data, and other factors) used as inputs to those pre-run AERMOD scenarios; thus limiting the flexibility of the IIOAC results for highly site-specific or date specific modeling needs (*e.g.*, if refined analyses are needed). The screening level analyses presented in this assessment, IIOAC provides reliable and reproduceable results which can be used to characterize upper-bound exposures and derive screening level risk estimates, giving EPA moderate confidence in the results and findings.

The Agency considered three different datasets for DBP releases for this assessment. Those datasets include EPA estimated releases based on production volumes of DBP from facilities that manufacture, process, repackage, or dispose of DBP (U.S. EPA, 2025q); releases reported to TRI by industry (2017–2022 reporting years); and releases reported to NEI (U.S. EPA, 2025q) (2017 and 2020 reporting years). This gives the Agency moderate confidence that release data utilized is representative and high-end releases are not missed. EPA uses the maximum daily releases of DBP across all OES/COUs as direct inputs to the IIOAC Model, giving the Agency high confidence that the releases used are health protective for a screening level analysis. However, the use of estimated or reported annual release data and number of operating days to calculate daily average releases assumes operations are continuous and releases are the same for each day of operation. This can underestimate short-term or daily exposure and deposition rates because results may miss actual peak releases (and associated exposures) if higher and lower releases occur on different days. The uncertainties associated with the release data are detailed in the *Draft Environmental Release and Occupational Exposure Assessment for Dibutyl Phthalate* (U.S. EPA, 2025q).

The maximum daily fugitive release value used in this assessment was reported to the 2017 NEI dataset and is associated with the Application of paints, coatings adhesives, and sealants OES. The maximum daily stack release value used in this assessment was reported to the TRI dataset and is associated with the Waste handling, treatment, and disposal OES. Both maximum daily release values represent the maximum daily release reported across all facilities and COUs and are used as direct inputs to the IIOAC Model to estimate concentrations and deposition rates. Additionally, these releases were reported by two different facilities in two different locations. Therefore, these two releases do not align either spatially or temporally. For this screening level ambient air assessment, EPA modeled these two releases assuming they occurred from the same location, at the same time, during the same reporting year, and under the same OES to determine a "total exposure" to DBP from both release types. These assumptions provide a conservative estimate of total exposure, ensure possible exposure from either release type are not missed, and retain health protective estimates of exposure and associated risk estimates. The lack of spatial or temporal alignment gives the Agency low confidence in the exposure scenario modeled (cannot occur at same time under assumptions modeled) and overestimates ambient concentrations and deposition rates at the evaluated distances. Due to the conservative assumptions made along with the use of the highest release estimates, EPA has robust confidence the modeled ambient air concentrations and deposition rates are highly conservative estimates appropriate for a screening level analysis for all OESs and associated COUs. Based on the risk findings described in Section 4.1.3.1—even with the conservative assumptions and exposure scenario modeled—results indicate the total exposure or deposition rate under this scenario still does not indicate an exposure or risk concern. Therefore, EPA has robust confidence that exposure to and deposition rates of DBP via the ambient air pathway do not pose an exposure or risk concern and no further, refined analysis is pursued. If new information becomes available and after EPA's consideration of such information and results, under the same scenario and assumptions, indicate an exposure or risk concern, then the Agency would have low confidence in the results and refine the analysis to be more representative of a real exposure scenario (*e.g.*, only determine exposures and derive risk estimates based on a single facility reporting both release types).

1378 # 4 HUMAN HEALTH RISK ASSESSMENT

DBP – Human Health Risk Assessment (Section 4):
Key Points

EPA evaluated all reasonably available information to support human health risk characterization of DBP for workers, ONUs, consumers, bystanders, and the general population. Exposures to workers, ONUs, consumers, bystanders, and the general population are described in Section 4.1. Human health hazards are described in Section 4.2. Human health risk characterization is described in Section 4.3. The following bullets summarize the key points.

Exposure Key Points

- EPA assessed inhalation and dermal exposures for workers and ONUs, as appropriate, for each OES (Section 4.1.1). Both dermal and inhalation were primary routes of exposure, depending on the OES.
- EPA assessed inhalation, dermal, and oral exposures for consumers and bystanders, as appropriate, for each TSCA COU (Section 4.1.2) in scenarios that represent a range of use patterns and behaviors. The primary route of exposure was dermal for most products, followed by inhalation.
- EPA assessed inhalation, oral, and dermal exposures for the general population via ambient air, surface water, drinking water, and fish ingestion for Tribal populations (Sections 4.1.3 and 4.3.4).
- EPA assessed non-attributable cumulative exposure to DEHP, DBP, BBP, DIBP, and DINP for the U.S. civilian population using NHANES urinary biomonitoring data and reverse dosimetry (Section 4.4.2).

Hazard Key Points

- EPA identified adverse effects on the developing male reproductive system consistent with a disruption of androgen action, leading to phthalate syndrome, as the most sensitive and robust non-cancer hazard associated with oral exposure to DBP in experimental animal models (Section 4.2).
- A non-cancer POD of 2.1 mg/kg-day (derived from a $BMDL_5$ = 9 mg/kg-day) was selected to characterize non-cancer risks for acute, intermediate, and chronic durations of exposure. A total uncertainty factor of 30 was selected for use as the benchmark margin of exposure.
- Under the *Guidelines for Carcinogen Risk Assessment* (U.S. EPA, 2005), EPA has preliminarily determined that there is *Suggestive Evidence of Carcinogenic Potential* of DBP in rats based on pancreatic cancer. Consistent with the guidelines, the Agency did not quantitatively evaluate DBP for cancer risk.
- EPA derived draft relative potency factors (RPFs) based on a common hazard endpoint (*i.e.*, reduced fetal testicular testosterone). Draft RPFs were derived via meta-analysis and benchmark dose (BMD) modeling.

Risk Assessment Key Points

- Dermal exposures drive acute non-cancer risks to workers in occupational settings (Section 4.3.2).
- Dermal exposures drive acute non-cancer risks to consumers (Section 4.3.3).
- For the general population, exposures to DBP through biosolids, landfills, surface water, drinking water, fish ingestion, and ambient air were not determined to be pathways of concern.(Sections 4.1.3 and 4.3.4).
- EPA considered PESS throughout the exposure assessment, hazard identification, and dose-response analysis supporting this draft risk evaluation (Section 4.3.4.1).
- EPA considered cumulative risk to workers and consumers through exposure to DBP from individual COUs in combination with cumulative non-attributable national exposure to DEHP, DBP, BBP, DIBP, and DINP as estimated from NHANES biomonitoring data (Sections 4.4.4 and 4.4.5).

4.1 Summary of Human Exposures

4.1.1 Occupational Exposures

The following subsections briefly describe EPA's approach to assessing occupational exposures and provide exposure assessment results for each OES. As stated in the final scope for DBP (U.S. EPA, 2020c), the Agency evaluated exposures to workers and occupational non-users (ONUs) via the inhalation route, and exposures to workers via the dermal route associated with the manufacturing, processing, use, and disposal of DBP. Also, EPA assessed dermal exposure to workers and ONUs from mist and dust deposited on surfaces. The *Draft Environmental Release and Occupational Exposure Assessment for Dibutyl Phthalate (DBP)* (U.S. EPA, 2025q) provides additional details on the development of approaches and the exposure assessment results.

4.1.1.1 Approach and Methodology

As described in the final scope document (U.S. EPA, 2020c), EPA distinguished exposure levels among potentially exposed employees for workers and ONUs. In general, the primary difference between workers and ONUs is that workers may handle DBP and have direct contact with the DBP, while ONUs work in the general vicinity of DBP but do not handle DBP. Where possible, for each condition of use (COU), EPA identified job types and categories for workers and ONUs.

As discussed in Section 3.1.1.1, EPA established OESs to assess the exposure scenarios within each COU; Table 3-1 provides a crosswalk between COUs and OESs. For occupational inhalation exposures, EPA primarily used chemical-specific inhalation exposure monitoring data for the OESs. In the absence of inhalation monitoring data, the Agency used inhalation exposure models to estimate central tendency and high-end exposures. For cases where occupational dermal exposure to liquid DBP was assessed, EPA used a flux-limited dermal absorption value derived from a study conducted by Doan et al. (2010) to estimate high-end and central tendency dermal exposures. For occupational dermal exposure to solid DBP, EPA used a flux-limited dermal absorption model to estimate high-end and central tendency dermal exposures for workers in each OES. For occupational dermal exposure assessment, EPA assumed a standard 8-hour workday and the chemical is contacted at least once per day. Because DBP has low volatility and relatively low absorption, it is possible that the chemical remains on the surface of the skin after dermal contact until the skin is washed. Therefore, in absence of exposure duration data, EPA has assumed that absorption of DBP from occupational dermal contact with materials containing DBP may extend up to 8 hours per day (U.S. EPA, 1991). However, dermal exposure may be eliminated if a worker uses proper personal protective equipment (PPE; *e.g.*, respirators, gloves) or washes their hands after contact with DBP or DBP-containing material. Therefore, the assumption of an 8-hour exposure duration for DBP may lead to overestimation of dermal exposure. For average adult workers, the surface area of contact was assumed equal to the area of one hand (*i.e.*, 535 cm^2) or two hands (*i.e.*, 1,070 cm^2) for central tendency or high-end exposures, respectively (U.S. EPA, 2011a). The dermal methods are described in the *Draft Environmental Release and Occupational Exposure Assessment for Dibutyl Phthalate (DBP)* (U.S. EPA, 2025q).

EPA evaluated the quality of data sources using the data quality review evaluation metrics and rating criteria described in the Draft Systematic Review Protocol (U.S. EPA, 2021a). The Agency assigned an overall quality level of high, medium, or low to the relevant data. In addition, EPA established an overall confidence level for the data when integrated into the occupational exposure assessment. The Agency considered the assessment approach, quality of the data and models, and uncertainties in assessment results to assign an overall weight of scientific evidence rating of robust, moderate, or slight.

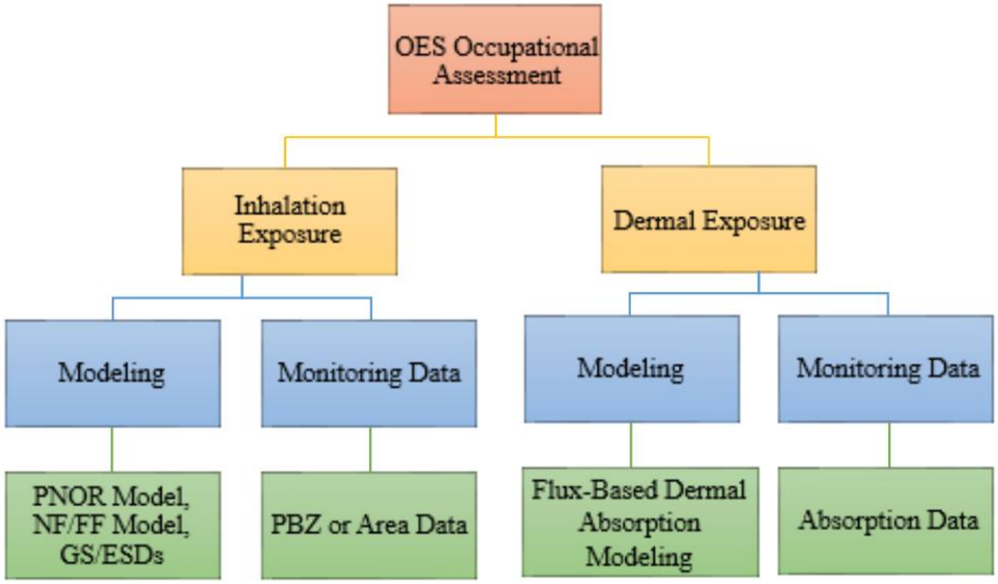

Figure 4-1. Approaches Used for Each Component of the Occupational Assessment for Each OES
PBZ = personal breathing zone; PNOR = particulates not otherwise regulated

For the inhalation and dermal exposure routes, EPA provided occupational exposure results that are representative of central tendency and high-end exposure conditions. The central tendency is expected to represent occupational exposures in the center of the exposure distribution for a given COU. For risk evaluation, EPA used the 50th percentile (median), mean (arithmetic or geometric), mode, or midpoint value of a distribution to represent the central tendency scenario. The Agency preferred to provide the 50th percentile of the distribution. However, if the full distribution was unknown, EPA used either the mean, mode, or midpoint of the distribution to represent the central tendency, depending on the statistics available for the distribution. The high-end exposure is expected to represent occupational exposures that occur at probabilities above the 90th percentile but below the highest exposure for any individual (U.S. EPA, 1992). For this draft risk evaluation, EPA provided high-end results at the 95th percentile. If the 95th percentile was not reasonably available, the Agency used a different percentile greater than or equal to the 90th percentile but less than or equal to the 99th percentile, depending on the statistics available for the distribution. If the full distribution is not known and the preferred statistics are not reasonably available, EPA estimated a maximum or bounding estimate in lieu of the high-end. Table 4-1 provides a summary of the approach used to assess worker and ONU exposures and the Agency's weight of scientific evidence rating for the given exposure assessments.

Table 4-1. Summary of Exposure Monitoring and Modeling Data for Occupational Exposure Scenarios

OES	Inhalation Exposure												Dermal Exposure		
	DBP Monitoring					Surrogate Monitoring					Modeling		Empirical		Modeling
	Worker	# Data Points / # Data Sources	ONU	# Data Point	Data Quality Ratings	Worker	# Data Points / # Data Sources	ONU	# Data Point	Data Quality Ratings	Worker	ONU	Worker	Data Quality Rating	Worker
Manufacturing	✓	3 data sources[a]	×	N/A	M	×	N/A	×	N/A	N/A	×	×	✓	M	×
Import and repackaging	×	N/A	×	N/A	N/A	✓	3 data sources[a]	×	N/A	M	×	×	✓	M	×
Incorporation into formulations, mixtures, or reaction products	×	N/A	×	N/A	N/A	✓	3 data sources[a]	×	N/A	M	×	×	✓	M	×
PVC plastics compounding	×	N/A	×	N/A	N/A	✓	4 data points[b]	×	N/A	M	✓	×	✓	M	✓
PVC plastics converting	✓	4 data points[b]	×	N/A	M	×	N/A	×	N/A	N/A	✓	×	×	N/A	✓
Non-PVC materials manufacturing (compounding and converting)	×	N/A	×	N/A	N/A	✓	4 data points[b]	×	N/A	M	✓	×	✓	M	✓
Application of paints and coatings	✓	14 data points	×	N/A	M/H	×	N/A	×	N/A	N/A	×	×	✓	M	×
Application of adhesives and sealants	✓	19 data points[c]	×	N/A	M	×	N/A	×	N/A	N/A	×	×	✓	M	×
Use of laboratory chemicals	×	N/A	×	N/A	N/A	✓	19 data points[c]	×	N/A	M	✓	×	✓	M	✓
Use of industrial process solvents	×	N/A	×	N/A	N/A	✓	3 data source[a]	×	N/A	M	×	×	✓	M	×
Use of lubricants and functional fluids	×	N/A	×	N/A	N/A	✓	19 data points[c]	×	N/A	M	×	×	✓	M	×
Use of penetrants and inspection fluids	×	N/A	×	N/A	N/A	×	N/A	×	N/A	N/A	✓	×	✓	M	×
Fabrication of final product from articles	✓	3 data points	×	N/A	M	×	N/A	×	N/A	N/A	✓	×	×	N/A	✓
Recycling	×	N/A	×	N/A	N/A	×	N/A	×	N/A	N/A	✓	×	×	N/A	✓
Waste handling, treatment, and disposal	×	N/A	×	N/A	N/A	×	N/A	×	N/A	N/A	✓	×	×	N/A	✓

OES	Inhalation Exposure												Dermal Exposure		
	DBP Monitoring					Surrogate Monitoring					Modeling		Empirical		Modeling
	Worker	# Data Points / # Data Sources	ONU	# Data Point	Data Quality Ratings	Worker	# Data Points / # Data Sources	ONU	# Data Point	Data Quality Ratings	Worker	ONU	Worker	Data Quality Rating	Worker

ONU = occupational non-user
Where EPA was not able to estimate ONU inhalation exposure from monitoring data or models, this was assumed equivalent to the central tendency experienced by workers for the corresponding OES.
Surrogate monitoring data means monitoring data from another similar OES was used.
M: Medium and H: High from EPA's systematic review process (U.S. EPA, 2021a)
Data quality ratings for reported data are based on EPA systematic review and include ratings Low (L), Medium (M), and High (H)
× No data available
✓ Data available
[a] For the Manufacturing, Import and repackaging, Incorporation into formulations, mixtures, or reaction products, and Use of industrial process solvents OESs, the same inhalation monitoring data were used. The monitoring data were obtained from three risk evaluations, each study presented a single exposure concentration during manufacturing of DBP. However, these exposure values were estimated from multiple data points measured during DBP manufacturing. For more information, see Section 3.1.4.2 of the *Draft Environmental Release and Occupational Exposure Assessment for Dibutyl Phthalate (DBP) (*U.S. EPA, 2025q*).*
[b] For PVC plastics compounding, PVC plastics converting, and Non-PVC materials manufacturing OESs, the same inhalation monitoring data from PVC plastics converting were used.
[c] For Application of adhesives and sealants, Use of laboratory chemicals, and Use of lubricants and functional fluids OESs, the same monitoring data from application of adhesives and sealants were used.

4.1.1.2 Number of Workers and ONUs

Table 4-2 summarizes the number of facilities and total number of exposed workers for all OESs. For scenarios in which the results are expressed as a range, the low end of the range is based on the 50th percentile estimate of the number of sites and the upper end of the range is based on the 95th percentile estimate of the number of sites. For some OESs, the estimated number of facilities is based on the number of reporting sites to the 2020 CDR (U.S. EPA, 2020b), NEI (U.S. EPA, 2023a), DMR (U.S. EPA, 2024a), and TRI databases (U.S. EPA, 2024o).

Table 4-2. Summary of Total Number of Workers and ONUs Potentially Exposed to DBP for Each OES

OES[a]	Total Exposed Workers	Total Exposed ONUs[b]	Number of Facilities	Notes
Manufacturing	195	90	5	Number of workers and ONU estimates based on the Bureau of Labor Statistics (BLS) and U.S. Census Bureau data (U.S. BLS, 2023; U.S. Census Bureau, 2015). Number of facilities estimated based on identified sites from CDR.
Import and Repackaging	560	252	28	Number of workers and ONU estimates based on the BLS and U.S. Census Bureau data (U.S. BLS, 2023; U.S. Census Bureau, 2015). Number of facilities estimated based on identified sites from CDR, TRI, NEI, and DMR.
Incorporation into formulations, mixtures, or reaction products	1,700	750	50	Number of workers and ONU estimates based on the BLS and U.S. Census Bureau data (U.S. BLS, 2023; U.S. Census Bureau, 2015). Number of facilities estimated based on identified sites from CDR, TRI, NEI, and DMR.
PVC plastics compounding	459	204	17	Number of workers and ONU estimates based on the BLS and U.S. Census Bureau data (U.S. BLS, 2023; U.S. Census Bureau, 2015). Number of facilities estimated based on identified sites from CDR, TRI, NEI, and DMR.
PVC plastics converting	180	50	10	Number of workers and ONU estimates based on the BLS and U.S. Census Bureau data (U.S. BLS, 2023; U.S. Census Bureau, 2015). Number of facilities estimated based on identified sites from CDR, TRI, NEI, and DMR.
Non-PVC material manufacturing	1,196	312	52	Number of workers and ONU estimates based on the BLS and U.S. Census Bureau data (U.S. BLS, 2023; U.S. Census Bureau, 2015). Number of facilities estimated based on identified sites from CDR, TRI, NEI, and DMR.
Application of adhesives and sealants	5,264−44,408	1,692−14,274	94−793	Number of workers and ONU estimates based on the BLS and U.S. Census Bureau data (U.S. BLS, 2023; U.S. Census Bureau, 2015). Number of facilities estimated using modeled data.

OES[a]	Total Exposed Workers	Total Exposed ONUs[b]	Number of Facilities	Notes
Application of paints and coatings	2,628–31,488	1,314–15,744	219–2,624	Number of workers and ONU estimates based on the BLS and U.S. Census Bureau data (U.S. BLS, 2023; U.S. Census Bureau, 2015). Number of facilities estimated using modeled data.
Industrial process solvent use	117	54	3	Number of workers and ONU estimates based on the BLS and U.S. Census Bureau data (U.S. BLS, 2023; U.S. Census Bureau, 2015). Number of facilities estimated based on identified sites from CDR, TRI, NEI, and DMR.
Use of laboratory chemicals	36,873	331,857	36,873	Number of workers and ONU estimates based on the BLS and U.S. Census Bureau data (U.S. BLS, 2023; U.S. Census Bureau, 2015). Number of facilities estimated using data from BLS.
Use of lubricants and functional fluids	293,656–3,503,104	73,414–875,776	3,337–39,808	Number of workers and ONU estimates based on the BLS and U.S. Census Bureau data (U.S. BLS, 2023; U.S. Census Bureau, 2015). Number of facilities estimated using modeled data.
Use of penetrants and inspection fluids	188,994–270,010	87,228–124,620	14,538–20,770	Number of workers and ONU estimates based on the BLS and U.S. Census Bureau data (U.S. BLS, 2023; U.S. Census Bureau, 2015). Number of facilities estimated using modeled data.
Fabrication or use of final products or articles	N/A			Number of sites data was unavailable for this OES. Based on the BLS and U.S. Census Bureau data (U.S. BLS, 2023; U.S. Census Bureau, 2015).
Recycling	754	406	58	Number of workers and ONU estimates based on the BLS and U.S. Census Bureau data (U.S. BLS, 2023; U.S. Census Bureau, 2015). Number of facilities estimated based on identified recycling sites.
Waste handling, treatment, and disposal	2,951	1,589	227	Number of workers and ONU estimates based on the BLS and U.S. Census Bureau data (U.S. BLS, 2023; U.S. Census Bureau, 2015). Number of facilities estimated based on identified sites from CDR, TRI, NEI, and DMR.

[a] An OES is based on a set of facts, assumptions, and inferences that describe how releases and exposures take place within an occupational COU. The occurrence of releases/exposures may be similar across multiple COUs (multiple COUs mapped to single OES), or there may be several ways in which releases/exposures take place for a given COU (single COU mapped to multiple OESs).

[b] ONUs do not directly handle DBP, but may be exposed to dust, vapors. or mists that enter their personal breathing zone while working in locations near where DBP is handled by workers.

4.1.1.3 Summary of Inhalation Exposure Assessment

Table 4-3 presents a summary of inhalation exposure results based on reasonably available monitoring data and exposure modeling for each OES. This tables provides a summary of the 8-hour time weighted average (8-hour TWA) inhalation exposure estimates, as well as the acute dose (AD), the intermediate average daily dose (IADD), and the chronic average daily dose (ADD). The *Draft Environmental Release and Occupational Exposure Assessment for Dibutyl Phthalate (DBP)* (U.S. EPA, 2025q) provides exposure results for females of reproductive age and ONUs—including additional details regarding AD, IADD, and ADD calculations along with EPA's approach and methodology for estimating inhalation exposures.

Table 4-3. Summary of Average Adult Worker Inhalation Exposure Results for Each OES[a]

OES	All Routes – 8-Hour TWA (mg/m³)		AD (mg/kg/day)		IADD (mg/kg/day)		ADD (mg/kg/day)		Method Used		
										Monitoring Data	
	CT	HE	CT	HE	CT	HE	CT	HE	Data Type(s)	Source(s)	Rating(s) [b]
Manufacturing	0.50	1.0	6.3E–02	0.13	4.6E–02	9.2E–02	4.3E–02	8.6E–02	Monitoring data	(ECB, 2008; ECJRC, 2004; SRC, 2001)	All three sources received a rating of medium
Import and repackaging	0.50	1.0	6.3E–02	0.13	4.6E–02	9.2E–02	4.3E–02	8.6E–02	Surrogate monitoring data	(ECB, 2008; ECJRC, 2004; SRC, 2001)	All three sources received a rating of medium
Incorporation into formulations, mixtures, or reaction products	0.50	1.0	6.3E–02	0.13	4.6E–02	9.2E–02	4.3E–02	8.6E–02	Surrogate monitoring data	(ECB, 2008; ECJRC, 2004; SRC, 2001)	All three sources received a rating of medium
PVC plastics compounding	0.34	2.9	4.3E–02	0.36	3.1E–02	0.26	2.9E–02	0.25	Surrogate monitoring data, PNOR Model[c] for dust	(ECJRC, 2004)	Source received a rating of medium
PVC plastics converting	0.34	2.9	4.3E–02	0.36	3.1E–02	0.26	2.9E–02	0.25	Monitoring data, PNOR Model for dust	(ECJRC, 2004)	Source received a rating of medium
Non-PVC materials manufacturing (compounding and converting)	0.29	1.7	3.6E–02	0.21	2.6E–02	0.15	2.4E–02	0.14	Surrogate monitoring data, PNOR Model for dust	(ECJRC, 2004)	Source received a rating of medium
Application of adhesives and sealants	5.0E–02	0.10	6.3E–03	1.3E–02	4.6E–03	9.2E–03	4.0E–03	8.6E–03	Monitoring data	(NIOSH, 1977)	Source received a rating of medium
Application of paints and coatings	0.83	5.2	0.10	0.66	7.6E–02	0.48	7.1E–02	0.45	Monitoring data	(OSHA, 2019; Rohm & Haas, 1990)	OSHA CEHD received a rating of high; the Rohm & Haas

OES	All Routes – 8-Hour TWA (mg/m³)		AD (mg/kg/day)		IADD (mg/kg/day)		ADD (mg/kg/day)		Method Used		
										Monitoring Data	
	CT	HE	CT	HE	CT	HE	CT	HE	Data Type(s)	Source(s)	Rating(s) [b]
											source received a rating of low
Use of industrial process solvents	0.50	1.0	6.3E–02	0.13	4.6E–02	9.2E–02	4.3E–02	8.6E–02	Surrogate monitoring data	(ECB, 2008; ECJRC, 2004; SRC, 2001)	All three sources received a rating of medium
Use of laboratory chemicals (solid)	3.8E–02	0.54	4.8E–03	6.8E–02	3.5E–03	5.0E–02	3.3E–03	4.6E–02	PNOR Model for dust	No monitoring data source	N/A
Use of laboratory chemicals (liquid)	5.0E–02	0.10	6.3E–03	1.3E–02	4.6E–03	9.2E–03	4.3E–03	8.6E–03	Surrogate monitoring data	(NIOSH, 1977)	Source received a rating of medium
Use of lubricants and functional fluids	5.0E–02	0.10	6.3E–03	1.3E–02	4.2E–04	1.7E–03	3.4E–05	1.4E–04	Surrogate monitoring data	(NIOSH, 1977)	Source received a rating of medium
Use of penetrants and inspection fluids	1.5	5.6	0.19	0.70	0.14	0.51	0.13	0.48	Near-field/far-field approach	No monitoring data source	N/A
Fabrication or use of final products from articles	0.10	0.84	1.3E–02	0.11	9.2E–03	7.7E–02	8.6E–03	7.2E–02	Monitoring data	(ECJRC, 2004; Rudel et al., 2001)	Both sources received a rating of medium
Recycling	0.11	1.6	1.4E–02	0.20	9.9E–03	0.14	9.2E–03	0.13	PNOR Model for dust	No monitoring data source	N/A
Waste handling, treatment, and disposal	0.11	1.6	1.4E–02	0.20	9.9E–03	0.14	9.2E–03	0.13	PNOR Model for dust	No monitoring data source	N/A

[a] AD = acute dose; ADD = chronic average daily dose; CT = central tendency; HE = high-end; IADD = intermediate average daily dose; OES = occupational exposure scenario; TWA = time-weighted average
[b] The ratings included in this table reflect the rating of the data source as determined by the systematic review process. The rating of the data source per the systematic review process is not reflective of the confidence in the risk estimates for the OES.
[c] Generic Model for Central Tendency and High-End Inhalation Exposure to Total and Respirable Particulates Not Otherwise Regulated ("PNOR Model") (U.S. EPA, 2021d)

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4.1.1.4 Summary of Dermal Exposure Assessment

Table 4-4 presents a summary of dermal exposure results, which are based on reasonably available empirical dermal absorption data and dermal absorption modeling. Flux-based dermal approaches were considered more appropriate because DBP has relatively low absorption and low volatility. This table provides a summary of the acute potential dose rate (APDR) for occupational dermal exposure estimates, as well as the AD, the IADD, and the chronic ADD. The *Draft Environmental Release and Occupational Exposure Assessment for Dibutyl Phthalate* (U.S. EPA, 2025q) provides exposure results for females of reproductive age and ONUs. The *Draft Environmental Release and Occupational Exposure Assessment for Dibutyl Phthalate* also provides additional details regarding AD, IADD, and ADD calculations along with EPA's approach and methodology for estimating dermal exposures.

Table 4-4. Summary of Average Adult Worker Dermal Exposure Results for Each OES

Dermal Estimates (Average Adult Worker)										
OES	**Exposure Type**		**APDR[a b] (mg/day)**		**AD[a] (mg/kg/day)**		**IADD[a] (mg/kg/day)**		**ADD[a] (mg/kg/day)**	
	Liquid[c]	**Solid[c]**	**CT[d]**	**HE[d]**	**CT[d]**	**HE[d]**	**CT[d]**	**HE[d]**	**CT[d]**	**HE[d]**
Manufacturing	X		100	201	1.3	2.5	0.92	1.8	0.86	1.7
Import and repackaging	X		100	201	1.3	2.5	0.92	1.8	0.86	1.7
Incorporation into formulation, mixture, or reaction product	X		100	201	1.3	2.5	0.92	1.8	0.86	1.7
PVC plastics compounding	X	X	102	204	1.3	2.5	0.93	1.9	0.87	1.7
PVC plastics converting		X	1.4	2.7	1.7E–02	3.4E–02	1.2E–02	2.5E–02	1.2E–02	2.3E–02
Non-PVC material manufacturing	X		102	204	1.3	2.5	0.93	1.9	0.87	1.7
Application of adhesives and sealants	X		100	201	1.3	2.5	0.92	1.8	0.80	1.7
Application of paints and coatings	X		100	201	1.3	2.5	0.92	1.8	0.86	1.7
Use of laboratory chemicals (liquid)	X		75	201	0.94	2.5	0.69	1.8	0.64	1.7
Use of laboratory chemicals (solid)		X	1.4	2.7	1.7E–02	3.4E–02	1.2E–02	2.5E–02	1.2E–02	2.3E–02
Industrial process solvent use	X		100	201	1.3	2.5	0.92	1.8	0.86	1.7
Use of lubricants and functional fluids	X		56	169	0.70	2.1	4.7E–02	0.28	3.8E–03	2.3E–02
Use of penetrants and inspection fluids	X		100	201	1.3	2.5	0.92	1.8	0.85	1.7
Fabrication or use of final products and articles		X	1.4	2.7	1.7E–02	3.4E–02	1.2E–02	2.5E–02	1.2E–02	2.3E–02

Dermal Estimates (Average Adult Worker)										
OES	**Exposure Type**		**APDR[a] [b] (mg/day)**		**AD[a] (mg/kg/day)**		**IADD[a] (mg/kg/day)**		**ADD[a] (mg/kg/day)**	
	Liquid[c]	**Solid[c]**	**CT[d]**	**HE[d]**	**CT[d]**	**HE[d]**	**CT[d]**	**HE[d]**	**CT[d]**	**HE[d]**
Recycling		X	1.4	2.7	1.7E–02	3.4E–02	1.2E–02	2.5E–02	1.2E–02	2.3E–02
Waste handling, treatment, and disposal		X	1.4	2.7	1.7E–02	3.4E–02	1.2E–02	2.5E–02	1.2E–02	2.3E–02

[a] AD = acute dose; ADD = average daily dose; APDR = acute potential dose rate; IADD = intermediate average daily dose
[b] APDR values are reported for either liquid or solid exposure types as indicated by the "Exposure Type" column
[c] EPA used dermal absorption data for 7% oil-in-water DBP formulations to estimate occupational dermal exposures for liquid (Doan et al., 2010). The study received a rating of medium from EPA's systematic review process. EPA used an aqueous absorption model to estimate occupational dermal exposures for solid (U.S. EPA, 2023c, 2004b).
[d] For average adult workers, central tendency means the surface area of contact was assumed equal to the area of one hand (*i.e.*, 535 cm^2) and high-end means the surface area of contact was assumed equal to the area of two hands (*i.e.*, 1,070 cm^2) (U.S. EPA, 2011a).

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4.1.1.5 Weight of Scientific Evidence Conclusions for Occupational Exposure

Judgment on the weight of scientific evidence is based on the strengths, limitations, and uncertainties associated with the exposure estimates. EPA considers factors that increase or decrease the strength of the evidence supporting the exposure estimate—including quality of the data/information, applicability of the exposure data to the COU (including considerations of temporal and locational relevance) and the representativeness of the estimate for the whole industry. The best professional judgment is summarized using the descriptors of robust, moderate, slight, or indeterminant, in accordance with the Draft Systematic Review Protocol (U.S. EPA, 2021a). For example, a conclusion of moderate is appropriate where exposure data is generated from a generic model with high data quality and some chemical-specific or industry-specific inputs, such that the exposure estimate is a reasonable representation of potential sites within the OES. A conclusion of slight is appropriate where there is limited information that does not sufficiently cover all potential exposures within the COU, and the assumptions and uncertainties are not fully known or documented. See the Draft Systematic Review Protocol (U.S. EPA, 2021a) for additional information on weight of scientific evidence conclusions. Table 4-5 provides a summary of EPA's overall confidence in its occupational exposure estimates for each of the OESs assessed.

1496 **Table 4-5. Summary of Assumptions, Uncertainty, and Overall Confidence in Exposure Estimates by OES**

OES	Weight of Scientific Evidence Conclusion in Exposure Estimates
Manufacturing	EPA considered the assessment approach, the quality of the data, and uncertainties in assessment results to determine a weight of scientific evidence conclusion for the full-shift TWA inhalation exposure estimates for the Manufacturing OES. The primary strength of this approach is the use of directly applicable monitoring data, which is preferrable to other assessment approaches, such as modeling or the use of occupational exposure limits (OELs). EPA used personal breathing zone (PBZ) air concentration data pulled from 3 sources to assess inhalation exposures (ECB, 2008; ECJRC, 2004; SRC, 2001). All 3 data sources received a rating of medium from EPA's systematic review process. These data were DBP-specific, though it is uncertain whether the measured concentrations accurately represent the entire industry. The primary limitations of these data include the uncertainty of the representativeness of these data toward the true distribution of inhalation concentrations for this scenario. Additionally, the dataset is only built on limited data points (3 data source) with a significant spread of measurements. The SRC source cites an ACC study that provides a datapoint as a worst-case scenario, the ECJRC, 2008 source only provides a single datapoint with uncertain statistics and the ECJRC, 2004 source provided a dataset with an uncertain range and number of samples. EPA also assumed 8 exposure hours per day and 250 exposure days per year based on continuous DBP exposure each working day for a typical worker schedule; it is uncertain whether this captures actual worker schedules and exposures. Although the use of monitoring data specific to this OES increases the strength of the analysis, the few uncertainties discussed in the paragraph above reduce confidence of the analysis. Therefore, based on these strengths and limitations, EPA concluded that the weight of scientific evidence for this assessment is moderate to robust.
Import and repackaging	EPA used surrogate monitoring data from DBP manufacturing facilities to estimate worker inhalation exposures, due to no relevant OES-specific data availability for import and repackaging inhalation exposures. The primary strength of this approach is the use of monitoring data, which is preferrable to other assessment approaches, such as modeling or the use of OELs. EPA used PBZ air concentration data pulled from 3 sources to assess inhalation exposures (ECB, 2008; ECJRC, 2004; SRC, 2001). All 3 data sources received a rating of medium from EPA's systematic review process. These data were DBP-specific, though it is uncertain whether the measured concentrations accurately represent the entire industry. The primary limitations of these data include uncertainty in the representativeness of these data for this OES and true distribution of inhalation concentrations in this scenario. Additionally, the dataset is only built on limited data points (3 data sources) with a significant spread of measurements. The SRC source cites an ACC study that provides a datapoint as a worst-case scenario, the ECJRC, 2008 source only provides a single datapoint with uncertain statistics and the ECJRC, 2004 source provided a dataset with an uncertain range and number of samples. EPA also assumed 8 exposure hours per day and 250 exposure days per year based on continuous DBP exposure each working day for a typical worker schedule; it is uncertain whether this captures actual worker schedules and exposures. Although the use of surrogate monitoring data increases the strength of the analysis, the few uncertainties discussed in the paragraph above reduce confidence of the analysis. Therefore, based on these strengths and limitations, EPA concluded that the weight of scientific evidence for this assessment is moderate.

OES	Weight of Scientific Evidence Conclusion in Exposure Estimates
Incorporation into formulations, mixtures, or reaction products	EPA used surrogate monitoring data from DBP manufacturing facilities to estimate worker inhalation exposures, due to no data availability for Incorporation into formulations, mixtures, or reaction products (adhesives, coatings, and other) inhalation exposures. The primary strength of this approach is the use of monitoring data, which is preferrable to other assessment approaches, such as modeling or the use of OELs. EPA used PBZ air concentration data pulled from 3 sources to assess inhalation exposures (ECB, 2008; ECJRC, 2004; SRC, 2001). All 3 data sources received a rating of medium from EPA's systematic review process. These data were DBP-specific, though it is uncertain whether the measured concentrations accurately represent the entire industry. The primary limitations of these data include uncertainty in the representativeness of these data for this OES and the true distribution of inhalation concentrations in this scenario. Additionally, the dataset is only built on limited data points (3 data sources) with a significant spread of measurements. The SRC source cites an ACC study that provides a datapoint as a worst-case scenario, the ECJRC, 2008 source only provides a single datapoint with uncertain statistics and the ECJRC, 2004 source provided a dataset with an uncertain range and number of samples. EPA also assumed 8 exposure hours per day and 250 exposure days per year based on continuous DBP exposure each working day for a typical worker schedule; it is uncertain whether this captures actual worker schedules and exposures. Although the use of surrogate monitoring data increases the strength of the analysis, the few uncertainties discussed in the paragraph above reduce confidence of the analysis. Therefore, based on these strengths and limitations, EPA concluded that the weight of scientific evidence for this assessment is moderate.
PVC plastics compounding	EPA considered the assessment approach, the quality of the data, and the uncertainties in the assessment results to determine a weight of scientific evidence conclusion for the 8-hour TWA inhalation exposure estimates for PVC plastics compounding. EPA used surrogate monitoring data from a PVC converting facility to estimate worker inhalation exposures due to no relevant OES-specific data. The primary strength of this approach is the use of monitoring data, which is preferrable to other assessment approaches, such as modeling or the use of OELs. EPA used PBZ air concentration data pulled from 1 source to assess inhalation exposures to vapor. This source provided worker exposures from 2 different studies (ECJRC, 2004) and received a rating of medium from EPA's systematic review process. EPA also expects compounding activities to generate dust from solid PVC plastic products; therefore, the Agency incorporated the PNOR Model (U.S. EPA, 2021d) into the assessment to estimate worker inhalation exposures to solid particulate. A strength of the model is that the respirable PNOR range was refined using OSHA CEHD datasets, which EPA tailored to the Plastics and Rubber Manufacturing NAICS code (NAICS 326), and the resulting dataset contains 237 discrete sample data points (OSHA, 2019). EPA estimated the highest expected concentration of DBP based on the Generic Scenario for the Use of Additives in Plastic Compounding (U.S. EPA, 2021e). The primary limitations of these data include uncertainty in the representativeness of the vapor monitoring data and the PNOR Model in capturing the true distribution of inhalation concentrations for this OES. Additionally, the vapor monitoring dataset consisted of just 4 datapoints for workers, none of the datapoints indicate the worker tasks, and 2 of the data points are for an unspecified sector of the "polymer industry." Furthermore, the OSHA CEHD dataset used in the PNOR Model is not specific to DBP. Finally, EPA

OES	Weight of Scientific Evidence Conclusion in Exposure Estimates
	assumed 8 exposure hours per day and 250 exposure days per year based on continuous DBP exposure during each working day for a typical worker schedule. It is uncertain whether this assumption captures actual worker schedules and exposures. Although the use of surrogate monitoring data increases the strength of the analysis, the few uncertainties discussed in the paragraph above reduce confidence of the analysis. Therefore, based on these strengths and limitations, EPA concluded that the weight of scientific evidence for this assessment is moderate.
PVC plastics converting	EPA considered the assessment approach, the quality of the data, and the uncertainties in the assessment results to determine a weight of scientific evidence conclusion for the 8-hour TWA inhalation exposure estimates for PVC plastics converting. EPA used PBZ air concentration data pulled from1 source to assess inhalation exposures to vapor. The primary strength of this approach is the use of directly applicable monitoring data, which is preferrable to other assessment approaches such as modeling or the use of OELs. This source provided worker exposures from 2 different studies (ECJRC, 2004) and received a rating of medium from EPA's systematic review process. EPA also expects converting activities to generate dust from solid PVC plastic products; therefore, the Agency incorporated the PNOR Model (U.S. EPA, 2021d) into the assessment to estimate worker inhalation exposures to solid particulate. A strength of the model is that the respirable PNOR range was refined using OSHA CEHD datasets, which EPA tailored to the Plastics and Rubber Manufacturing NAICS code (NAICS 326) and the resulting dataset contains 237 discrete sample data points (OSHA, 2019). EPA estimated the highest expected concentration of DBP based on the Generic Scenario for the Use of Additives in Plastic Compounding (U.S. EPA, 2021e). The primary limitations of these data include uncertainty in the representativeness of the vapor monitoring data and the PNOR Model in capturing the true distribution of inhalation concentrations for this OES. Additionally, the vapor monitoring dataset consisted of just four datapoints for workers, none of the datapoints indicate the worker tasks, and 2 of the data points are for an unspecified sector of the "polymer industry." Further, the OSHA CEHD dataset used in the PNOR Model is not specific to DBP. Finally, EPA assumed 8 exposure hours per day and 250 exposure days per year based on continuous DBP exposure during each working day for a typical worker schedule. It is uncertain whether this assumption captures actual worker schedules and exposures. Although the use of monitoring data specific to this OES increases the strength of the analysis, the few uncertainties discussed in the paragraph above reduce confidence of the analysis. Therefore, based on these strengths and limitations, EPA concluded that the weight of scientific evidence for this assessment is moderate to robust.
Non-PVC materials compounding and converting	EPA considered the assessment approach, the quality of the data, and the uncertainties in the assessment results to determine a weight of scientific evidence conclusion for the 8-hour TWA inhalation exposure estimates for non-PVC materials compounding and converting. The Agency used surrogate monitoring data from a PVC converting facility to estimate worker inhalation exposures due to no relevant OES-specific data. The primary strength of this approach is the use of monitoring data, which is preferrable to other assessment approaches such as modeling or the use of OELs. EPA used PBZ air concentration data pulled from 1 source to assess inhalation exposures to vapor. This source provided worker exposures from 2 different studies (ECJRC, 2004) and received a rating of medium from EPA's systematic review process.

OES	Weight of Scientific Evidence Conclusion in Exposure Estimates
	EPA also expects compounding activities to generate dust from solid PVC plastic products; therefore, the Agency incorporated the PNOR Model (U.S. EPA, 2021d) into the assessment to estimate worker inhalation exposures to solid particulate. A strength of the model is that the respirable PNOR range was refined using OSHA CEHD datasets, which EPA tailored to the Plastics and Rubber Manufacturing NAICS code (NAICS 326) and the resulting dataset contains 237 discrete sample data points (OSHA, 2019). EPA estimated the highest expected concentration of DBP based on the Emission Scenario Document on Additives in Rubber Industry (OECD, 2004a). The primary limitations of these data include uncertainty in the representativeness of the vapor monitoring data and the PNOR Model in capturing the true distribution of inhalation concentrations for this OES. Additionally, the vapor monitoring dataset consisted of just 4 datapoints for workers, none of the datapoints indicate the worker tasks, and 2 of the data points are for an unspecified sector of the "polymer industry." Further, the OSHA CEHD dataset used in the PNOR Model is not specific to DBP. Finally, EPA assumed 8 exposure hours per day and 250 exposure days per year based on continuous DBP exposure during each working day for a typical worker schedule. It is uncertain whether this assumption captures actual worker schedules and exposures. Although the use of surrogate monitoring data increases the strength of the analysis, the few uncertainties discussed in the paragraph above reduce confidence of the analysis. Therefore, based on these strengths and limitations, EPA concluded that the weight of scientific evidence for this assessment is moderate.
Application of adhesives and sealants	EPA considered the assessment approach, the quality of the data, and the uncertainties in the assessment results to determine a weight of scientific evidence conclusion for the 8-hour TWA inhalation exposure estimates for the application of adhesives and sealants. The Agency used monitoring data from a NIOSH HHE that documented exposures at a single furniture assembly site to estimate worker inhalation exposures to vapor. The primary strength of this approach is the use of directly applicable monitoring data, which is preferrable to other assessment approaches such as modeling or the use of OELs. EPA used PBZ air concentration data from this source to assess inhalation exposures (NIOSH, 1977). The source received a rating of medium from EPA's systematic review process. The primary limitations of these data include uncertainty in the representativeness of the vapor monitoring data in capturing the true distribution of inhalation concentrations for this OES. Only 1 use site type, furniture manufacturing, is represented by the data and this may not represent the entire adhesive and sealant industry. Additionally, 100% of the vapor monitoring datapoints were below the LOD and therefore the actual exposure concentration is unknown with the LOD used as an upper limit of exposure. Finally, EPA assumed 8 exposure hours per day and 232–250 exposure days per year based on continuous DBP exposure during each working day for a typical worker schedule with the exposure days representing the 50–95th percentile of the exposure day distribution. It is uncertain whether this assumption captures actual worker schedules and exposures. Although the use of monitoring data specific to this OES increases the strength of the analysis, the few uncertainties discussed in the paragraph above reduce confidence of the analysis. Therefore, based on these strengths and limitations, EPA concluded that the weight of scientific evidence for this assessment is moderate to robust and provides an upper-bound estimate of exposures.

OES	Weight of Scientific Evidence Conclusion in Exposure Estimates
Application of paints and coatings	EPA considered the assessment approach, the quality of the data, and the uncertainties in the assessment results to determine a weight of scientific evidence conclusion for the 8-hour TWA inhalation exposure estimates for the application of paints and coatings. EPA identified 2 full-shift PBZ monitoring samples in OSHA's CEHD and a monitoring dataset from an industry sponsored study found through EPA's literature search. The primary strength of this approach is the use of directly applicable monitoring data, which is preferrable to other assessment approaches such as modeling or the use of OELs. EPA used PBZ air concentration data from the 2 sources, which represent 3 different use facilities, to assess inhalation exposures (OSHA, 2019; Rohm & Haas, 1990). The OSHA CEHD source received a rating of high and the Rohm & Haas source received a rating of low from EPA's systematic review process. The primary limitations of these data include uncertainty in the representativeness of the monitoring data in capturing the true distribution of inhalation concentrations for this OES. Three different use sites are represented by the data but these may not represent the overall DBP-containing paint and coating industry. Finally, EPA assumed 8 exposure hours per day and 250 exposure days per year based on continuous DBP exposure during each working day for a typical worker schedule. It is uncertain whether this assumption captures actual worker schedules and exposures. Although the use of monitoring data specific to this OES increases the strength of the analysis, the few uncertainties discussed in the paragraph above reduce confidence of the analysis. Therefore, based on these strengths and limitations, EPA concluded that the weight of scientific evidence for this assessment is moderate to robust.
Use of industrial process solvents	EPA considered the assessment approach, the quality of the data, and the uncertainties in the assessment results to determine a weight of scientific evidence conclusion for the 8-hour TWA inhalation exposure estimates for the Use of industrial process solvents. Due to no relevant OES-specific data, EPA used surrogate monitoring data from DBP manufacturing facilities to estimate worker inhalation exposures. The primary strength of this approach is the use of monitoring data, which is preferrable to other assessment approaches such as modeling or the use of OELs. EPA used PBZ air concentration data pulled from 3 sources to assess inhalation exposures (ECB, 2008; ECJRC, 2004; SRC, 2001). All 3 data sources received a rating of medium from EPA's systematic review process. These data were DBP-specific, though it is uncertain whether the measured concentrations accurately represent the entire industry. The primary limitations of these data include uncertainty in the representativeness of these data for this OES and the true distribution of inhalation concentrations in this scenario. Additionally, the dataset is only built on limited data points (3 data sources) with a significant spread of measurements. The SRC source sites an ACC conversation that provides a datapoint as a worst-case scenario, the ECJRC, 2008 source only provides a single datapoint with uncertain statistics and the ECJRC, 2004 source provided a dataset with an uncertain range and number of samples. EPA also assumed 8 exposure hours per day and 250 exposure days per year based on continuous DBP exposure each working day for a typical worker schedule; it is uncertain whether this captures actual worker schedules and exposures. DBP exposure each working day for a typical worker schedule; it is uncertain whether this captures actual worker schedules and exposures.

OES	Weight of Scientific Evidence Conclusion in Exposure Estimates
	Although the use of surrogate monitoring data increases the strength of the analysis, the few uncertainties discussed in the paragraph above reduce confidence of the analysis. Therefore, based on these strengths and limitations, EPA concluded that the weight of scientific evidence for this assessment is moderate.
Use of laboratory chemicals	EPA considered the assessment approach, the quality of the data, and the uncertainties in the assessment results to determine a weight of scientific evidence conclusion for the 8-hour TWA inhalation exposure estimates for the Use of laboratory chemicals. Due to no relevant OES-specific data, the Agency used surrogate monitoring data from a NIOSH HHE for Application of adhesives and sealants OES to estimate worker vapor inhalation exposures as well as the PNOR Model (U.S. EPA, 2021d) to characterize worker particulate inhalation exposures. The primary strength of this approach is the use of monitoring data, which are preferrable to other assessment approaches such as modeling or the use of OELs. EPA used PBZ air concentration data from the NIOSH HHE to assess inhalation exposures (NIOSH, 1977). The source received a rating of medium from EPA's systematic review process. EPA also used the PNOR Model (U.S. EPA, 2021d) to estimate worker inhalation exposure to solid particulate. The model data is based on OSHA CEHD data (OSHA, 2019). EPA used a subset of the respirable particulate data from the generic model identified with the Professional, Scientific, and Technical Services NAICS code (NAICS code 54) to assess this OES, which the Agency expects to be the most representative subset of the particulate data for use of laboratory chemicals in the absence of DBP-specific data. EPA estimated the highest expected concentration of DBP in identified DBP-containing products applicable to this OES. The primary limitation of this approach is uncertainty in the representativeness of the vapor monitoring data and the PNOR Model in capturing the true distribution of inhalation concentrations for this OES. Additionally, the vapor monitoring data come from 1 source where the identified samples were below the LOD and therefore the actual exposure concentration is unknown with the LOD used as an upper limit of exposure. Further, the OSHA CEHD dataset used in the PNOR Model is not specific to DBP. EPA also assumed 8 exposure hours per day and 250 exposure days per year based on continuous DBP exposure each working day for a typical worker schedule; it is uncertain whether this captures actual worker schedules and exposures. Although the use of surrogate monitoring data increases the strength of the analysis, teh few uncertainties discussed in the paragraph above reduce confidence of the analysis. Therefore, based on these strengths and limitations, EPA concluded that the weight of scientific evidence for this assessment is moderate and provides an upper-bound estimate of exposures.
Use of lubricants and functional fluids	EPA considered the assessment approach, the quality of the data, and the uncertainties in the assessment results to determine a weight of scientific evidence conclusion for the 8-hour TWA inhalation exposure estimates for the Use of lubricants and functional fluids. Due to no relevant OES-specific data, the Agency used surrogate monitoring data from the OES for application of adhesives containing DBP to estimate worker vapor inhalation exposures. The primary strength of this approach is the use of monitoring data, which are preferrable to other assessment approaches, such as modeling or the use of OELs. EPA used PBZ air concentration data from this source to assess inhalation exposures (NIOSH, 1977). The source received a rating of medium from EPA's systematic review process. The primary limitation of this approach is uncertainty in the representativeness of the vapor monitoring data in capturing the true distribution of inhalation concentrations for this OES. Additionally, the vapor monitoring data come from 1 source and 100% of the

OES	Weight of Scientific Evidence Conclusion in Exposure Estimates
	data were below the LOD. EPA also assumed 8 exposure hours per day and 2 to 4 exposure days per year based on a typical equipment maintenance schedule; it is uncertain whether this captures actual worker schedules and exposures. Although the use of surrogate monitoring data increases the strength of the analysis, teh few uncertainties discussed in the paragraph above reduce confidence of the analysis. Therefore, based on these strengths and limitations, EPA concluded that the weight of scientific evidence for this assessment is moderate and provides an upper-bound estimate of exposures
Use of penetrants and inspection fluids	EPA considered the assessment approach, the quality of the data, and uncertainties in assessment results to determine a weight of scientific evidence conclusion for the 8-hour TWA inhalation exposure estimates. EPA developed a Penetrant and Inspection Fluid Near-Field/Far-Field Inhalation Exposure Model which uses a near-field/far-field approach and the inputs to the model were derived from references that received ratings of medium-to-high for data quality in the systematic review process. EPA combined this model with Monte Carlo modeling to estimate occupational exposures in the near-field (worker) and far-field (ONU) inhalation exposures. A strength of the Monte Carlo modeling approach is that variation in model input values and a range of potential exposure values is more likely than a discrete value to capture actual exposure at sites, the high number of data points (simulation runs), and the full distributions of input parameters. EPA identified and used a DINP-containing penetrant/inspection fluid product as surrogate to estimate concentrations, application methods, and use rate. The primary limitation is the uncertainty in the representativeness of values toward the true distribution of potential inhalation exposures. EPA lacks facility and DBP-specific product use rates, concentrations, and application methods, therefore, estimates are made based on surrogate DINP-containing product. The Agency only found 1 product to represent this use scenario; however, and its representativeness of all DBP-containing penetrants and inspection fluids is not known. Also, EPA based exposure days and operating days as specified in the ESD on the Use of Metalworking Fluids (OECD, 2011c), which may not be representative of all facilities and workers that use these products. Although the use of Monte Carlo modeling increases the strength of the analysis, teh few uncertainties discussed in the paragraph above reduce confidence of the analysis. Therefore, based on these strengths and limitations, EPA has concluded that the weight of scientific evidence for this assessment is moderate.
Fabrication or Use of Final Product and Articles	EPA considered the assessment approach, the quality of the data, and uncertainties in assessment results to determine a weight of scientific evidence conclusion for the full-shift TWA inhalation exposure estimates for the fabrication or use of final products or articles OES. EPA used monitoring data from a facility melting, shaping, and gluing plastics and a facility welding plastic roofing components (ECJRC, 2004; Rudel et al., 2001)to assess worker inhalation exposures to vapor. Both sources received a rating of medium from EPA's systematic review process. EPA also utilized the PNOR Model (U.S. EPA, 2021d) to estimate worker inhalation exposure to solid particulate. The primary strength of this approach is the use of monitoring data, which is preferrable to other assessment approaches such as modeling or the use of OELs. For the vapor exposure, EPA used workplace DBP air concentration data found from 2 sources to assess inhalation exposures to vapor. This data was DBP-specific and from facilities manipulating finished DBP-containing articles.

OES	Weight of Scientific Evidence Conclusion in Exposure Estimates
	The respirable particulate concentrations used by the generic model is based on OSHA CEHD data (OSHA, 2019). EPA used a subset of the respirable particulate data from the generic model identified with the Furniture and Related Product Manufacturing NAICS code (NAICS code 337) to assess this OES, which EPA expects to be the most representative subset of the particulate data for this OES. EPA estimated the highest expected concentration of DBP in particulates during product fabrication using plasticizer additive concentration information from the Use of Additives in Plastic Converting Generic Scenario (U.S. EPA, 2004a). These strengths increase the weight of evidence. The primary limitation is the uncertainty in the representativeness of values toward the true distribution of potential inhalation exposures. Specifically, EPA lacks facility-specific particulate concentrations in air, and the representativeness of the data set used in the model towards sites that actually handle DBP is uncertain. Further, the model lacks metadata on worker activities. EPA assumed 8 exposure hours per day based on continuous DBP particulate exposure while handling DBP-containing products on site each working day for a typical worker schedule; it is uncertain whether this captures actual worker schedules and exposures. The Agency set the number of exposure days for both central-tendency and high-end exposure estimates at 250 days per year based on EPA default assumptions. Vapor exposures are not expected to significantly contribute to overall inhalation exposure compared to particulate exposures. These limitations decrease the weight of evidence. Although the use of monitoring data specific to this OES increases the strength of the analysis, the few uncertainties discussed in the paragraph above reduce confidence of the analysis. Therefore, based on these strengths and limitations, EPA has concluded that the weight of scientific evidence for this assessment is moderate and provides an upper-bound estimate of exposures.
Recycling	EPA considered the assessment approach, the quality of the data, and uncertainties in assessment results to determine a weight of scientific evidence conclusion for the full-shift TWA inhalation exposure estimates for the recycling OES. EPA utilized the PNOR Model (U.S. EPA, 2021d) to estimate worker inhalation exposure to solid particulate. The respirable particulate concentrations used by the generic model are based on OSHA CEHD data (OSHA, 2019). EPA used a subset of the respirable particulate data from the generic model identified with the Administrative and Support and Waste Management and Remediation Services NAICS code (NAICS code 56) to assess this OES, which EPA expects to be the most representative subset of the particulate data for this OES. EPA estimated the highest expected concentration of DBP in plastic using plasticizer additive concentration information from the Use of Additives in Plastic Converting Generic Scenario (U.S. EPA, 2004a). These strengths increase the weight of evidence. The primary limitation is the uncertainty in the representativeness of values toward the true distribution of potential inhalation exposures. Specifically, EPA lacks facility-specific particulate concentrations in air, and the representativeness of the data set used in the model towards sites that actually handle DBP is uncertain. Further, the model lacks metadata on worker activities. The Agency set the number of exposure days for both central-tendency and high-end exposure estimates at 250 days per year based on EPA default assumptions. Also, it was assumed that each worker is potentially exposed for 8 hours per workday; however, it is uncertain whether this captures actual worker schedules and exposures. These limitations decrease the weight of evidence. Although the use of PNOR Model which is based on OSHA CEHD monitoring data increases the strength of the analysis, the few uncertainties discussed in the paragraph above reduces confidence of the analysis. Therefore, based on these strengths and

OES	Weight of Scientific Evidence Conclusion in Exposure Estimates
	limitations, EPA has concluded that the weight of scientific evidence for this assessment is moderate and provides an upper-bound estimate of exposures.
Waste handling, treatment, and disposal	EPA considered the assessment approach, the quality of the data, and uncertainties in assessment results to determine a weight of scientific evidence conclusion for the full-shift TWA inhalation exposure estimates for the waste handling, treatment, and disposal OES. EPA utilized the PNOR Model (U.S. EPA, 2021d) to estimate worker inhalation exposure to solid particulate. The respirable particulate concentrations used by the generic model are based on OSHA CEHD data (OSHA, 2019). EPA used a subset of the respirable particulate data from the generic model identified with the Administrative and Support and Waste Management and Remediation Services NAICS code (NAICS code 56) to assess this OES, which EPA expects to be the most representative subset of the particulate data for this OES. EPA estimated the highest expected concentration of DBP in plastic using plasticizer additive concentration information from the Generic Scenario for the Use of Additives in Plastic Compounding (U.S. EPA, 2021e). These strengths increase the weight of evidence. The primary limitation is the uncertainty in the representativeness of values toward the true distribution of potential inhalation exposures. Specifically, EPA lacks facility-specific particulate concentrations in air, and the representativeness of the data set used in the model towards sites that actually handle DBP is uncertain. Furthermore, the model lacks metadata on worker activities. The Agency set the number of exposure days for both central-tendency and high-end exposure estimates at 250 days per year based on EPA default assumptions. Also, it was assumed that each worker is potentially exposed for 8 hours per workday; however, it is uncertain whether this captures actual worker schedules and exposures. These limitations decrease the weight of evidence. Although the use of PNOR Model, which is based on OSHA CEHD monitoring data, increases the strength of the analysis, few uncertainties discussed in the paragraph above reduce confidence of the analysis. Therefore, based on these strengths and limitations, EPA has concluded that the weight of scientific evidence for this assessment is moderate and provides an upper-bound estimate of exposures.
Dermal – Liquids	EPA used dermal absorption data for 7% oil-in-water DBP formulations to estimate occupational dermal exposures for liquid (Doan et al., 2010). The tests were performed on guinea pigs, which have more permeable skin than humans (OECD, 2004b), meaning the dermal absorption value is likely protective for human skin. However, it is acknowledged that variations in chemical concentration and co-formulant components affect the rate of dermal absorption. Additionally, it is unclear how representative the data from Doan et al. (2010) are for neat DBP. Because EPA assumed absorptive flux of DBP measured from guinea pig experiments serves as an upper bound of potential absorptive flux of chemical into and through the skin for dermal contact with all liquid products. EPA is confident that the dermal absorption data using guinea pigs provides an upper bound of dermal absorption of DBP. For occupational dermal exposure assessment, EPA assumed a standard 8-hour workday and the chemical is contacted at least once per day. Because DBP has low volatility and relatively low absorption, it is possible that the chemical remains on the surface of the skin after dermal contact until the skin is washed. Therefore, in absence of exposure duration data, EPA has assumed that absorption of DBP from occupational dermal contact with materials containing DBP may extend up to 8 hours per day (U.S. EPA, 1991). However, if a worker uses proper PPE or washes their hands after contact with DBP or DBP-containing materials dermal exposure may be eliminated. Therefore, the assumption of an 8-hour exposure duration for DBP may lead to overestimation of dermal

OES	Weight of Scientific Evidence Conclusion in Exposure Estimates
	exposure. For average adult workers, the surface area of contact was assumed equal to the area of 1 hand (*i.e.*, 535 cm^2), or 2 hands (*i.e.*, 1,070 cm^2), for central tendency exposures, or high-end exposures, respectively (U.S. EPA, 2011a). Other parameters such as frequency and duration of use, and surface area in contact, are well understood and representative. Despite moderate confidence in the estimated values themselves, EPA has robust confidence that the dermal liquid exposure estimates are upper bound of potential exposure scenarios.
Dermal – Solids	It is expected that dermal exposure to solid matrices would result in far less absorption, but there are no studies that report dermal absorption of DBP from a solid matrix. For cases of dermal absorption of DBP from a solid matrix, EPA assumed that DBP will first migrate from the solid matrix to a thin layer of moisture on the skin surface. Therefore, absorption of DBP from solid matrices is considered limited by aqueous solubility and is estimated using an aqueous absorption model (U.S. EPA, 2023c, 2004b). Nevertheless, it is assumed that absorption of the aqueous material serves as a reasonable upper bound for contact with solid materials. Also, EPA acknowledges that variations in chemical concentration and co-formulant components affect the rate of dermal absorption. For OES with lower concentrations of DBP in the solid, it is possible that the estimated amount absorbed using the modeled flux value would exceed the amount of DBP available in the dermal load. In these cases, EPA capped the amount absorbed to the maximum amount of DBP in the solid (*i.e.*, the product of the dermal load and the weight fraction of DBP). For occupational dermal exposure assessment, EPA assumed a standard 8-hour workday and the chemical is contacted at least once per day. Because DBP has low volatility and relatively low absorption, it is possible that the chemical remains on the surface of the skin after dermal contact until the skin is washed. So, in absence of exposure duration data, EPA has assumed that absorption of DBP from occupational dermal contact with materials containing DBP may extend up to 8 hours per day (U.S. EPA, 1991). However, if a worker uses proper PPE or washes their hands after contact with DBP or DBP-containing materials dermal exposure may be eliminated. Therefore, the assumption of an 8-hour exposure duration for DBP may lead to overestimation of dermal exposure. EPA also assumed an area of contact for average adult workers ranging from 535 cm^2 (central tendency) to 1,070 cm^2 (high-end) (U.S. EPA, 2011a). The occupational dermal exposure assessment is limited in that it does not consider the uniqueness of each material potentially contacted; however, the dermal exposure estimates are expected to be representative of materials potentially encountered in occupational settings. Therefore, the dermal absorption estimates assume that dermal absorption of DBP from solid objects would be limited by the aqueous solubility of DBP. EPA has moderate confidence in the aspects of the exposure estimate for solid articles because of the high uncertainty in the assumption of partitioning from solid to liquid, and because subsequent dermal absorption is not well characterized. Additionally, there are uncertainties associated to the flux-limited approach which likely results in overestimations due to the assumption about excess DBP in contact with skin for the entire work duration. Other parameters such as frequency and duration of use, and surface area in contact have unknown uncertainties due to lack of information about use patterns. Despite moderate confidence in the estimated values themselves, EPA has robust confidence that the exposure estimates are upper bound of potential exposure scenarios.

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4.1.1.5.1 Strengths, Limitations, Assumptions, and Key Sources of Uncertainty for the Occupational Exposure Assessment

EPA assigned overall confidence descriptions of high, medium, or low to the exposure assessments based on the strength of the underlying scientific evidence. When the assessment is supported by robust evidence, EPA's overall confidence in the exposure assessment is high; when supported by moderate evidence, EPA's overall confidence is medium; when supported by slight evidence, EPA's overall confidence is low.

Strengths

The exposure scenarios and exposure factors underlying the inhalation and dermal assessment are supported by moderate to robust evidence. Occupational inhalation exposure estimates were informed by moderate or robust sources of directly applicable and surrogate monitoring data or modeling was used to estimate the inhalation exposure estimates. Exposure factors for occupational inhalation exposure include duration of exposure, body weight, and breathing rate, which were informed by moderate to robust data sources.

Limitations

The principal limitation of the exposure assessments is uncertainty in the representativeness of the data and models used as there is limited direct exposure monitoring data for DBP in the literature from systematic review. A limitation of the modeling methodologies is that most of the model input data from GSs/ESDs, such as air speed or loss factors, are generic for the OESs and not specific to the use of DBP within the OESs. Additionally, the selected generic models and data may not be representative of all chemical- or site-specific work practices and engineering controls. Limitations associated with dermal exposure assessment are described in Table 4-5.

Assumptions

When determining the appropriate model for assessing exposures to DBP, the Agency considered the physical form of DBP during different OESs. DBP may be present in various physical forms such as a powder, mist, paste, or in solution during the various OESs. EPA assessed each respective OES assuming the physical form of DBP based on available product data, CDR data, and information from applicable GSs/ESDs. Because the physical form of DBP can influence exposures substantially, EPA assumed DBP is present in the physical form that is most prevalent and/or most protective for the given OES when assessing the exposures.

EPA calculated chronic ADD values assuming workers and ONUs are exposed at the same level for their entire working lifetime, which may result in an overestimate. Individuals may change jobs during the course of their career such that they are no longer exposed to DBP and the actual ADD values become lower than the estimates presented. EPA collected tenure data to estimate central tendency and high-end working years of exposure that is assumed to inherently take into account workers changing jobs. Assumptions associated with dermal exposure assessment are described in Table 4-5.

Uncertainties

EPA addressed variability in inhalation models by identifying key model parameters and applying statistical distributions that mathematically define the parameter's variability. The Agency defined statistical distributions for parameters using documented statistical variations where available. Where the statistical variation was unknown, EPA made assumptions to estimate the parameter distribution using available literature data, such as GSs and ESDs. However, there is uncertainty as to the representativeness of the parameter distributions because these data are often not specific to sites that use DBP. In general, the effects of these uncertainties on the exposure estimates are unknown as the uncertainties may result in either overestimation or underestimation of exposures, depending on the actual distributions of each of the model input parameters. Uncertainties associated with dermal exposure assessment are described in Table 4-5.

4.1.2 Consumer Exposures

The following subsections briefly describe EPA's approach to assessing consumer exposures and provide exposure assessment results for each COU. The *Draft Consumer and Indoor Dust Exposure Assessment for Dibutyl Phthalate (DBP)* (U.S. EPA, 2025c) provides additional details on the development of approaches and the exposure assessment results. The consumer exposure assessment evaluated exposures from individual COUs whereas the indoor dust assessment uses a subset of consumer articles with large surface area and presence in indoor environments to garner COU specific contributions to the total exposures from dust.

4.1.2.1 Summary of Consumer and Indoor Dust Exposure Scenarios and Modeling Approach and Methodology

The major steps in performing a consumer exposure assessment are summarized below:

- identification and mapping of product and article examples following the consumer COU table (Table 4-6), product, and article identification;
- compilation of products' and articles' manufacturing use instructions to determine patterns of use;
- selection of exposure routes and exposed populations according to product/article use descriptions;
- identification of data gaps and further search to fill gaps with studies, chemical surrogates or product and article proxies, or professional judgement;
- selection of appropriate modeling tools based on available information and chemical properties;
- gathering of input parameters per exposure scenario; and
- parameterization of selected modeling tools.

Consumer products or articles containing DBP were matched with the identified consumer COUs. Table 4-6 summarizes the consumer exposure scenarios by COU for each product example(s), the exposure routes, which scenarios are also used in the indoor dust assessment, and whether the analysis was conducted qualitatively or quantitatively, see Sections 2.2.1 and 2.2.2 in (U.S. EPA, 2025c) for detailed descriptions, explanations, and rationale. The indoor dust assessment uses consumer product and article information for selected items with the goal of recreating the indoor environment. The subset of consumer products and articles that are used in the indoor dust assessment are selected for their potential to have large surface area for dust collection, roughly larger than 1 m^2.

When a quantitative analysis of reasonably available information was conducted, exposure from the consumer COUs was estimated by modeling. Exposure via inhalation and ingestion routes were modeled using EPA's CEM, Version 3.2 (U.S. EPA, 2023c). Dermal exposures for both liquid products and solid articles were calculated outside of CEM, see *Draft Consumer Exposure Analysis for Dibutyl Phthalate (DBP)* (U.S. EPA, 2025d) for calculations and inputs. CEM dermal modeling uses a dermal model approach that assumes infinite DBP migration from product to skin without considering saturation which result in overestimations of dose and subsequent risk, see Section 2.3 in U.S. EPA (2025c) for a detailed explanation. Dermal exposures were estimated using a computational framework implemented within a spreadsheet environment using a flux-limited, dermal absorption approach for liquid and solid products (U.S. EPA, 2025d). For each exposure route, EPA used the 10th percentile, average, and 95th percentile value of an input parameter (*e.g.,* weight fraction, surface area) where possible to characterize low, medium, and high exposure scenarios for a given COU. If only a range was reported, EPA used the minimum and maximum of the range as the low and high values, respectively. The average of the reported low and high values from the reported range was used for the medium exposure scenario. See *Draft Consumer and Indoor Dust Exposure Assessment for Dibutyl Phthalate (DBP)* (U.S. EPA, 2025c) for details about the consumer modeling approaches, sources of data, model parameterization, and assumptions. High-, medium-, and low-intensity use exposure scenarios serve as a two-pronged approach. First, it provides a sensitivity analysis with insight on the impact of the main modeling input parameters (*e.g.,* skin contact area, duration of contact, and frequency of contact) in the doses and risk estimates. And second, the high-intensity use exposure scenarios are used first to screen for potential risks at the upper bound of possible exposures and then, if needed, to refine.

Exposure via the inhalation route occurs from inhalation of DBP gas-phase emissions or when DBP partitions to suspended particulate from direct use or application of products. However, DBP's low volatility is expected to result in negligible gas-phase inhalation exposures. Sorption to suspended and settled dust is likely to occur based on monitoring data (see indoor dust monitoring data in Section 4.1.2.1) and its affinity for organic matter that is typically present in household dust). Thus, inhalation and ingestion of suspended and settled dust is considered in this draft assessment. Exposure via the dermal route can occur from direct contact with products and articles. Exposure via ingestion depends on the product or article use patterns. Exposure can occur via direct mouthing (*i.e.,* directly putting product in mouth) in which the person can ingest settled dust with DBP or directly ingesting DBP from migration to saliva. Additionally, ingestion of suspended dust can occur when DBP migrates from article to dust or partitions from gas-phase to suspended dust.

EPA made some adjustments to match CEM's lifestages to those listed in the U.S. Centers for Disease Control and Prevention (CDC) guidelines (CDC, 2021) and EPA's *A Framework for Assessing Health Risks of Exposures to Children* (U.S. EPA, 2006). CEM lifestages are re-labeled from this point forward as follows:

- Adult (21+ years) → Adult
- Youth 2 (16–20 years) → Teenager
- Youth 1 (11–15 years) → Young teen
- Child 2 (6–10 years) → Middle childhood
- Child 1 (3–5 years) → Preschooler
- Infant 2 (1–2 years) → Toddler
- Infant 1 (<1 year) → Infant

EPA assessed acute, intermediate, and chronic exposures to DBP from consumer COUs. For the acute dose rate calculations, an averaging time of 1 day is used representing the maximum time-integrated dose over a 24-hour period during the exposure event. The chronic dose rate is calculated iteratively at a 30-second interval during the first 24 hours and every subsequent hour for 60 days and averaged over 1 year. Intermediate dose is the exposure to continuous or intermittent (depending on product) use during a 30-day period, which is roughly 1 month. See Sections 2.2.1 and 2.2.2 and Appendix A in (U.S. EPA, 2025c) for details about acute, chronic, and intermediate dose calculations. Professional judgment and product use descriptions were used to estimate events per day and per month/year for the calculation of the intermediate/chronic dose.

Table 4-6. Summary of Consumer COUs, Exposure Scenarios, and Exposure Routes

Consumer Condition of Use Category	Consumer Condition of Use Subcategory	Product/Article	Exposure Scenario and Route [a]	Evaluated Routes				
						Ingestion		
				Inhalation[b]	Dermal	Suspended Dust	Settled Dust	Mouthing
Automotive, fuel, agriculture, outdoor use products	Automotive care products	See automotive adhesives	Use of product in DIY small-scale auto repair and hobby activities. Direct contact during use; inhalation of emissions during use	✓	✓	✗	✗	✗
Construction, paint, electrical, and metal products	Adhesives and sealants	Adhesive for small repairs	Direct contact during use	✗	✓	✗	✗	✗
Construction, paint, electrical, and metal products	Adhesives and sealants	Automotive adhesives	Use of product in DIY small-scale auto repair and hobby activities. Direct contact during use; inhalation of emissions during use	✓	✓	✗	✗	✗
Construction, paint, electrical, and metal products	Adhesives and sealants	Construction adhesives	Direct contact during use	✗	✓	✗	✗	✗
Construction, paint, electrical, and metal products	Paints and coatings	Metal coatings	Use of product in DIY home repair and hobby activities. Direct contact during use; inhalation of emissions during use	✓	✓	✗	✗	✗
Construction, paint, electrical, and metal products	Paints and coatings	Sealing and refinishing sprays (indoor use)	Application of product in house via spray. Direct contact during use; inhalation of emissions during use	✓	✓	✗	✗	✗
Construction, paint, electrical, and metal products	Paints and coatings	Sealing and refinishing sprays (outdoor use)	Application of product outdoors via spray. Direct contact during use; inhalation of emissions during use	✓	✓	✗	✗	✗
Furnishing, cleaning, treatment care products	Fabric, textile, and leather products	Synthetic leather clothing	Direct contact during use	✗	✓	✗	✗	✗
Furnishing, cleaning, treatment care products	Fabric, textile, and leather products	Synthetic leather furniture	Direct contact during use; inhalation of emissions / ingestion of airborne particulate; ingestion by mouthing	✓[c]	✓	✓[c]	✓[c]	✓
Furnishing, cleaning, treatment/care products	Cleaning and furnishing care products	Spray cleaner	Application of product in house via spray. Direct contact during use; inhalation of emissions during use	✓	✓	✗	✗	✗

Consumer Condition of Use Category	Consumer Condition of Use Subcategory	Product/Article	Exposure Scenario and Route [a]	Evaluated Routes: Inhalation[b]	Evaluated Routes: Dermal	Evaluated Routes: Ingestion: Suspended Dust	Evaluated Routes: Ingestion: Settled Dust	Evaluated Routes: Ingestion: Mouthing
Furnishing, cleaning, treatment/care products	Cleaning and furnishing care products	Waxes and polishes	Application of product in house via spray. Direct contact during use; inhalation of emissions during use	✓	✓	✗	✗	✗
Furnishing, cleaning, treatment/care products	Floor coverings; construction and building materials covering large surface areas including stone, plaster, cement, glass and ceramic articles; fabrics, textiles, and apparel	Vinyl flooring	Direct contact, inhalation of emissions / ingestion of dust adsorbed chemical	✓[c]	✓	✓[c]	✓[c]	✗
Furnishing, cleaning, treatment/care products	Floor coverings; construction and building materials covering large surface areas including stone, plaster, cement, glass and ceramic articles; fabrics, textiles, and apparel	Wallpaper	Direct contact during installation (teenagers and adults) and while in place; inhalation of emissions / ingestion of dust adsorbed chemical	✓[c]	✓	✓[c]	✓[c]	✗
Other uses	Novelty articles	Adult toys	Direct contact during use; ingestion by mouthing	✗	✓	✗	✗	✓
Other uses	Automotive articles	Synthetic leather seats. see synthetic leather furniture	Direct contact during use; inhalation of emissions / ingestion of airborne particulate; ingestion by mouthing	✓[c]	✓	✓[c]	✓[c]	✗
Other uses	Automotive articles	Car mats	Direct contact during use; inhalation of emissions / ingestion of airborne particulate; ingestion by mouthing	✓[c]	✓	✓[c]	✓[c]	✗
Other uses	Chemiluminescent light sticks	Small articles with semi routine contact; glow sticks	Direct contact during use	✗	✓	✗	✗	✗
Other uses	Lubricants and lubricant additives	No consumer products identified. See adhesives for small repairs	Current products were not identified. Foreseeable uses were matched with the adhesives for small repairs because similar use patterns are expected.	✗	✓	✗	✗	✗
Packaging, paper, plastic, hobby products	Ink, toner, and colorant products	No consumer products identified. See adhesives for small repairs	Current products were not identified. Foreseeable uses were matched with the	✗	✓	✗	✗	✗

Consumer Condition of Use Category	Consumer Condition of Use Subcategory	Product/Article	Exposure Scenario and Route [a]	Evaluated Routes				
						Ingestion		
				Inhalation[b]	Dermal	Suspended Dust	Settled Dust	Mouthing
			adhesives for small repairs because similar use patterns are expected.					
Packaging, paper, plastic, hobby products	Packaging (excluding food packaging), including rubber articles; plastic articles (hard); plastic articles (soft); other articles with routine direct contact during normal use, including rubber articles; plastic articles (hard)	Footwear	Direct contact during use	✗	✓	✗	✗	✗
Packaging, paper, plastic, hobby products	Packaging (excluding food packaging), including rubber articles; plastic articles (hard); plastic articles (soft); other articles with routine direct contact during normal use, including rubber articles; plastic articles (hard)	Shower curtains	Direct contact during use; inhalation of emissions / ingestion of dust adsorbed chemical while hanging in place	✓ [c]	✓	✓ [c]	✓ [c]	✗
Packaging, paper, plastic, hobby products	Packaging (excluding food packaging), including rubber articles; plastic articles (hard); plastic articles (soft); other articles with routine direct contact during normal use, including rubber articles; plastic articles (hard)	Small articles with semi routine contact; miscellaneous items including a pen, pencil case, hobby cutting board, costume jewelry, tape, garden hose, disposable gloves, and plastic bags/pouches	Direct contact during use	✗	✓	✗	✗	✗
Packaging, paper, plastic, hobby products	Toys, playground, and sporting equipment	Children's toys (legacy). produced before cpsia statutory and regulatory limitations, 0.1%.	Collection of toys. Direct contact during use; inhalation of emissions / ingestion of airborne PM; ingestion by mouthing	✓ [c]	✓	✓ [c]	✓ [c]	✓
Packaging, paper, plastic, hobby products	Toys, playground, and sporting equipment	Children's toys (new). produced after cpsia statutory and regulatory limitations, 0.1%.	Collection of toys. Direct contact during use; inhalation of emissions / ingestion of airborne particulate; ingestion by mouthing	✓ [c]	✓	✓ [c]	✓ [c]	✓

Consumer Condition of Use Category	Consumer Condition of Use Subcategory	Product/Article	Exposure Scenario and Route [a]	Evaluated Routes				
						Ingestion		
				Inhalation[b]	Dermal	Suspended Dust	Settled Dust	Mouthing
Packaging, paper, plastic, hobby products	Toys, playground, and sporting equipment	Small Articles with Semi Routine contact; miscellaneous items including a football, balance ball, and pet toy	Direct contact during use	✗	✓	✗	✗	✗
Packaging, paper, plastic, hobby products	Toys, playground, and sporting equipment	Tire crumb and artificial turf	Direct contact during use (particle ingestion via hand-to-mouth)	✓	✓		✓ [d]	
Disposal	Disposal	Down the drain products and articles	Down the drain and releases to environmental media	✗	✗	✗	✗	✗
Disposal	Disposal	Residential end-of-life disposal, product demolition for disposal	Product and article end-of-life disposal and product demolition for disposal	✗	✗	✗	✗	✗

DIY–do-it-yourself
CPSIA – Consumer Product Safety Improvement Act of 2008 (CPSIA section 108(a), 15 U.S.C. § 2057c(a);16 CFR. 1307.3(a)), Congress permanently prohibited the sale of children's toys or childcare articles containing concentrations of more than 0.1 percent DBP.
[a] See Sections 2.2.1 and 2.2.2 in (U.S. EPA, 2025c) for details about exposure scenarios per COU and product example and exposure routes assessed quantitatively and qualitatively.
[b] Inhalation scenarios considered suspended dust and gas-phase emissions.
[c] Scenario used in Indoor Dust Exposure Assessment in Section 4 in (U.S. EPA, 2025c). These indoor dust articles scenarios consider the surface area from multiple articles such as toys, while furniture and flooring already have large surface areas. For these articles dust can deposit and contribute to significantly larger concentration of dust than single small articles
[d] The tire crumb and artificial turf ingestion route assessment considers all 3 types of ingestions, settled dust, suspended dust, and mouthing altogether, but results cannot be provided separately has it was done for all other articles and products.
✓ Quantitative consideration
✗ Qualitative Consideration

Inhalation and Ingestion Exposure Routes Modeling Approaches

Key parameters for articles modeled in CEM 3.2 2 (U.S. EPA, 2023c) are summarized in detail in Section 2 in *Draft Consumer and Indoor Dust Exposure Assessment for Dibutyl Phthalate (DBP)* (U.S. EPA, 2025c). Calculations, sources, input parameters, and results are also available in *Draft Consumer Exposure Analysis for Dibutyl Phthalate (DBP)* (U.S. EPA, 2025d). Generally, and when possible, model parameters were determined based on specific articles identified in this assessment and CEM defaults were only used where specific information was not available. A list of some of the most important in developing representative scenarios for the selected modeling tools and approaches input parameters for exposure from articles and products is included below:

- weight fraction (articles and products);
- density (articles and products);
- duration of use (products);
- frequency of use for chronic, acute, and intermediate (products);
- product mass used (products);
- article surface area (articles);
- chemical migration rate to saliva (articles);
- area mouthed (articles); and
- use environment volume (articles and products).

Of these, the chemical migration rate from articles to saliva and area mouthed are most important to mouthing exposure scenarios. According to a sensitivity analysis conducted for CEM input parameters, duration, frequency, and amount used are key determinants of estimated exposure concentrations.

For each scenario, high-, medium-, and low-intensity use exposure scenarios were developed in which values for duration of use, frequency of use, and surface area were determined based on reasonably available information or professional judgment. Each input parameter listed above was parameterized according to the article-specific data found via systematic review. If article-specific data were not available, CEM default parameters were used, or if CEM default parameters were not applicable, an assumption based on article use descriptions by manufacturers was used, always leaning on the health protective values. For example, for all scenarios, the near-field modeling option was selected to account for a small personal breathing zone around the user during product use in which concentrations are higher, rather than employing a single well-mixed room. This represents a conservative modeling assumption in the absence of article-specific emission data. A near-field volume of 1 m^3 was selected. See Section 2.1 for weight fraction selection and Section 2.2.3 for parameterization details in the *Draft Consumer and Indoor Dust Exposure Assessment for Dibutyl Phthalate (DBP)* (U.S. EPA, 2025c).

Dermal Exposure Routes Modeling Approaches

Dermal modeling was conducted outside of CEM. The use of CEM for dermal absorption, which relies on total concentration rather than aqueous saturation concentration, would greatly overestimate exposure to DBP in liquid and solid products and articles. See U.S. EPA (2025c) for details. The dermal dose of DBP associated with use of both liquid products and solid articles was calculated in a spreadsheet, see *Draft Consumer Exposure Analysis for Dibutyl Phthalate (DBP)* (U.S. EPA, 2025d). EPA used a dermal exposure modeling approach with a range of conservative and plausible input parameters for contact surface area as well as duration and frequency of contact. The flux-limited, screening dermal absorption approaches for liquid and solid products and articles assume an excess of DBP in contact with the skin independent of concentration in the article/product. Dermal flux values for liquid products was from Doan et al. (2010), and solid products flux values were calculated and applied in the corresponding scenario. The flux-limited screening approach provides an upper bound of dermal absorption of DBP and likely results in some overestimations, see Section 4.1.2.4 for a discussion on limitations, strengths, and confidence. For each product or article, high-, medium-, and low-intensity use exposure scenarios were developed. Values for duration of dermal contact and area of exposed skin were determined based on the reasonably expected use for each item. Key parameters for the dermal model are shown in Section 2.3 in (U.S. EPA, 2025c).

4.1.2.2 Modeling Dose Results by COU for Consumer and Indoor Dust

This section summarizes the dose estimates from inhalation, ingestion, and dermal exposure to DBP in consumer products and articles. Detailed tables of the dose results for acute, intermediate, and chronic exposures are available in the *Draft Consumer Risk Calculator for Dibutyl Phthalate (DBP)* (U.S. EPA, 2025e). Modeling dose results for acute, intermediate, and chronic exposures as well as data patterns are described in Section 3 in the *Draft Consumer and Indoor Exposure Assessment for Dibutyl Phthalate (DBP)* (U.S. EPA, 2025c). The remainder of this section provides a brief summary of the main dose results patterns for visualizations.

For young teens, teenagers, and young adults (11–20 years) and adults (21+ years), dermal contact was a strong driver of exposure to DBP across all routes, with the dose received being generally higher than or similar to the dose received from exposure via inhalation or ingestion. The largest acute dose estimated was for dermal exposure to adhesives, sealers, coatings, and waxes for young teens to adults. The largest chronic dose estimated was for dermal and inhalation exposure to metal coatings for young teens to adults, followed by dermal exposure to adhesives, footwear, and waxes. It is noteworthy that the dermal analysis used a flux-limited approach, which has larger uncertainties than inhalation dose results—see Section 4.1.2.4 for a detailed discussion of uncertainties within approaches, inputs, and overall estimate confidence.

Among the younger lifestages, infant to 10 years, the pattern was less clear as these ages were not designated as product users and therefore not modeled for dermal contact with any of the liquid products assessed that resulted in larger dermal doses for the older lifestages. Key differences in exposures among lifestages include designation as a product user or bystander; behavioral differences such as hand to mouth contact times and time spent on the floor; and dermal contact expected from touching specific articles that may not be appropriate for some lifestages.

4.1.2.3 Indoor Dust Assessment

Products and articles that contain DBP are ubiquitous in modern indoor environments and DBP can partition, migrate, or evaporate (to a lesser extent based on physical and chemical properties) into indoor air and concentrate in household dust. See Sections 4.1 and 4.2 of the *Draft Consumer and Indoor Exposure Assessment for Dibutyl Phthalate (DBP)* (U.S. EPA, 2025c) for a summary of indoor dust monitoring data that EPA used to establish the presence of DBP in indoor dust in the residential environment. Exposure to DBP through dust ingestion, dust inhalation, and dermal absorption is a particular concern for young children between the ages of 6 months and 2 years. This is because crawling on the ground and pulling up on ledges increases hand-to-dust contact as does placing their hands and objects in their mouths. Specifically, exposure to DBP via ingestion of dust was assessed for all articles expected to contribute significantly to dust concentrations due to high surface area (exceeding ~1 m^2) for either a single article or collection of similar articles, as appropriate. In a screening assessment, EPA considered the aggregation of chronic dust ingestion doses, see Section 4.3 in in the *Draft Consumer and Indoor Exposure Assessment for Dibutyl Phthalate (DBP)* (U.S. EPA, 2025c). The highest dose was for preschoolers aged 3 to 5 years.

Articles included in the indoor assessment included the following:

- synthetic leather furniture,
- vinyl flooring,
- in-place wallpaper,
- car mats,
- shower curtains,
- children's toys, both legacy and new, and
- tire crumb.

4.1.2.4 Weight of Scientific Evidence Conclusions for Consumer Exposure

Key sources of uncertainty for evaluating exposure to DBP in consumer goods and strategies to address those uncertainties are described in detail in Section 5.1 of the *Draft Consumer and Indoor Dust Exposure Assessment for Dibutyl Phthalate (DBP)* (U.S. EPA, 2025c). Generally, designation of robust confidence suggests that the supporting scientific evidence weighed against the uncertainties is adequate to characterize exposure assessments. The supporting weight of scientific evidence outweighs the uncertainties to the point where it is unlikely that the uncertainties could have a significant effect on the exposure estimate. The designation of moderate confidence suggests that the supporting scientific evidence weighed against the uncertainties is reasonably adequate to characterize exposure assessments. The designation of slight confidence is assigned when the weight of scientific evidence may not be adequate to characterize the scenario, when the assessor is making the best scientific assessment possible in the absence of complete information, and when there are additional uncertainties that may need to be considered. The DBP consumer exposure overall confidence to use the results for risk characterization ranges from moderate to robust, depending on COU scenario. The basis for the moderate to robust confidence in the overall exposure estimates is a balance between using parameters that will represent various populations' use patterns and leaning on conservative assumptions that are deemed not excessive or unreasonable and are well characterized.

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

The exposure assessment of chemicals from consumer products and articles has inherent challenges due to many sources of uncertainty in the analysis, including variations in product formulation, patterns of consumer use, frequency, duration, and application methods. Variability in environmental conditions may also alter physical and/or chemical behavior of the product or article. Table 4-7 summarizes the overall confidence per COU and discusses the rationale used to assign the overall certainty. The subsections preceding Table 4-7 describe sources of uncertainty for several parameters used in consumer exposure modeling that apply across COUs and provide an in depth understanding of sources of uncertainty and limitations and strengths within the analysis. The confidence to use the results for risk characterization ranges from moderate to robust.

Product Formulation and Composition

Variability in the formulation of consumer products, including changes in ingredients, concentrations, and chemical forms, can introduce uncertainty in exposure assessments. In addition, data were sometimes limited for weight fractions of DBP in consumer goods. EPA obtained DBP weight fractions in various products and articles from material safety data sheets, databases, and existing literature. A significant number of DBP concentration in consumer goods data values were published across several studies published by the Danish EPA (Danish EPA, 2020). EPA used the Danish EPA information under the assumption that the weight fractions reported are representative of DBP content that could be present in items sold in the United States. Where possible, EPA obtained multiple values for weight fractions for similar products or articles. The lowest value was used in the low exposure scenario, the highest value in the high exposure scenario, and the average of all values in the medium exposure scenario. EPA decreased uncertainty in exposure and subsequent risk estimates in the high-, medium-, and low-intensity use scenarios by capturing the weight fraction variability and obtaining a better characterization of the varying composition of products and articles within one COU. Overall weight fraction confidence is *moderate* for products/articles with multiple sources but insufficient description on how the concentrations were obtained, *robust* for products/articles with more than one source, and *slight* for articles with only one source with unconfirmed content or little understanding on how the information was produced.

Product Use Patterns

Consumer use patterns such as frequency of use, duration of use, method of application, and skin contact area are expected to differ. Where possible, high, medium, and low default values from CEM 3.2's prepopulated scenarios were selected for mass of product used, duration of use, and frequency of use. In instances where no prepopulated scenario was appropriate for a specific product, low, medium, and high values for each of these parameters were estimated based on the manufacturers' product descriptions. EPA decreased uncertainty by selecting use pattern inputs that represent product and article use descriptions and furthermore capture the range of possible use patterns in the high to low intensity use scenarios. Exposure and risk estimates are considered representative of product use patterns and well characterized. The overall confidence for most use patterns is rated *robust*.

Article Use Patterns

For articles inhalation and ingestion exposures, the high-, medium-, and low-intensity use scenarios default values from CEM 3.2's prepopulated scenarios were selected for indoor use environment/room volume, interzone ventilation, and surface layer thickness. For articles' dermal exposures use patterns such as duration and frequency of use and skin contact area are expected to have a range of low to high use intensities. For articles that do not use duration of use as an input in CEM, professional judgment was used to select the duration of use/article contact duration for the low, medium, and high exposure scenario levels for most articles except carpet tiles and vinyl flooring. Carpet tiles and vinyl flooring contact duration values were taken from EPA's *Standard Operating Procedures for Residential Pesticide Exposure Assessment* for the high exposure level (2 hours; time spent on floor surfaces) (U.S. EPA, 2012c). ConsExpo (U.S. EPA, 2012c) for the medium exposure level (1 hour; time a child spends crawling on treated floor), and professional judgment for the low exposure level (0.5 hour). There are more uncertainties in the assumptions and professional judgment for contact duration inputs for articles; thus, EPA has *moderate* confidence in those inputs.

Article Surface Area

The surface area of an article directly affects the potential for DBP emissions to the environment. For each article modeled for inhalation exposure, low, medium, and high estimates for surface area were calculated in Section 2 in U.S. EPA (2025c). This approach relied on manufacturer-provided dimensions where possible, or values from EPA's *Exposure Factors Handbook* for floor and wall coverings. For small items that might be expected to be present in a home in significant quantities, such as children's toys, aggregate values were calculated for the cumulative surface area for each type of article in the indoor environment. Overall confidence in surface area is *robust* for articles like furniture, wall coverings, flooring, toys, and shower curtains because there is a good understanding of the presence and dimensions of these articles in indoor environments.

Human Behavior

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

Mouthing durations are a source of uncertainty in human behavior. The data used in this assessment are based on a study in which parents observed children (n = 236) ages 1 month to 5 years of age for 15 minutes each session and 20 sessions in total (Smith and Norris, 2003). There was considerable variability in the data due to behavioral differences among children of the same lifestage. For instance, while children aged 6 to 9 months had the highest average mouthing duration for toys at 39 minutes per day, the minimum duration was 0 minutes and the maximum was 227 minutes per day. The observers noted that the items mouthed were made of plastic roughly 50 percent of the mouthing time, but this was not limited to soft plastic items likely to contain significant plasticizer content. In another study, 169 children aged 3 months to 3 years were monitored by trained observers for 12 sessions at 12 minutes each (Greene, 2002). They reported mean mouthing durations ranging from 0.8 to 1.3 minutes per day for soft plastic toys and 3.8 to 4.4 minutes per day for other soft plastic objects (except pacifiers). Thus, it is likely that the mouthing durations used in this assessment provide a health protective estimate for mouthing of soft plastic items likely to contain DBP. EPA assigned a *moderate* confidence associated with the duration of activity for mouthing because the magnitude of the overestimation is not well characterized. All other human behavior parameters are well understood or the ranges used capture use patterns representative of various lifestages, which results in a *robust* confidence in use patterns.

Inhalation and Ingestion Modeling Tool

Confidence in the model used considers whether the model has been peer reviewed, as well as whether it is being applied in a manner appropriate to its design and objective. The model used, CEM 3.2, has been peer reviewed (ERG, 2016), is publicly available, and has been applied in the manner intended by estimating exposures associated with uses of household products and/or articles. This also considers the default values data source(s) such as building and room volumes, interzonal ventilation rates, and air exchange rates. Overall confidence in the proper use of CEM for consumer exposure modeling is *robust*.

Dermal Modeling of DBP Exposure for Liquids

Experimental dermal data was identified via the systematic review process to characterize consumer dermal exposures to liquids or mixtures and formulations containing DBP. Section 2.3.1 in U.S. EPA (2025c) provides a description of the selected study and rationale to use (Doan et al., 2010) whereas Section 2.3.2 summarizes the approach and dermal absorption values used. The confidence in the dermal exposure to liquid products model used in this assessment is *moderate*.

EPA selected Doan et al. (2010) as a representative study for dermal absorption to liquids. Doan et al. (2010) is a study in guinea pigs and uses a formulation consisting of 7 percent oil-in-water, which is preferred over studies that use neat chemicals. In addition, Doan et al. (2010) conducted both *in vivo* and *in vitro* experiments in female, hairless guinea pigs to compare absorption measurements using the same dose of DBP, which increases confidence in the data used. Although there is uncertainty regarding the magnitude of the difference between dermal absorption through guinea pigs' skin vs. human skin for DBP, based on DBP physical and chemical properties (size, solubility), EPA is confident that the dermal absorption data using guinea pigs for (Doan et al., 2010) provides an upper-bound estimate of dermal absorption of DBP.

Another source of uncertainty regarding the dermal absorption of DBP from products or formulations stems from the varying concentrations and co-formulants that exist in products or formulations containing DBP. Dermal contact with products or formulations that have lower concentrations of DBP may exhibit lower rates of flux since there is less material available for absorption. Conversely, co-formulants or materials within the products or formulations may lead to enhanced dermal absorption—even at lower concentrations—but EPA is unclear of the magnitude of the enhanced dermal absorption. Therefore, it is uncertain whether the products or formulations containing DBP would result in decreased or increased dermal absorption.

In summary, for the purposes of this draft risk evaluation, EPA assumes that the absorptive flux of DBP measured from *in vitro* guinea pig experiments serves as an upper bound of potential absorptive flux of chemical into and through the skin for dermal contact with all liquid products or formulations.

Dermal Modeling of DBP Exposure for Solids

Because experimental dermal data were not identified via the systematic review process to estimate dermal exposures to solid products or articles containing DBP, a modeling approach was used to estimate exposures (see Section 2.3.3 in U.S. EPA (2025c)). EPA notes that there is uncertainty with respect to the modeling of dermal absorption of DBP from solid matrices or articles. Similarly, since there were no available data related to the dermal absorption of DBP from solid matrices or articles, EPA has assumed that dermal absorption of DBP from solid objects would be limited by aqueous solubility of DBP. During direct dermal contact, DBP can migrate to the aqueous phase available in the skin surface or be weakly bound to the polymer. The fraction of DBP associated with polymer chains is less likely to contribute to dermal exposure as compared to the aqueous fraction of DBP because the chemical is strongly hydrophobic. To determine the maximum steady-state aqueous flux of DBP, EPA utilized CEM (U.S. EPA, 2023c) to first estimate the steady-state aqueous permeability coefficient of DBP. The estimation of the steady-state aqueous permeability coefficient within CEM (U.S. EPA, 2023c) is based on a quantitative structure-activity relationship (QSAR) model presented by ten Berge (2009), which considers chemicals with $\log(K_{ow})$ ranging from −3.70 to 5.49 and molecular weights ranging from 18 to 584.6. The molecular weight and $\log(K_{ow})$ of DBP falls within the range suggested by ten Berge (2009). Therefore, there is low to medium uncertainty regarding the accuracy of the QSAR model used to predict the steady-state aqueous permeability coefficient for DBP. There are some uncertainties on the assumption of migration from solid to aqueous media to skin, which assumes the aqueous dermal exposure model assumes that DBP absorbs as a saturated aqueous solution (*i.e.*, concentration of absorption is equal to water solubility), which would be the maximum concentration of absorption of DBP expected from a solid material. EPA has *moderate* confidence in the dermal exposure to solid products or articles modeling approach

Ingestion via Mouthing

The chemical migration rate of DBP was estimated based on data compiled in a review published by the Danish EPA in 2016 (Danish EPA, 2016), see Section 2.2.3.1 in U.S. EPA (2025c). For chemical migration rates to saliva, existing data were highly variable both within and between studies; for example, the mild mouthing intensity range from 0.04 to 5.8 µg/cm^2-h with an average of 0.17 µg/cm^2-h and a standard deviation of 1.4 µg/cm^2-h. As such, based on available data for chemical migration rates of DBP to saliva, the range of values used in this assessment (0.17, 24.3, and 48.5 µg/cm^2-h for the mild, medium, and harsh intensity respectively) are considered likely to capture the true value of the parameter depending on article expected uses. For example, EPA assumes children mouthing practices can be mild, medium, or harsh for children's toys. Although adults' mouthing practices for adult toys are not expected to be harsh. Harsh mouthing of adult toys can likely result in the breakage or destruction of the article and adults tend to control the harshness of their mouthing better than infants and toddlers. EPA calculated a high-intensity use of adult toys using harsh mouthing approaches as part of the screening approach and recognized that this highly conservative result is very unlikely behavior. The

Agency did not identify use pattern information regarding adult toys and most inputs are based on professional judgment assumptions.

A major limitation of all existing data is that DBP weight fractions for products tested in mouthing studies skew heavily towards relatively high weight fractions (30–60%) whereas measurements for weight fractions less than 15 percent are rarely represented in the dataset. Thus, it is unclear whether the migration rate values are applicable to consumer goods with low (<15%) weight fractions of DBP, where rates might be lower than represented by typical or worst-case values determined by existing data sets.

EPA has a *moderate* confidence in mouthing estimates due to uncertainties about professional judgment inputs regarding mouthing durations for adult toys and synthetic leather furniture for children. In general, the chemical migration rate input parameter has a moderate confidence due to the large variability in the empirical data used in this assessment and unknown correlation between chemical migration rate and DBP concentration in articles.

Table 4-7. Weight of Scientific Evidence Summary Per Consumer COU

Consumer COU Category and Subcategory	Weight of Scientific Evidence	Overall Confidence
Construction, paint, electrical, and metal products; Adhesives and sealants	Three different scenarios were assessed under this COU for three product types with differing use patterns: Adhesives for small repairs, automotive adhesives, and construction adhesives. Adhesives for small repairs and construction adhesives were assessed for dermal exposures only, due to the small product amount and surface area used in each application, inhalation and ingestion would have low exposure potential for these two scenarios. Automotive adhesives were assessed for dermal and inhalation exposures. The overall confidence in this COU's inhalation exposure estimate is robust because the CEM default parameters represent actual use patterns and location of use. See Section 2.1.2 in U.S. EPA (2025c) for number of products, product examples, and weight fraction data. For dermal exposure EPA used a dermal flux-limited approach, which was estimated based on DBP dermal absorption in guinea pigs. The flux-limited approach likely results in overestimations due to the assumption about excess DBP in contact with skin. An overall moderate confidence in dermal assessment of adhesives was assigned. Uncertainties about the difference between human and guinea pig skin absorption increase uncertainty and due to increased permeability of guinea pig skin as compared to human skin dermal absorption estimates likely overestimate exposures. Other parameters such as frequency and duration of use, and surface area in contact, are well understood and representative, resulting in a moderate overall confidence.	Inhalation–Robust Dermal – Moderate
Construction, paint, electrical, and metal products; Paints and coatings	Three different scenarios were assessed under this COU for 3 product types with differing use patterns: metal coatings, indoor sealing and refinishing sprays, and outdoor sealing and refinishing sprays. All 3 scenarios were assessed for dermal and inhalation exposures. The overall confidence in this COU inhalation exposure estimate is robust because the CEM default parameters represent actual use patterns and location of use. See Section 2.1.2 in U.S. EPA (2025c) for number of products, product examples, and weight fraction data. For dermal exposure EPA used a dermal flux-limited approach, which was estimated based on DBP dermal absorption in guinea pigs. The flux-limited approach likely results in overestimations due to the assumption about excess DBP in contact with skin. An overall moderate confidence in dermal	Inhalation–Robust Dermal – Moderate

Consumer COU Category and Subcategory	Weight of Scientific Evidence	Overall Confidence
	assessment of adhesives was assigned. Uncertainties about the difference between human and guinea pigs skin absorption increase uncertainty and due to increased permeability of guinea pig skin as compared to human skin dermal absorption estimates likely overestimate exposures. Other parameters such as frequency and duration of use, and surface area in contact, are well understood and representative, resulting in an overall confidence of moderate.	
Furnishing, cleaning, treatment care products; Fabric, textile, and leather products	Two different scenarios were assessed under this COU for articles with differing use patterns: synthetic leather clothing and synthetic leather furniture. Indoor synthetic furniture articles were assessed for all exposure routes as part of the indoor exposure assessment (*i.e.*, inhalation, ingestion (suspended and settled dust, and mouthing), and dermal), while synthetic clothing was only assessed for dermal contact since the articles were too small to result in significant inhalation and ingestion exposures. The overall confidence in the synthetic leather furniture and clothing COU inhalation exposure estimate is robust because the CEM default parameters are representative of typical use patterns and location of use. The stay-at-home activity use input parameter is considered a conservative input that although representative of actual uses for some populations is also believed to result in an upper-bound exposure. See Section 2.1.1 in U.S. EPA (2025c) for article examples and weight fraction data. The indoor furniture ingestion via mouthing exposure estimate overall confidence is moderate due to uncertainties in the parameters used for chemical migration to saliva, such as large variability in empirical migration rate data for harsh, medium, and mild mouthing approaches. Additionally, there are uncertainties from the unknown correlation between chemical concentration in articles and chemical migration rates, and no reasonably available data were available to compare and confirm selected rate parameters to better understand uncertainties. The dermal absorption estimate assumes that dermal absorption of DBP from solid objects would be limited by the aqueous solubility of DBP. EPA has moderate confidence in the aspects of the exposure estimate for solid articles because of the high uncertainty in the assumption of partitioning from solid to liquid, and because subsequent dermal absorption is not well characterized. Additionally, there are uncertainties associated to the flux-limited approach which likely results in overestimations due to the assumption about excess DBP in contact with skin. Other parameters such as frequency and duration of use, and surface area in contact have unknown uncertainties due to lack of information about use patterns, resulting in an overall confidence of moderate.	Inhalation – Robust Ingestion – Moderate Dermal – Moderate
Furnishing, cleaning, treatment/care products; Floor coverings; construction and building materials covering large surface areas including stone, plaster, cement, glass, and ceramic articles; fabrics, textiles, and apparel	Two different scenarios were assessed under this COU for articles with differing use patterns: vinyl flooring and wallpaper. Both scenarios were part of the indoor assessment and evaluated for all exposure routes except mouthing. The scenarios capture the variability from varying manufacturing formulations in the high-, medium-, and low-intensity use estimates and the weight fraction ranges reported. The overall confidence in the vinyl flooring and wallpaper COU inhalation exposure estimate is moderate because the CEM input parameters are representative, but there are uncertainties in the surface area used and location of use. The stay-at-home activity use input parameter is considered a conservative input that although representative of actual uses for some populations is also believed to result in an upper-bound exposure. See Section 2.1.1 in U.S. EPA (2025c) for article examples and weight fraction data.	Inhalation – Moderate Ingestion – Moderate Dermal – Moderate

Consumer COU Category and Subcategory	Weight of Scientific Evidence	Overall Confidence
	The dermal absorption estimate assumes that dermal absorption of DBP from solid objects would be limited by the aqueous solubility of DBP. EPA has moderate confidence in the aspects of the exposure estimate for solid articles because of the high uncertainty in the assumption of partitioning from solid to liquid, and because subsequent dermal absorption is not well characterized. Additionally, there are uncertainties associated to the flux-limited approach which likely results in overestimations due to the assumption about excess DBP in contact with skin. Other parameters such as frequency and duration of use, and surface area in contact, have unknown uncertainties due to lack of information about use patterns, resulting in an overall confidence of moderate.	
Other uses; Novelty articles	One scenario, adult toys, was assessed for this COU. The scenario was assessed for dermal contact and ingestion via mouthing exposures. Inhalation exposures were determined to be minimal due to small surface area to release DBP. The adult toys ingestion exposure estimate overall confidence is moderate due to uncertainties in the parameters used for chemical migration to saliva such as large variability in empirical migration rate data for harsh, medium, and mild mouthing approaches. Additionally, there are uncertainties from the unknown correlation between chemical concentration in articles and chemical migration rates, and no data were reasonably available to compare and confirm selected rate parameters to better understand uncertainties. In addition, there are unknown uncertainties in the use duration input parameters which were assumed based on professional judgment. EPA calculated a high-intensity use of adult toys using harsh mouthing approaches as part of the screening approach, however recognizing that this highly conservative use pattern is very unlikely behavior, it is not to be used to estimate risk. EPA did not identify use pattern information regarding adult toys. The dermal absorption estimate assumes that dermal absorption of DBP from solid objects would be limited by the aqueous solubility of DBP. EPA has moderate confidence in the aspects of the exposure estimate for solid articles because of the high uncertainty in the assumption of partitioning from solid to liquid, and because subsequent dermal absorption is not well characterized. Additionally, there are uncertainties associated to the flux-limited approach which likely results in overestimations due to the assumption about excess DBP in contact with skin. Other parameters such as frequency and duration of use, and surface area in contact have unknown uncertainties due to lack of information about use patterns, resulting in an overall confidence of moderate.	Ingestion – Moderate Dermal – Moderate
Other uses; Automotive articles	Two different scenarios were assessed under this COU for articles with differing use patterns: car mats and synthetic leather seats. Both scenarios were part of the indoor assessment and evaluated for all exposure routes except mouthing. The overall confidence in the inhalation exposure estimate for the car mats and synthetic leather seats COU is robust because the CEM input parameters are representative. The stay-at-home activity use input parameter is considered a conservative input that although representative of actual uses for some populations is also believed to result in an upper-bound exposure. See Section 2.1.1 in U.S. EPA (2025c) for article examples and weight fraction data. The dermal absorption estimate assumes that dermal absorption of DBP from solid objects would be limited by the aqueous solubility of DBP. EPA has moderate confidence in the aspects of the exposure estimate for solid articles because of the high uncertainty in the assumption of partitioning from solid to liquid, and because subsequent dermal absorption is not well characterized. Additionally, there are uncertainties associated to the flux-limited approach	Inhalation and Dust Ingestion – Robust Dermal – Moderate

Consumer COU Category and Subcategory	Weight of Scientific Evidence	Overall Confidence
	which likely results in overestimations due to the assumption about excess DBP in contact with skin. Other parameters such as frequency and duration of use, and surface area in contact have unknown uncertainties due to lack of information about use patterns, resulting in an overall confidence of moderate.	
Other uses; Chemiluminescent light sticks	One scenario was assessed for this COU, chemiluminescent light sticks. The scenario was assessed for dermal exposures. Inhalation and ingestion exposures were determined to be minimal due to small surface area to release DBP. The dermal absorption estimate assumes that dermal absorption of DBP from solid objects would be limited by the aqueous solubility of DBP. EPA has moderate confidence in the aspects of the exposure estimate for solid articles because of the high uncertainty in the assumption of partitioning from solid to liquid, and because subsequent dermal absorption is not well characterized. Additionally, there are uncertainties associated to the flux-limited approach which likely results in overestimations due to the assumption about excess DBP in contact with skin. Other parameters such as frequency and duration of use, and surface area in contact, have unknown uncertainties due to lack of information about use patterns, resulting in an overall confidence of moderate.	Dermal – Moderate
Packaging, paper, plastic, hobby products; Packaging (excluding food packaging), including rubber articles; plastic articles (hard); plastic articles (soft); other articles with routine direct contact during normal use, including rubber articles; plastic articles (hard)	Three different scenarios were assessed under this COU for 3 article types with differing use patterns: footwear, shower curtains, and small articles with semi routine contact (*e.g.*, miscellaneous items including a pen, pencil case, hobby cutting board, costume jewelry, tape, garden hose, disposable gloves, and plastic bags/pouches). Footwear and small articles with semi routine contact scenarios were assessed for dermal exposures only. Shower curtains were assessed for dermal and also part of the indoor assessment and evaluated for all exposure routes except mouthing. The overall confidence in this COU inhalation exposure estimate is robust because the CEM input parameters are representative. The stay-at-home activity use input parameter is considered a conservative input that although representative of actual uses for some populations is also believed to result in an upper-bound exposure. See Section 2.1.1 in U.S. EPA (2025c) for article examples and weight fraction data. The dermal absorption estimate assumes that dermal absorption of DBP from solid objects would be limited by the aqueous solubility of DBP. EPA has moderate confidence in the aspects of the exposure estimate for solid articles because of the high uncertainty in the assumption of partitioning from solid to liquid, and because subsequent dermal absorption is not well characterized. Additionally, there are uncertainties associated to the flux-limited approach which likely results in overestimations due to the assumption about excess DBP in contact with skin. Other parameters such as frequency and duration of use, and surface area in contact, have unknown uncertainties due to lack of information about use patterns, resulting in an overall confidence of moderate.	Inhalation and Dust Ingestion – Robust Dermal – Moderate
Packaging, paper, plastic, hobby products; Toys, playground, and sporting equipment Packaging, paper, plastic, hobby products; Toys, playground, and sporting equipment	Four different scenarios were assessed under this COU for various articles with differing use patterns: legacy children's toys, and new children's toys, tire crumb and artificial turf, and a variety of PVC articles with potential for routine contact. Toys scenarios were included in the indoor assessment for all exposure routes (inhalation, dust ingestion, mouthing, and dermal) with varying use patterns and inputs. Tire crumb was also part of the indoor assessment for all exposure routes except mouthing, while articles of routine contact were only assessed for dermal exposures since they are too small to result in impactful inhalation or ingestion exposures. The high-, medium-, and low-intensity scenarios capture variability and provide a range of representative use patterns. The overall confidence in this COU inhalation exposure estimate is robust because a good understanding of the CEM model parameter inputs and representativeness of actual use patterns and location of use. The stay-at-home	CEM Inhalation – Robust Ingestion, Tire crumb Inhalation, and Dermal – Moderate

Consumer COU Category and Subcategory	Weight of Scientific Evidence	Overall Confidence
	activity use input parameter is considered a conservative input that although representative of actual uses for some populations is also believed to result in an upper-bound exposure. See Section 2.1.1 in U.S. EPA (2025c) for article examples and weight fraction data. Tire crumb inhalation confidence is moderate due to higher uncertainty in using surrogate chemical air concentrations, while all other parameters are well understood and representative of use patterns by the various age groups. The overall confidence in this COU's mouthing and dermal exposure assessment is moderate. The mouthing parameters used like duration and surface area for infants to children are very well understood, while older groups have less specific information because mouthing behavior is not expected. The chemical migration value is DBP specific, and the only sources of uncertainty are related to a large variability in empirical migration rate data for harsh, medium, and mild mouthing approaches. Additionally, there are uncertainties from the unknown correlation between chemical concentration in articles and chemical migration rates, and no data were reasonably available to compare and confirm selected rate parameters to better understand uncertainties. Dermal absorption estimates are based on the assumption that dermal absorption of DBP from solid objects will be limited by aqueous solubility of DBP. EPA has moderate confidence for solid objects because the high uncertainty in the assumption of partitioning from solid to liquid and subsequent dermal absorption is not well characterized. Additionally, there are uncertainties associated to the flux-limited approach which likely results in overestimations due to the assumption about excess DBP in contact with skin. Other parameters like frequency and duration of use, and surface area in contact have unknown uncertainties due to lack of information about use patterns, making the overall confidence of moderate.	

4.1.3 General Population Exposures

General population exposures occur when DBP is released into the environment and the environmental media is then a pathway for exposure. As described in the *Draft Environmental Release and Occupational Exposure Assessment for Dibutyl Phthalate (DBP)* (U.S. EPA, 2025q), releases of DBP are expected in air, water, and disposal to landfills. Figure 4-2 provides a graphic representation of where and in which media DBP is estimated to be found due to environmental releases and the corresponding route of exposure for the general population.

EPA began its DBP exposure assessment using a screening level approach that relies on conservative assumptions. Conservative assumptions, including default input parameters for modeling environmental media concentrations, help characterize exposure resulting from the high-end of the expected distribution. Several of the OESs presented in Table 1-1 report facility location data and releases in the Toxics Release Inventory (TRI) and Discharge Monitoring Report (DMR) databases. When facility location- or scenario-specific information were unavailable, EPA used generic EPA models and default input parameter values as described in the *Draft Environmental Release and Occupational Exposure Assessment for Dibutyl Phthalate (DBP)* (U.S. EPA, 2025q). Details on the use of screening level analyses in exposure assessment can be found in EPA's *Guidelines for Human Exposure Assessment* (U.S. EPA, 2019d).
EPA considered a subset of the general population living near facilities releasing DBP to the ambient air (which includes fenceline communities) as part of the ambient air exposure assessment. EPA utilized a

pre-screening methodology described in EPA's *Draft TSCA Screening Level Approach for Assessing Ambient Air and Water Exposures to Fenceline Communities (Version 1.0)* (U.S. EPA, 2022b) for the ambient air exposure risk assessment. For other exposure pathways, EPA's screening method assessing high-end exposure scenarios used release data that reflect exposures expected to occur in proximity to releasing facilities, which would include fenceline populations.

EPA evaluated the reasonably available information for releases of DBP from facilities that use, manufacture, or process DBP under industrial and/or commercial COUs subject to TSCA regulations detailed in the *Draft Environmental Release and Occupational Exposure Assessment for Dibutyl Phthalate (DBP)* (U.S. EPA, 2025q). As described in Section 3.3, using the release data, EPA modeled predicted concentrations of DBP in surface water, sediment, drinking water, and ambient air in the United States. Table 3-6 summarizes the high-end DBP concentrations in environmental media from environmental releases. The reasoning for assessing different pathways qualitatively or quantitatively is discussed briefly in Section 3.3 and additional detail can be found in the *Draft Environmental Media, General Population, and Environmental Exposure Assessment for Dibutyl Phthalate (DBP)* (U.S. EPA, 2025p).

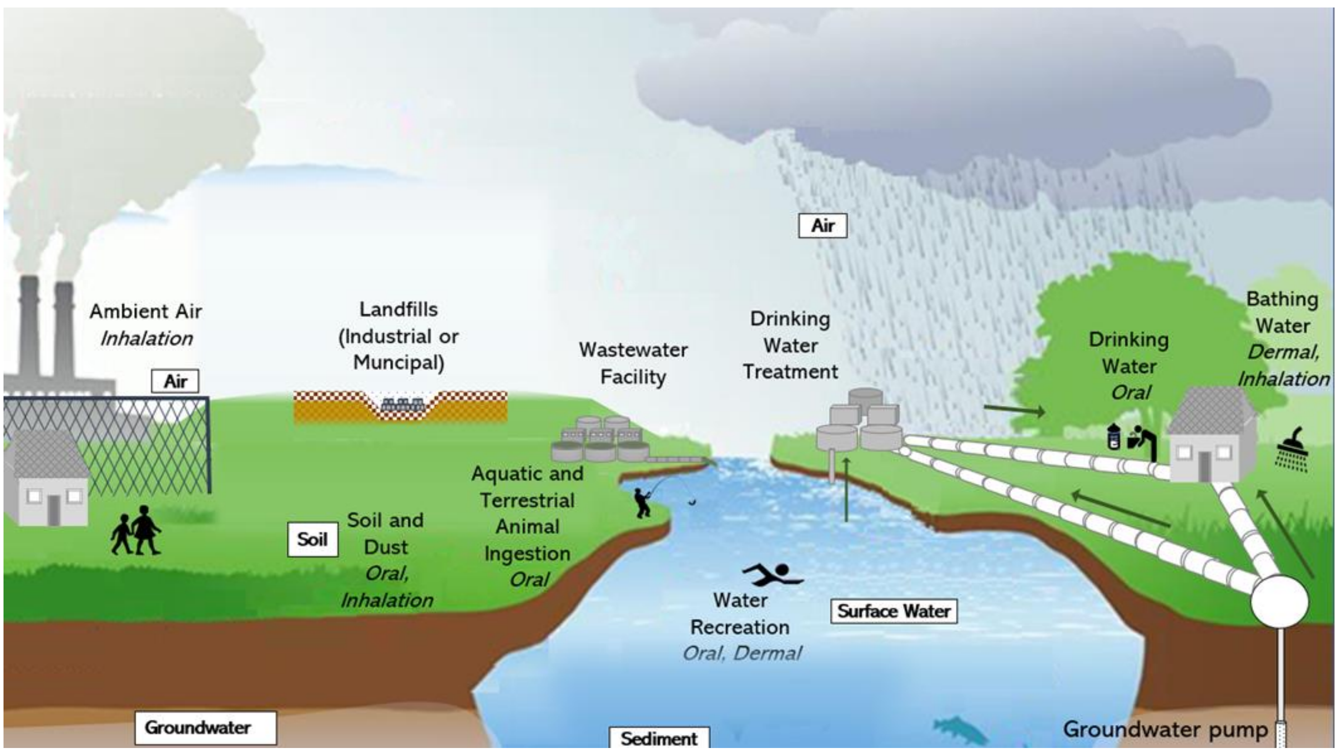

Figure 4-2. Potential Human Exposure Pathways to DBP for the General Population
Potential routes of exposure are shown in italics under each potential pathway of exposure.

High-end estimates of DBP concentration in the various environmental media presented in the *Draft Environmental Media, General Population, and Environmental Exposure Assessment for Dibutyl Phthalate (DBP)* (U.S. EPA, 2025p) were used for screening level purposes in the general population exposure assessment. EPA's *Guidelines for Human Exposure Assessment* (U.S. EPA, 2019d) defines high-end exposure estimates as a "plausible estimate of individual exposure for those individuals at the upper end of an exposure distribution, the intent of which is to convey an estimate of exposure in the upper range of the distribution while avoiding estimates that are beyond the true distribution." If risk is not found for these individuals with high-end exposure, no risk is anticipated for central tendency exposures, which is defined as "an estimate of individuals in the middle of the distribution." Therefore, if there is no risk for an individual identified as having the potential for the highest exposure associated with a COU for a given pathway of exposure, that pathway was determined not to be a pathway of concern and not pursued further. If any pathways were identified as a pathway of concern for the general population, further exposure assessments for that pathway would be conducted to include higher tiers of modeling when available, refinement of exposure estimates, and exposure estimates for additional subpopulations and OES/COUs.

Identifying individuals at the upper end of an exposure distribution included consideration of high-end exposure scenarios defined as those associated with the industrial and commercial releases from a COU and OES that resulted in the highest environmental media concentrations. As described in Section 3.3, EPA focused on estimating high-end concentrations of DBP from the largest estimated releases for the purpose of its screening level assessment for environmental and general population exposures. This means that EPA considered the environmental concentration of DBP in a given environmental media resulting from the OES that had the highest release compared to any other OES for the same releasing media. Release estimates from OES resulting in lower environmental media concentrations were not considered for this screening level assessment. Additionally, individuals with the greatest intake rate of DBP per body weight were considered to be those at the upper end of the exposure.

Table 4-8 summarizes the high-end exposure scenarios that were considered in the screening level analysis, including the lifestage assessed as the most potentially exposed population based on intake rate and body weight. Table 4-8 also indicates which pathways were evaluated quantitatively or qualitatively. Exposure was assessed quantitatively only when environmental media concentrations were quantified for the appropriate exposure scenario. For example, exposure from soil or groundwater resulting from DBP release to the environment via biosolids or landfills was not quantitatively assessed because DBP concentrations to the environment from biosolids and landfills were not quantified. Due to the high confidence in the biodegradation rates and physical and chemical data, there is robust confidence that DBP will not be mobile and will have low persistence potential in receiving soils. Similarly, there is robust confidence that DBP is unlikely to be present in landfill leachates. However, exposure was still assessed qualitatively for exposures potentially resulting from biosolids and landfills. Further details on the screening level approach and exposure scenarios evaluated by EPA for the general population are provided in the *Draft Environmental Media, General Population, and Environmental Exposure Assessment for Dibutyl Phthalate (DBP)* (U.S. EPA, 2025p). OESs resulting in the highest modeled environmental media concentrations were selected for the purpose of screening level analyses.

Table 4-8. Exposure Scenarios Assessed in General Population Screening Level Analysis

OES	Exposure Pathway	Exposure Route	Exposure Scenario	Lifestage	Analysis (Quantitative or Qualitative)
All	Biosolids	All scenarios assessed qualitatively			Qualitative
All	Landfills	All scenarios assessed qualitatively			Qualitative
Manufacturing	Surface water	Dermal	Dermal exposure to DBP in surface water during swimming	All	Quantitative
Waste handling, treatment, and disposal		Oral	Incidental ingestion of DBP in surface water during swimming	All	Quantitative

OES	Exposure Pathway	Exposure Route	Exposure Scenario	Lifestage	Analysis (Quantitative or Qualitative)
Manufacturing	Drinking water	Oral	Ingestion of drinking water	All	Quantitative
Waste handling, treatment, and disposal					
Manufacturing	Fish ingestion	Oral	Ingestion of fish for general population	Adults and young toddlers (1–2 years old)	Quantitative
			Ingestion of fish for subsistence fishers	Adults (16 to <70 years old)	Quantitative
			Ingestion of fish for Tribal populations	Adults (16 to <70 years old)	Quantitative
Waste handling, treatment, disposal (stack)	Ambient air	Inhalation	Inhalation of DBP in ambient air from industrial releases	All	Quantitative
Application of paints, coatings, adhesives, and sealants (fugitive)		Oral	Ingestion of DBP in soil from air to soil deposition resulting from industrial releases	Infant and Children (6 month to 12 years)	Quantitative

EPA also considered biomonitoring data, specifically urinary biomonitoring data from CDC's NHANES, to estimate exposure using reverse dosimetry (see Section 10.2 of the *Draft Environmental Media, General Population, and Environmental Exposure Assessment for Dibutyl Phthalate (DBP)* (U.S. EPA, 2025p)). Reverse dosimetry is a powerful tool for estimating exposure, but reverse dosimetry modeling does not distinguish between routes or pathways of exposure and does not allow for source apportionment (*i.e.*, exposure from TSCA COUs cannot be isolated from uses that are not subject to TSCA). Instead, reverse dosimetry provides an estimate of the total dose (or aggregate exposure) responsible for the measured biomarker. Therefore, intake doses estimated using reverse dosimetry are not directly comparable to the exposure estimates from the various environmental media presented in this document. However, the total intake dose estimated from reverse dosimetry can help contextualize the exposure estimates from exposure pathways outlined in Table 4-8 as being potentially under- or overestimated.

4.1.3.1 General Population Screening Level Exposure Assessment Results

Land Pathway

EPA evaluated general population exposures via the land pathway (*i.e.*, application of biosolids, landfills) qualitatively. Due to hydrophobicity (log K_{OW} = 4.5) and affinity for sorption to soil and organic constituents in soil (log K_{OC} = 3.14–3.94), DBP is unlikely to migrate to groundwater via runoff after land application of biosolids. Additionally, the half-life of less than 1 day to 19 days in aerobic soils (U.S. EPA, 2024j) indicates that DBP will have low persistence potential in the aerobic environments associated with freshly applied biosolids. Because the physical and chemical properties of DBP indicate that it is unlikely to migrate from land applied biosolids to groundwater via runoff, EPA did not model groundwater concentrations resulting from land application of biosolids.

Although there are limited measured data on DBP in landfill leachates, DBP may leach from landfill material but is expected to have limited mobility beyond the landfill. DBP in leachate is unlikely to infiltrate groundwater due to the high affinity to organic matter and sediment. Interpretation of the high-quality physical and chemical property data also suggest that DBP is unlikely to be present in landfill leachate. Therefore, EPA concludes that further assessment of DBP in landfill leachate is not needed.

Surface Water Pathway – Incidental Ingestion and Dermal Contact from Swimming

As described in Section 3.3, EPA conducted modeling of reported releases, when available, to surface water at the point of release (*i.e.*, in the immediate water body receiving the effluent) to assess the expected resulting environmental media concentrations from TSCA COUs. When reported releases were unavailable for an OES, EPA estimated releases to surface water using generic scenarios as explained in Section 3.2. EPA conducted modeling with VVWM-PSC to estimate concentrations of DBP within surface water and to estimate settled sediment in the benthic region of streams. Releases associated with the Manufacturing OES resulted in the highest total water column concentrations among reported releases, with water concentrations of 885 µg/L using 30Q5 flow (Table 4-9). Because of relevance to the exposure route, acute incidental surface water exposures and acute drinking water exposures were derived from the 30Q5 flow concentrations, and chronic drinking water exposures were derived from the harmonic mean (HM) flow concentrations. COUs mapped to the Manufacturing OES are shown in Table 3-1. As described in Section 3.3.1.1, Manufacturing OES was chosen as an appropriate OES for a screening level assessment based on it resulting in a conservatively high surface water concentration based on high volumes of releases associated with low flow metrics (P50). Additionally, the generic release scenario for the Manufacturing OES estimates a combined release to wastewater, incineration, or landfill. Because the proportion of the release from Manufacturing OES to just surface water could not be determined from reasonably available information, for screening purposes, EPA assumed that all of the release would be to wastewater to represent an upper bound of surface water concentrations.

These water column concentrations from the Manufacturing OES were used to estimate the (1) acute dose rate (ADR) and average daily dose (ADD) from dermal exposure, and (2) incidental ingestion of DBP while swimming for adults (21+ years), youths (11–15 years), and children (6–10 years). Detailed results for all exposures can be found in *Draft Environmental Media, General Population, and Environmental Exposure Assessment for Dibutyl Phthalate (DBP)* (U.S. EPA, 2025p). In this section, exposure scenarios leading to the highest modeled dose are shown in Table 4-9.

For the purpose of a screening level assessment, EPA used a MOE approach using high-end exposure estimates to determine if exposure pathways were pathways of concern for potential non-cancer risks. MOEs for general population exposure through dermal exposure and incidental ingestion during swimming ranged from 203 to 403 (compared to a benchmark of 30) for surface water concentrations estimated using releases from Manufacturing OES (P50). Because all estimated MOEs exceeded the benchmark, no additional scenarios were assessed. Thus, based on a screening level assessment, risks for non-cancer health effects are not expected for the incidental ingestion or incidental dermal contact to surface water during swimming.

Surface Water Pathway – Drinking Water

Similar to the assessment of incidental ingestion and dermal contact from swimming described above, for screening level purposes, EPA assessed the OES resulting in the highest modeled surface water concentrations in the drinking water exposure analysis. Manufacturing OES resulted in the highest total water column concentrations among reported releases, with water concentrations of 885 µg/L using 30Q5 flow (Table 4-9). Because of relevance to the exposure route, acute drinking water exposures were derived from the 30Q5 flow concentrations whereas chronic drinking water exposures were derived from the harmonic mean flow concentrations. As described above and in Section 3.3, surface water concentrations modeled using releases associated with the Manufacturing OES represent an upper-bound based on many conservative assumptions—including all of the estimated total release going to surface water, high releases paired with low flow assumptions (P50), and no treatment of wastewater before release to the environment.

ADR and ADD values from drinking water exposure to DBP were calculated for various age groups but the most exposed lifestage, infants (birth to <1 year), is shown below. Detailed results for all exposures can be found in *Draft Environmental Media, General Population, and Environmental Exposure Assessment for Dibutyl Phthalate (DBP)* (U.S. EPA, 2025p). Exposure scenarios leading to the highest modeled dose are shown in Table 4-9; note that acute doses are presented here as they are greater than chronic doses.

MOE for general population exposure through drinking water were 17 for the drinking water scenario based on surface water concentrations estimated from releases associated with Manufacturing OES paired with a low flow (P50) for the lifestage with the highest exposure (compared to a benchmark of 30) (Table 4-9). While there is moderate to robust confidence in the use of Manufacturing releases as an upper-bounding condition to screen for risk (see Section 3.3), there is only slight confidence in the precision of the estimated concentrations. This is particularly true in the case of the lowest flow (P50) condition as EPA does not expect large releasers to discharge to a body of water consistent with the low flow rate. Therefore, there is greater confidence that the medium (P75) and high flow (P90) scenarios are representative of real-world practices. Because of this, EPA assessed additional scenarios including drinking water exposures from the Manufacturing OES paired with a medium (P75) and high (P90) flow as refinements to the most conservative scenario (*i.e.*, Manufacturing releases to P50 flow). For the refined scenarios the MOEs for the highest exposed lifestage were 319 and 4,958 for medium (P75) and high flow (P90), respectively.

EPA also assessed the Waste handling, treatment, and disposal OES, which had the highest reported release to surface water based on DMR. The Agency has higher confidence in the surface water concentrations estimated from this release due to direct reporting of the release amounts and receiving water bodies from the facilities within the OES. For the drinking water scenario for Waste handling, treatment, and disposal OES, the MOE for the lifestage with the highest exposure (infants) was 1,026.

Based on the screening level assessment, EPA estimates low potential exposure to DBP via drinking water—even under high-end release scenarios and without considering expected treatment removal efficiencies from drinking water treatment. These exposure estimates also assume that the drinking water intake location is very close (within a few km) to the point of discharge and do not incorporate any dilution beyond the point of discharge. Actual concentrations in raw and finished water are likely to be lower than these conservative estimates as applying dilution factors will decrease the exposure for all scenarios, while additional distances downstream would allow further partitioning and degradation. Based on screening level analysis, risks for non-cancer health effects are not expected for the drinking water pathway; therefore, the drinking water pathway is not considered to be a pathway of concern to DBP for the general population.

Table 4-9. Summary of the Highest Doses in the General Population through Surface and Drinking Water Exposure

OES [a]	Water Column Concentration	Incidental Dermal Surface Water [b]		Incidental Ingestion Surface Water [c]		Drinking Water [d]	
	30Q5 Conc. (µg/L)	ADR (mg/kg-day)	Acute MOE (Benchmark MOE = 30)	ADR (mg/kg-day)	Acute MOE (Benchmark MOE = 30)	ADR (mg/kg-day)	Acute MOE (Benchmark MOE = 30)
Manufacturing (P50)	885.0	1.04E−02	203	4.74E−03	443	1.25E−01	17
Manufacturing (P75)	46.6	Not assessed[e]	Not assessed[e]	Not assessed[e]	Not assessed[e]	6.58E−03	319
Manufacturing (P90)	3.0	Not assessed[e]	Not assessed[e]	Not assessed[e]	Not assessed[e]	4.24E-04	4,958
Waste handling, treatment, and disposal	14.5	Not assessed[e]	Not assessed[e]	Not assessed[e]	Not assessed[e]	2.05E−03	1,026

ADR = acute dose rate, MOE = margin of exposure; OES = occupational exposure scenario
[a] Table 3-1 provides a crosswalk of industrial and commercial COUs to OES.
[b] Most exposed age group: Adults (21+ years)
[c] Most exposed age group: Youth (11–15 years)
[d] Most exposed age group: Infant (birth to <1 year)
[e] These scenarios were not assessed because the MOE exceeded the benchmark of 30 in the prior scenario used for screening

Fish Ingestion

The key parameters to estimate human exposure to DBP via fish ingestion are the surface water concentration, bioaccumulation factor (BAF), and fish ingestion rate. Surface water concentrations for DBP associated with a particular COU were modeled using VVWM-PSC as described in Section 3.3.1.1. The harmonic mean flow and resulting estimated concentrations in surface water and fish tissue were applied to calculate exposure via fish ingestion because the harmonic mean flow is considered representative of long-term DBP concentrations that would enter fish tissue over time. The details on the BAF, which considers the animal's uptake of a chemical from both diet and the water column, can be found in the *Draft Environmental Media, General Population, and Environmental Exposure Assessment for Dibutyl Phthalate (DBP)* (U.S. EPA, 2025p).

EPA evaluated exposure and potential risk to DBP through fish ingestion for populations and age groups that had the highest fish ingestion rate per kg of body weight—including for adults and young toddlers in the general population, adult subsistence fishers, and adult Tribal populations. Children were not considered for reasons explained in Sections 7.2 and 7.3 of the *Draft Environmental Media, General Population, and Environmental Exposure Assessment for Dibutyl Phthalate (DBP)* (U.S. EPA, 2025p). Only the fish ingestion rate changes across the different populations; the surface water concentration and BAF remain the same. ADR and ADD values from fish ingestion exposure to DBP were calculated for various populations and age groups and can be found in Section 7 of the *Draft Environmental Media, General Population, and Environmental Exposure Assessment for Dibutyl Phthalate (DBP)* (U.S. EPA, 2025p), but Table 4-10 shows only results for the Tribal populations as they represent the highest exposure because of their elevated fish ingestion rates compared to both the general population and subsistence fisher population. Exposure to Tribal populations were estimated based on current mean

(U.S. EPA, 2011a) and current 95th percentile (Polissar et al., 2016) fish ingestion rate. Current ingestion rate refers to the present-day consumption levels that are suppressed by contamination, degradation, or loss of access. Heritage rates existed prior to non-indigenous settlement on Tribal fishers' resources and changes to culture and lifeways. Therefore, current ingestion rates are considered more representative of contemporary rates of fish consumption and are presented below. Heritage rates are discussed in further detail in *Draft Environmental Media, General Population, and Environmental Exposure Assessment for Dibutyl Phthalate (DBP)* (U.S. EPA, 2025p).

EPA used the solubility limit for DBP in water (11.2 mg/L; see Table 2-1) as the initial tier of the screening level analysis, and screening level risk estimates were below the benchmark MOE for all populations (U.S. EPA, 2025p). The next highest-tier refinement used the Manufacturing OES (high-end releases) that resulted in the highest modeled DBP concentrations in surface water. As discussed in Section 3.3, surface water concentrations for the Manufacturing OES were estimated for various flows (*i.e.*, P50, P75, and P90). EPA expects larger releases to occur to water bodies with higher flow rates consistent with the P75 and P90 rather than lower flow rates represented by the P50. As such, DBP exposure via fish ingestion for the Manufacturing OES based on the P50 flow rates was not evaluated. Table 4-10 presents only risk estimates for Tribal populations as the most highly exposed populations. Risk estimates using the Manufacturing OES (high-end releases, P75 flow rate) were above the benchmark MOE for all populations except Tribal populations at the current 95th percentile ingestion rate (MOE = 19 and 25). Risk estimates using the P90 flow rate were above the benchmark MOE for all populations.

While risk estimates for the Manufacturing OES at the P75 flow rate were below the benchmark MOE for Tribal populations at the current 95th percentile ingestion rate, EPA has only slight confidence in the results. That is because the Manufacturing OES had modeled releases from generic scenarios discharging to multiple environmental media and there is insufficient information to determine the fraction of release going to each of the media types (Section 3.3.1.1). EPA instead relied on reported releases from TRI and DMR to evaluate the fish ingestion pathway. The Waste handling, treatment, and disposal OES had the highest reported release to surface water based on DMR. No risk estimates were below the benchmark MOE for this OES. EPA has moderate-to-robust confidence in these risk estimates. Overall, the exposure to DBP via fish ingestion is not expected to be a pathway of concern.

Based on screening level analysis, risks for non-cancer health effects are not expected for Tribal populations via the fish ingestion pathway; therefore, the fish ingestion pathway is not considered to be a pathway of concern to DBP for Tribal populations, subsistence fishers, and the general population. Further discussion on the resulting risk estimates from higher-tier refinements and conclusions is provided in Section 4.3.4.

Table 4-10. Fish Ingestion for Adults in Tribal Populations Summary

Calculation Method[c]	Current Mean Ingestion Rate[b] (Benchmark MOE = 30)		Current Tribal Ingestion Rate[b], 95th Percentile[b]	
	ADR/ADD (mg/kg-day)	Chronic and Acute MOE[a]	ADR/ADD (mg/kg-day)	Chronic and Acute MOE[a]
Water solubility limit (11.2 mg/L)	12.4 (tilapia) 9.50 (common carp)	0.2 (tilapia) 0.2 (common carp)	50.1 (tilapia) 38.3 (common carp)	0.0 (tilapia) 0.1 (common carp)
Manufacturing (HE, P75, 0.02 mg/L)	2.70E–02 (tilapia) 2.07E–02 (common carp)	78 (tilapia) 102 (common carp)	1.09E–01 (tilapia) 8.35E–05 (common carp)	19 (tilapia) 25 (common carp)
Manufacturing (HE, P90, 0.002 mg/L)	1.88E–03 (tilapia) 1.44E–03 (common carp)	1,116 (tilapia) 1,457 (common carp)	7.60E–03 (tilapia) 5.82E–03 (common carp)	276 (tilapia) 361 (common carp)
Waste handling, treatment, disposal – POTW (4.60E–05 mg/L)	1.61E–02 (tilapia) 1.23E–02 (common carp)	131 (tilapia) 171 (common carp)	6.48E–02 (tilapia) 4.96E–02 (common carp)	32 (tilapia) 42 (common carp)

ADR = acute dose rate; ADD = average daily dose; CT = central tendency; HE = high-end, 95th percentile; MOE = margin of exposure
[a] The acute and chronic MOEs are identical because the exposure estimates and the POD do not change between acute and chronic.
[b] Current ingestion rate (mean at 2.7 g/kg-day and 95th percentile at 10.9 g/kg-day used in this assessment) refers to the present-day consumption levels that are suppressed by contamination, degradation, or loss of access.
[c] Screening level assessment started with the water solubility limit and using the OES with highest surface water concentrations (Plastic compounding).

Ambient Air Pathway

As part of the ambient air exposure assessment, EPA considered exposures to the general population in proximity to releasing facilities, including fenceline communities, by utilizing a previously peer-reviewed, pre-screening methodology described in EPA's *Draft TSCA Screening Level Approach for Assessing Ambient Air and Water Exposures to Fenceline Communities (Version 1.0)* (U.S. EPA, 2022b). EPA used the IIOAC model to estimate ambient air concentrations and deposition rates using pre-run results from a suite of dispersion scenarios in a variety of meteorological and land-use settings within American Meteorological Society/EPA Regulatory Model (AERMOD). The maximum fugitive release value used in this assessment was reported to the 2017 NEI dataset and is associated with the Application of paints, coatings, adhesives, and sealants OES. The maximum stack release value used in this assessment was reported to the TRI dataset and is associated with the Waste handling, treatment, and disposal OES. Both maximum release values represent the maximum release reported across all facilities and COUs and are used as direct inputs to the IIOAC model to estimate concentrations and deposition rates. EPA used the maximum 95th percentile modeled concentrations and deposition rates across a series of exposure scenarios considering particle size and urban/rural topography to characterize exposures and derive risk estimates. Calculations for general population exposure to ambient air via inhalation and ingestion from air to soil deposition for lifestages expected to be highly exposed based on exposure factors can be found in *Draft Ambient Air IIOAC Exposure Results and Risk Calculations Dibutyl Phthalate (DBP)* (U.S. EPA, 2025a). Inhalation exposure to DBP from ambient air is expected to be much higher than exposure to DBP via soil ingestion resulting from air to soil deposition and is, therefore, presented below for the screening level analysis.

For a screening level assessment, EPA utilized the highest ambient air concentrations modeled from release data from actual release facilities using conservative assumptions. The highest 95th percentile modeled daily average concentration used to derive acute risk estimates for fugitive releases was 16.73 μg/m^3 and for stack releases was 0.53 μg/m^3. These concentrations occurred at 100 m from the releasing facility and together result in a total exposure from facility releases of 17.26 μg/m^3. They are attributable to two separate OESs: fugitive releases from Application of paints, coatings adhesives, and sealants (corresponding to the Industrial/commercial use; Construction, paint, electrical, and metal products; and Adhesives and sealants/paints and coatings COUs) and stack releases from Waste handling, treatment, and disposal (corresponding to the Disposal COU). The highest 95th percentile modeled annual average concentration used to derive chronic risk estimates for fugitive releases was 11.46 μg/m^3 and 0.37 μg/m^3 for stack releases. These concentrations occurred at 100 m from the releasing facility, together result in a total exposure from facility releases of 11.82 μg/m^3 and are attributable to two separate OESs (fugitive releases from Application of paints, coatings adhesives, and sealants and stack releases from Waste handling, treatment, and disposal). Table 3-1 shows COUs mapped to each OES

Table 4-11 summarizes the total exposures and the associated MOE calculated using the inhalation human equivalent concentration (HEC). The HEC is derived in the *Draft Non-cancer Human Health Hazard Assessment for Dibutyl Phthalate (DBP)* (U.S. EPA, 2024f) and based on an 80 kg adult. Using the highest modeled 95th percentile air concentration, MOEs for general population exposure through inhalation of ambient air are 695 for acute and 1,015 for chronic (compared to a benchmark of 30) for an adult. Because the HEC was derived for adults, MOEs for other lifestages were not calculated. However, considering similar or smaller inhalation rates for younger lifestages and greatest body weight difference of a factor of 16.7 between an adult (80 kg) and newborn (4.8 kg) based on EPA's *Exposure Factors Handbook: 2011 Edition* (U.S. EPA, 2011b), MOEs for all lifestages will still exceed the benchmark based on the estimates for adults.

Because these derived risk estimates based on the conservative screening analysis are well above relative benchmarks for non-cancer health effects, EPA concludes inhalation of DBP via the ambient air pathway is not a pathway of concern for the general population. Additionally, because exposure via soil ingestion resulting from air to soil deposition is less than exposure from inhalation via ambient air, the Agency concludes that soil ingestion resulting from air to soil deposition is not a pathway of concern for the general population.

Table 4-11. General Population Ambient Air Inhalation Exposure Summary

OES[a]	Acute (Daily Average)[b]		Chronic (Annual Average)[b]	
	Air Concentration[c] (μg/m^3)	MOE	Air Concentration[c] (μg/m^3)	MOE
Application of paints, coatings, adhesives, and sealants (fugitive) Waste handling, treatment, and disposal (stack)	17.26	695	11.82	1,015

[a] Table 3-1 provides a crosswalk of industrial and commercial COUs to OES.
[b] EPA assumes the general population is continuously exposed (*i.e.*, 24 hours per day, 365 days per year) to outdoor ambient air concentrations. Therefore, daily average modeled ambient air concentrations are equivalent to acute exposure concentrations, and annual average modeled ambient air concentrations are equivalent to chronic exposure concentrations.
[c] Air concentrations are reported for the high-end (95th percentile) modeled value at 100 m from the emitting facility and stack plus fugitive releases combined.

4.1.3.2 Daily Intake Estimates for the U.S. Population Using NHANES Urinary Biomonitoring Data

EPA used a screening level approach to calculate sentinel exposures to the general population from TSCA releases. EPA also analyzed urinary biomonitoring data from the CDC's NHANES dataset to provide context for aggregate exposures in the U.S. non-institutionalized, civilian population. The NHANES dataset reports urinary concentrations for 15 phthalate metabolites specific to individual phthalate diesters. EPA analyzed data for two metabolites of DBP; mono-3-hydroxybutyl phthalate (MHBP) (measured in the 2015–2018 NHANES cycles) and mono-n-butyl phthalate (MnBP) (measured in the 1999–2018 NHANES cycles). Urinary metabolite levels reported in the most recent NHANES survey (*i.e.*, 2017–2018) were used to calculate daily intake for various demographic groups reported within NHANES (Table 4-12). Median daily intake estimates across demographic groups ranged from 0.21 to 0.56 µg/kg-day, while 95th percentile daily intake estimates ranged from 0.59 to 2.02 µg/kg-day. The highest daily intake value estimated was for male toddlers (3 to <6 years old) and was 2.02 µg/kg-day at the 95th exposure percentile. Detailed results of the NHANES analysis can be found in Section 11.1 of *Draft Environmental Media, General Population, and Environmental Exposure Assessment for Dibutyl Phthalate (DBP)* (U.S. EPA, 2025p).

Using 50th and 95th percentile daily intake values calculated from reverse dosimetry, EPA calculated MOEs ranging from 4,100 to 10,000 at the 50th percentile and 1,000 to 3,600 at the 95th percentile across demographic groups using the acute/intermediate/chronic POD (*i.e.*, an HED of 2,100 µg/kg-day) based on reduced fetal testicular testosterone (Table 4-13). The lowest calculated MOE of 1,000 was for male toddlers (3 to <6 years old), based on the 95th percentile exposure estimate. All calculated MOEs at the 50th and 95th percentiles were above the benchmark of 30, indicating that aggregate exposure to DBP alone does not pose a risk to the non-institutionalized, U.S. civilian population.

General population exposure estimates calculated from exposure to ambient air, surface water, fish ingestion, and soil from TSCA releases are not directly analogous to daily intake values estimated via reverse dosimetry from NHANES. While NHANES may be used to provide context for aggregate exposures in the U.S. population, NHANES is not expected to capture exposures from specific TSCA COUs that may result in high-dose exposure scenarios (*e.g.*, occupational exposures to workers)—as compared to EPA's general population exposure assessment which evaluates sentinel exposures for specific exposure scenarios corresponding to TSCA releases. However, as a screening level analysis, media-specific general population exposure estimates calculated were compared to daily intake values calculated using reverse dosimetry of NHANES biomonitoring data. Comparison of the values showed that many of the exposure estimates resulting from incidental dermal contact or ingestion of surface water (assuming no wastewater treatment) (Table 4-9) and ingestion of fish for adults in Tribal populations (assuming heritage ingestion rate; see the *Draft Environmental Media, General Population, and Environmental Exposure Assessment for Dibutyl Phthalate (DBP)* (U.S. EPA, 2025p)) exceeded the total daily intake values estimated using NHANES (Table 4-12).

Exposure estimates for the general population via ambient air, surface water, and drinking water resulting from TSCA releases quantified in this document are likely overestimates. This is because exposure estimates from individual pathways exceed the total intake values calculated from NHANES measured even at the 95th percentile of the U.S. population for all ages. Further, this is consistent with the U.S. CPSC's conclusion that DBP exposure comes primarily from diet for women, infants, toddlers, and children and that the outdoor environment is not a major source of exposure to DBP (CPSC, 2014).

Table 4-12. Daily Intake Values and MOEs for DBP Based on Urinary Biomonitoring from the 2017 to 2018 NHANES Cycle

Demographic	50th percentile Daily Intake (95% CI) (µg/kg-day)	95th percentile Daily Intake (95% CI) (µg/kg-day)	50th Percentile MOE (Benchmark = 30)	95th Percentile MOE (Benchmark = 30)
All	0.33 (0.3–0.36)	1.16 (0.96–1.35)	6,400	1,800
Females	0.31 (0.27–0.35)	1.02 (0.93–1.11)	6,800	2,100
Males	0.34 (0.31–0.37)	1.33 (0.93–1.72)	6,200	1,600
White non-Hispanic	0.33 (0.29–0.38)	0.97 (0.7–1.24)	6,400	2,200
Black non-Hispanic	0.32 (0.28–0.37)	1.18 (0.84–1.52)	6,600	1,800
Mexican-American	0.29 (0.24–0.33)	0.91 (0.68–1.13)	7,200	2,300
Other	0.38 (0.31–0.44)	1.8 (–0.29–3.88)	5,500	1,200
Above poverty level	0.38 (0.33–0.43)	1.26 (0.91–1.62)	5,500	1,700
Below poverty level	0.31 (0.27–0.34)	1.04 (0.84–1.24)	6,800	2,000
Toddlers (3 to <6 years old)	0.55 (0.5–0.6)	1.54 (1.07–2)	3,800	1,400
Children (6 to <11 years old)	0.36 (0.31–0.41)	1.37 (0.88–1.86)	5,800	1,500
Adolescents (12 to <16 years old)	0.28 (0.21–0.34)	0.62 (0.37–0.88)	7,500	3,400
Adults (16+ years old)	0.21 (0.17–0.25)	0.61 (0.39–0.84)	10,000	3,400
Male toddlers (3 to <6 years old)	0.56 (0.49–0.63)	2.02 (1.31–2.74)	3,800	1,000
Male children (6 to <11 years old)	0.38 (0.32–0.44)	1.41 (–0.01 to 2.83)	5,500	1,500
Male adolescents (12 to <16 years old)	0.33 (0.26–0.4)	0.62 (–1.03 to 2.27)	6,400	3,400
Male adults (16+ years old)	0.21 (0.15–0.28)	0.59 (0.35–0.83)	10,000	3,600
Female toddlers (3 to <6 years old)	0.51 (0.44–0.57)	1.44 (1.04–1.84)	4,100	1,500
Female children (6 to <11 years old)	0.34 (0.28–0.41)	0.95 (0.62–1.29)	6,200	2,200
Female adolescents (12 to <16 years old)	0.26 (0.17–0.34)	0.61 (0.29–0.94)	8,100	3,400
Women of reproductive age (16–49 years old)	0.21 (0.16–0.26)	0.61[a]	10,000	3,400
Female adults (16+ years old)	0.21 (0.16–0.26)	0.61[a]	10,000	3,400

[a] 95% confidence intervals (CI) could not be calculated due to small sample size or a standard error of zero.

4.1.3.3 Overall Confidence in General Population Screening Level Exposure Assessment

The weight of scientific evidence supporting the general population exposure estimate is decided based on the strengths, limitations, and uncertainties associated with the exposure estimates. These are discussed in detail for ambient air, surface water, drinking water, and fish ingestion in the *Draft Environmental Media, General Population, and Environmental Exposure Assessment for Dibutyl*

Phthalate (DBP) (U.S. EPA, 2025p). EPA summarized its weight of scientific evidence using confidence descriptors: robust, moderate, slight, or indeterminate. The Agency used general considerations (*i.e.*, relevance, data quality, representativeness, consistency, variability, uncertainties) as well as chemical-specific considerations for its weight of scientific evidence conclusions.

EPA determined robust confidence in its qualitative assessment of biosolids and landfills. For its quantitative assessment for surface water, drinking water, ambient air, and fish ingestion, the Agency modeled exposure due to various general population exposure scenarios resulting from different pathways of exposure. Exposure estimates utilized high-end inputs for the purpose of risk screening. When available, monitoring data was compared to modeled estimates to evaluate overlap, magnitude, and trends. EPA has robust confidence that modeled releases used are appropriately conservative for a screening level analysis. Therefore, the Agency has robust confidence that no exposure scenarios will lead to greater doses than presented in this evaluation. Despite slight and moderate confidence in the estimated values themselves, confidence in exposure estimates capturing high-end exposure scenarios was robust given that many of the modeled values exceeded those of monitored values and exceeded total daily intake values calculated from NHANES biomonitoring data. This adds to confidence that exposure estimates captured high-end exposure scenarios.

4.1.4 Human Milk Exposures

Infants are potentially more susceptible than older children, teens, and adults for various reasons—including their higher exposure per body weight, immature metabolic systems, and the potential for chemical toxicants to disrupt sensitive developmental processes. Reasonably available information from studies of experimental animal models also indicates that DBP is a developmental and reproductive toxicant (U.S. EPA, 2024f). EPA considered exposure and hazard information, as well as pharmacokinetic models, to determine the most scientifically supportable appropriate approach to evaluate infant exposure to DBP from human milk ingestion (U.S. EPA, 2025p).

EPA identified 13 biomonitoring studies, one of which is from the United States, from reasonably available information that investigated if DBP or its metabolites were present in human milk. None of the studies characterized if any of the study participants may be occupationally exposed to DBP. Nonetheless, DBP or its metabolites were consistently detected in human milk. However, it is important to note that biomonitoring data do not distinguish between exposure routes or pathways and do not allow for source apportionment. In other words, biomonitoring data reflect total infant exposure through human milk ingestion and the contribution of specific TSCA COUs to overall exposure cannot be determined.

Furthermore, no human health studies have evaluated only lactational exposure from quantified levels of DBP in milk. While EPA explored the potential to model milk concentrations and concluded that there is insufficient information (*e.g.*, sensitive and specific half-life data) available to support modeling of the milk pathway, the Agency also concluded that modeling is not needed to adequately evaluate risks associated with exposure through milk. This is because the POD used in this assessment is based on male reproductive effects resulting from maternal exposures throughout sensitive phases of development in multigenerational studies. EPA therefore has confidence that the risk estimates calculated based on maternal exposures are protective of a nursing infant's greater susceptibility during this unique lifestage whether due to sensitivity or greater exposure per body weight. Further discussion of the human milk pathway is provided in the *Draft Environmental Media, General Population, and Environmental Exposure for Dibutyl Phthalate (DBP)* (U.S. EPA, 2025p).

4.1.5 Aggregate and Sentinel Exposure

TSCA section 6(b)(4)(F)(ii) (15 USC 2605(b)(4)(F)(ii)) requires EPA, in conducting a risk evaluation, to describe whether aggregate and sentinel exposures under the COUs were considered and the basis for their consideration.

EPA defines aggregate exposure as "the combined exposures to an individual from a chemical substance across multiple routes and across multiple pathways (40 CFR § 702.33)." For the draft DBP risk evaluation, the Agency considered aggregate risk across all routes of exposure for each individual consumer and occupational COU evaluated for acute, intermediate, and chronic exposure durations. EPA did not consider aggregate exposure for the general population. As described in Section 4.1.3, a risk screening approach was used for the general population exposure assessment.

EPA did not consider aggregate exposure scenarios across COUs because the Agency did not find any evidence to support such an aggregate analysis based on the reasonably available information, such as statistics of populations using certain products represented across COUs, or workers performing tasks across COUs. However, EPA considered combined exposure across all routes of exposure for each individual occupational and consumer COU to calculate aggregate risks (Sections 4.3.2 and 4.3.3).

EPA defines sentinel exposure as "the exposure to a chemical substance that represents the plausible upper-bound of exposure relative to all other exposures within a broad category of similar or related exposures (40 CFR 702.33)." In terms of this draft risk evaluation, the Agency considered sentinel exposures by considering risks to populations who may have upper-bound exposures; for example, workers and ONUs who perform activities with higher exposure potential or consumers who have higher exposure potential or certain physical factors like body weight or skin surface area exposed. EPA characterized high-end exposures in evaluating exposure using both monitoring data and modeling approaches. Where statistical data are available, the Agency typically uses the 95th percentile value of the available dataset to characterize high-end exposure for a given condition of use. For general population and consumer exposures, EPA occasionally characterized sentinel exposure through a "high-intensity use" category based on elevated consumption rates, breathing rates, or user-specific factors.

4.2 Summary of Human Health Hazard

4.2.1 Background

This section briefly summarizes the non-cancer and cancer human health hazards of DBP (Sections 4.2.2 and 4.2.3, respectively). Additional information on the non-cancer and cancer human health hazards of DBP are provided in the *Draft Non-cancer Human Health Hazard Assessment for Dibutyl Phthalate (DBP)* (U.S. EPA, 2024f) and the *Draft Cancer Human Health Hazard Assessment for Di(2-ethylhexyl) Phthalate (DEHP), Dibutyl Phthalate (DBP), Butyl Benzyl Phthalate (BBP), Diisobutyl Phthalate (DIBP), and Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025b).

4.2.2 Non-Cancer Human Health Hazards of DBP

The majority of toxicokinetic data for DBP is derived from oral exposure studies. Although reasonably available data on other routes of exposure are sparse, there is some indication that DBP can be expected to be readily absorbed through the lung (U.S. EPA, 2024f). Following oral exposure, DBP is hydrolyzed in the gastrointestinal tract to MBP, which is then absorbed, systemically distributed, and can undergo further metabolism (*e.g.*, oxidation, glucuronidation) in the liver. Metabolites of DBP—not the parent phthalate—are associated with the adverse effects of DBP. Most (67–97%) of the administered dose of MBP is excreted in urine within 24 hours while a small proportion is also eliminated in the feces. DBP and its metabolites can cross the placenta to the developing fetus. As stated in the *Draft Non-Cancer Human Health Hazard Assessment for Dibutyl Phthalate (DBP)* (U.S. EPA, 2024f), the Agency assumed an oral absorption of 100 percent and an inhalation absorption of 100 percent. EPA is proposing to use DBP dermal absorption data from an study by Doan et al. (2010) to estimate the dermal flux of DBP, as described previously in the Summary of Occupational Exposures (Sections 4.1.1) and Summary of Consumer Exposures (Section 4.1.2).

EPA identified effects on the developing male reproductive system as the most sensitive and robust non-cancer hazard associated with oral exposure to DBP in experimental animal models. Effects on the developing male reproductive system were also identified as the most sensitive and robust non-cancer effect following oral exposure to DBP by existing assessments of DBP, including those by the U.S. Consumer Product Safety Commission (CPSC, 2014), Health Canada (Health Canada, 2020), European Chemicals Bureau (ECJRC, 2004), European Chemicals Agency (ECHA, 2017a, b, 2010), The European Food Safety Authority (EFSA, 2019, 2005), the Australian National Industrial Chemicals Notification and Assessment Scheme (NICNAS, 2013), the National Toxicology Program Center for the Evaluation of Risks to Human Reproduction (NTP, 2003), the California Office of Environmental Health Hazard Assessment (OEHHA, 2007), and in other assessments (NASEM, 2017). EPA also considered epidemiologic evidence qualitatively as part of hazard identification and characterization. However, the Agency did not use epidemiology studies quantitatively for dose-response assessment—primarily due to uncertainty associated with exposure characterization that is further discussed in the *Draft Non-cancer Human Health Hazard Assessment for Dibutyl Phthalate (DBP)* (U.S. EPA, 2024f). Use of epidemiologic evidence qualitatively is consistent with phthalates assessment by Health Canada (Health Canada, 2020) and the U.S. CPSC (2014).

EPA identified 37 oral exposure studies (35 of rats, 2 of mice) that investigated the developmental and reproductive effects of DBP following gestational and/or perinatal exposure to DBP, including multi-generational studies of reproduction (Wine et al., 1997; NTP, 1995). However, there are limited data that evaluate the effects of DBP following inhalation or dermal exposures. Data that evaluate chronic exposures via any route are limited to one study (NTP, 2021). Across available studies, the most sensitive developmental effects identified by EPA include effects on the developing male reproductive system consistent with a disruption of androgen action and development of phthalate syndrome. The Agency has previously concluded in the *Draft Proposed Approach for Cumulative Risk Assessment of High-Priority Phthalates and a Manufacturer-Requested Phthalate under the Toxic Substances Control Act* (U.S. EPA, 2023d) that oral exposure to DBP can induce effects on the developing male reproductive system consistent with a disruption of androgen action and described a mode of action (MOA) for phthalate syndrome.

EPA is proposing a point of departure (POD) of 9 mg/kg-day (derived from a $BMDL_5$; human equivalent dose [HED] of 2.1 mg/kg-day) based on phthalate syndrome-related effects on the developing male reproductive system (*i.e.*, decreased fetal testicular testosterone) to estimate non-cancer risks from oral exposure to DBP for acute, intermediate, and chronic durations of exposure in this draft risk evaluation of DBP. The proposed POD was derived from EPA's updated meta-analysis originally conducted by the National Academies of Sciences, Engineering, and Medicine (NASEM, 2017) and subsequent benchmark dose (BMD) modeling of decreased fetal testicular testosterone (*ex vivo* testicular testosterone production or testicular testosterone content) in eight studies of rats exposed to DBP during gestation (Gray et al., 2021; Furr et al., 2014; Johnson et al., 2011; Struve et al., 2009; Howdeshell et al., 2008; Martino-Andrade et al., 2008; Johnson et al., 2007; Kuhl et al., 2007). The 95 percent lower confidence limit of the BMD associated with a five percent response (*i.e.*, $BMDL_5$) is 9 mg/kg-day (HED 2.1 mg/kg-day) and is within the range of candidate PODs (*i.e.*, 1−10 mg/kg-day) identified from other studies based on antiandrogenic effects on the developing male reproductive system (Furr et al., 2014; Moody et al., 2013; Boekelheide et al., 2009; Lee et al., 2004). These studies support the selection of the $BMDL_5$ of 9 mg/kg-day for the acute, intermediate, and chronic duration POD. The sole chronic study identified by EPA does not offer a more sensitive candidate chronic POD (*i.e.*, the 2-year NTP (2021) study of rats supports a LOAEL of 510 mg/kg-day (HED = 130 mg/kg-day).

EPA performed ¾-body weight scaling to yield the HED and is applying the animal-to-human uncertainty factor (*i.e.*, interspecies uncertainty factor; UF_A) of 3× and the within human variability uncertainty factor (*i.e.*, intraspecies uncertainty factor; UF_H) of 10×. Thus, a total UF of 30× is applied for use as the benchmark MOE. Overall, based on the strengths, limitations, and uncertainties discussed in the *Draft Non-cancer Human Health Hazard Assessment for Dibutyl Phthalate (DBP)* (U.S. EPA, 2024f), *EPA has robust overall confidence in the proposed POD based on effects on the developing male reproductive system. This POD will be used to characterize risk from exposure to DBP for acute, intermediate, and chronic exposure scenarios*. The applicability and relevance of this POD for all exposure durations (acute, intermediate, and chronic) is described in the *Draft Non-cancer Human Health Hazard Assessment for Dibutyl Phthalate (DBP)* (U.S. EPA, 2024f). Risk estimates based on the selected POD are relevant for females of reproductive age and males at any lifestage. Decreased fetal testicular testosterone is the most sensitive endpoint. Additionally, there is (1) epidemiological evidence that DBP exposure can adversely affect the developing male reproductive system consistent with phthalate syndrome in males of any age, and (2) that DBP exposure at higher concentrations can cause other health effects in females as well (see the *Draft Non-cancer Human Health Hazard Assessment for Dibutyl Phthalate (DBP)* (U.S. EPA, 2024f)). Therefore, EPA considers the proposed POD to be relevant across sex, lifestage, and durations of exposure.

No data are available for the dermal or inhalation routes that are suitable for deriving route-specific PODs. Therefore, EPA is using the proposed acute/intermediate/chronic oral POD to evaluate risks from dermal exposure to DBP. Differences between oral and dermal absorption are accounted for in dermal exposure estimates in the draft risk evaluation for DBP. For the inhalation route, EPA is extrapolating the oral HED to an inhalation human equivalent concentration (HEC) per EPA's *Methods for Derivation of Inhalation Reference Concentrations and Application of Inhalation Dosimetry* (U.S. EPA, 1994) using the updated human body weight and breathing rate relevant to continuous exposure of an individual at rest provided in EPA's *Exposure Factors Handbook: 2011 Edition* (U.S. EPA, 2011b). The oral HED and inhalation HEC values selected by EPA to estimate non-cancer risk from acute/intermediate/chronic exposure to DBP in the draft risk evaluation of DBP are summarized in Table 4-13.

4.2.3 Cancer Human Health Hazards of DBP

As discussed in the *Draft Cancer Human Health Hazard Assessment for Di(2-ethylhexyl) Phthalate (DEHP), Dibutyl Phthalate (DBP), Butyl Benzyl Phthalate (BBP), Diisobutyl Phthalate (DIBP), and Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025b), available *in vivo* and *in vitro* genotoxicity assays of DBP and *in vivo* carcinogenicity studies of DBP in rats and mice indicate that DBP is not a direct acting genotoxicant or mutagen. However, there is some limited evidence that DBP might be weakly genotoxic in some *in vitro* assays.

DBP has been evaluated for carcinogenicity in two recent chronic oral exposure studies (1 in rats, 1 in mice) conducted by NTP (2021). Across available carcinogenicity studies, DBP showed no carcinogenic activity in male or female B6C3F1 mice exposed to up to 1,306 to 1,393 mg/kg-day DBP through the diet for 2 years, or in female SD rats exposed to up to 600 mg/kg-day DBP through the diet for 2 years (NTP, 2021). In male SD rats, treatment with 510 mg/kg-day DBP caused a significant trend in increased incidence of pancreatic acinar cell adenomas in male SD rats fed diets containing DBP for 2 years (NTP, 2021). Overall, EPA considers there to be *some limited evidence to support the conclusion that chronic oral exposure to DBP causes pancreatic tumors in rats*. As discussed further in the *Draft Cancer Human Health Hazard Assessment for DEHP, DBP, BBP, DIBP, and DCHP* (U.S. EPA, 2025b), read-across to other toxicologically similar phthalates such as DEHP and BBP that also induce pancreatic acinar cell tumors in rats provides additional evidence to support the conclusion that phthalates, including DBP, can cause pancreatic acinar cell adenomas in rats, supporting EPA's conclusion.

Under the *Guidelines for Carcinogen Risk Assessment* (U.S. EPA, 2005), EPA reviewed the weight of scientific evidence for the carcinogenicity of DBP and has preliminarily determined that there is *Suggestive Evidence of Carcinogenic Potential* of DBP in rodents. According to the *Guidelines for Carcinogen Risk Assessment* (U.S. EPA, 2005), a descriptor of *Suggestive Evidence of Carcinogenic Potential* is appropriate "when the weight of evidence is suggestive of carcinogenicity; a concern for potential carcinogenic effects in humans is raised, but the data are judged not sufficient for a stronger conclusion. This descriptor covers a spectrum of evidence associated with varying levels of concern for carcinogenicity, ranging from a positive cancer result in the only study on an agent to a single positive cancer result in an extensive database that includes negative studies in other species." EPA's determination is based on evidence of pancreatic acinar cell adenomas in one study of male SD rats (NTP, 2021). Pancreatic tumors were not observed in female SD rats or B6C3F1 mice of either sex in NTP bioassays (NTP, 2021). According to the *Guidelines for Carcinogen Risk Assessment* (U.S. EPA, 2005), when there is *Suggestive Evidence*, "the Agency generally would not attempt a dose-response assessment, as the nature of the data generally would not support one." Consistently, EPA is not conducting a dose-response assessment for DBP or evaluating DBP for carcinogenic risk to humans.

Further information can be found in the *Draft Cancer Human Health Hazard Assessment for Di(2-ethylhexyl) Phthalate (DEHP), Dibutyl Phthalate (DBP), Butyl Benzyl Phthalate (BBP), Diisobutyl Phthalate (DIBP), and Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2025b).

Table 4-13. Non-Cancer HECs and HEDs Used to Estimate Risks for Acute, Intermediate, and Chronic Exposure Scenarios

Target Organ System	Species	Duration	POD (mg/kg-day)	Effect	HED [a] (mg/kg-day)	HEC (mg/m^3) [ppm]	Benchmark MOE	Reference (TSCA Study Quality Rating) [b]
Developing male reproductive system	Rat	5–14 days throughout gestation	$BMDL_5$ = 9	↓ fetal testicular testosterone	2.1	12 [1.0]	UF_A= 3 UF_H=10 *Total UF=30*	(Gray et al., 2021) (High) (Furr et al., 2014) (High) (Johnson et al., 2011) (Medium) (Struve et al., 2009) (Medium) (Howdeshell et al., 2008) (High) (Martino-Andrade et al., 2008) (Medium) (Johnson et al., 2007) (Medium) (Kuhl et al., 2007) (Low)

$BMDL_5$ = benchmark dose (lower confidence limit) associated with a 5% response level; HEC = human equivalent concentration; HED = human equivalent dose; MOE = margin of exposure; POD = point of departure; UF = uncertainty factor

[a] EPA used allometric body weight scaling to the ¾-power to derive the HED. Consistent with EPA Guidance (U.S. EPA, 2011c), the interspecies uncertainty factor (UF_A), was reduced from 10 to 3 to account for the remaining uncertainty associated with interspecies differences in toxicodynamics. EPA used a default intraspecies (UF_H) of 10 to account for variation in sensitivity within human populations.

[b] The $BMDL_5$ was derived through meta-regression and BMD modeling of fetal testicular testosterone data from eight studies of DBP with rats (Gray et al., 2021; Furr et al., 2014; Johnson et al., 2011; Struve et al., 2009; Howdeshell et al., 2008; Martino-Andrade et al., 2008; Johnson et al., 2007; Kuhl et al., 2007).

4.3 Human Health Risk Characterization

4.3.1 Risk Assessment Approach

The exposure scenarios, populations of interest, and toxicological endpoints used for evaluating risks from acute, short-term/intermediate, and chronic/lifetime exposures are summarized below in Table 4-14.

Table 4-14. Exposure Scenarios, Populations of Interest, and Hazard Values

<table>
<tr><td rowspan="4">Population of Interest and Exposure Scenario</td><td>Workers
Male and female adolescents and adults (16+ years old) and females of reproductive age directly working with DBP under light activity (breathing rate of 1.25 m³/h) (for further details see (U.S. EPA, 2025q))
<u>Exposure Durations</u>
• Acute – 8 hours for a single workday
• Intermediate – 8 hours per workday for 22 days per 30-day period
• Chronic – 8 hours per workday for 250 days per year for 31 or 40 working years
<u>Exposure Routes</u>
• Inhalation and dermal</td></tr>
<tr><td>Occupational Non-Users
Male and female adolescents and adults (16+ years old) indirectly exposed to DBP within the same work area as workers (breathing rate of 1.25 m³/h) (for further details see (U.S. EPA, 2025q))
<u>Exposure Durations</u>
• Acute, Intermediate, and Chronic – same as workers
<u>Exposure Routes</u>
• Inhalation, dermal (for COUs where mist and dust deposited on surfaces)</td></tr>
<tr><td>Consumers
Male and female infants (<1 year), toddlers (1–2 years), children (3–5 years and 6–10 years), young teens (11–15 years), teenagers (16–20 years) and adults (21+ years) exposed to DBP through product or articles use (for further details see (U.S. EPA, 2025c))
<u>Exposure Durations</u>
• Acute – 1 day exposure
• Intermediate – 30 days per year
• Chronic – 365 days per year
<u>Exposure Routes</u>
• Inhalation, dermal, and oral</td></tr>
<tr><td>Bystanders
Male and female infants (<1 year), toddlers (1–2 years), and children (3–5 years and 6–10 years) incidentally exposed to DBP through product use (for further details see (U.S. EPA, 2025c))
<u>Exposure Durations</u>
• Acute – 1 day exposure
• Intermediate – 30 days per year
• Chronic – 365 days per year
<u>Exposure Routes</u>
• Inhalation</td></tr>
</table>

Population of Interest and Exposure Scenario	**General Population** Male and female infants, children, youth, and adults exposed to DBP through drinking water, surface water, soil from air to soil deposition, and fish ingestion (for further details see (U.S. EPA, 2025p)) Exposure Durations • *Acute* – Exposed to DBP continuously for a 24-hour period • *Chronic* – Exposed to DBP continuously up to 33 years Exposure Routes – Inhalation, dermal, and oral (depending on exposure scenario)
	Cumulative Exposure Based on NHANES Biomonitoring Children aged 3–5, 6–11 years, and 11 to <16 years; male and female adults 16+ years; and females of reproductive age (16–49 years of age) exposed to DEHP, DBP, BBP, DIBP, and DINP through all exposure pathways and routes as measured through urinary biomonitoring (*i.e.*, NHANES) (for further details see (U.S. EPA, 2025x)) Exposure Durations • Durations not easily characterized in urinary biomonitoring studies • Likely between acute and intermediate as phthalates have elimination half-lives on the order of several hours and are quickly excreted from the body in urine. Spot urine samples, as collected through NHANES, are representative of relatively recent exposures. Exposure Routes NHANES urinary biomonitoring data provides an estimate of aggregate exposure (*i.e.*, exposure through oral, inhalation, and dermal routes)
Health Effects, Concentration and Time Duration	**Non-Cancer Acute/Intermediate/Chronic Value** Sensitive health effect: Developmental toxicity (*i.e.*, reduced fetal testicular testosterone content) HEC Daily, continuous (assumes breathing rate of 0.6125 m^3/h and 24 hours/day for continuous exposure (U.S. EPA, 2011a)) = 12 mg/m^3 (1.0 ppm) HED Daily = 2.1 mg/kg-day; dermal and oral Total UF (benchmark MOE) = 30 (UF_A = 3; UF_H = 10) **Hazard Relative Potency** Relative potency factors for DBP, DEHP, BBP, DIBP, DCHP, and DINP were derived based on reduced fetal testicular testosterone. DBP was selected as the index chemical (for further details see (U.S. EPA, 2025x)). RPF_{DBP} = 1 (index chemical) RPF_{DEHP} = 0.84 RPF_{BBP} = 0.52 RPF_{DIBP} = 053 RPF_{DCHP} = 1.66 RPF_{DINP} = 0.21 Index chemical (DBP) POD = HED daily = 2.1 mg/kg-day Total UF (benchmark MOE) = 30 (UF_A = 3; UF_H = 10)

4.3.1.1 Estimation of Non-Cancer Risks

EPA used a margin of exposure (MOE) approach to identify potential non-cancer risks for individual exposure routes (*i.e.*, oral, dermal, inhalation). The MOE is the ratio of the non-cancer POD divided by a human exposure dose. Acute, short-term, and chronic MOEs for non-cancer inhalation and dermal risks were calculated using Equation 4-1.

Equation 4-1. Margin of Exposure Calculation

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

Where:

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

MOE risk estimates may be interpreted in relation to benchmark MOEs. Benchmark MOEs are typically the total UF for each non-cancer POD. The MOE estimate is interpreted as a human health risk of concern if the MOE estimate is less than the benchmark MOE (*i.e.*, the total UF). On the other hand, if the MOE estimate is equal to or exceeds the benchmark MOE, the risk is not considered to be of concern and mitigation is not needed. Typically, the larger the MOE, the more unlikely it is that a non-cancer adverse effect occurs relative to the benchmark. When determining whether a chemical substance presents unreasonable risk to human health or the environment, calculated risk estimates are not "bright-line" indicators of unreasonable risk, and EPA has the discretion to consider other risk-related factors in addition to risks identified in the risk characterization.

4.3.1.2 Estimation of Non-Cancer Aggregate Risks

As described in Section 4.1.5, EPA considered aggregate risk across all routes of exposure for each individual consumer and occupational COU evaluated for acute, intermediate, and chronic exposure durations. To identify potential non-cancer risks for aggregate exposure scenarios for workers (Section 4.3.2) and consumers (Section 4.3.3), EPA used the total MOE approach (U.S. EPA, 2001). For this approach, MOEs for each exposure route of interest in the aggregate scenario must first be calculated. The total MOE for the aggregate scenario can then be calculated using Equation 4-2.

Equation 4-2. Total Margin of Exposure Calculation

$$Total\ MOE = \frac{1}{\frac{1}{MOE_{Oral}} + \frac{1}{MOE_{Dermal}} + \frac{1}{MOE_{Inhalation}} \cdots}$$

Where:

Total MOE	=	Margin of exposure for aggregate scenario (unitless)
MOE_{Oral}	=	Margin of exposure for oral route (unitless)
MOE_{Dermal}	=	Margin of exposure for dermal route (unitless)
$MOE_{Inhalation}$	=	Margin of exposure for inhalation route (unitless)

Total MOE risk estimates may be interpreted in relation to benchmark MOEs, similarly as to described in the preceding Section 4.3.1.1.

4.3.2 Risk Estimates for Workers

This section summarizes risk estimates for workers from inhalation and dermal exposures, as well as aggregated exposures to DBP from individual DBP OESs and COUs across routes (

Table 4-18). Risks are calculated for all exposed workers based on the DBP-derived PODs described in Section 4.2.2. The occupational exposure values (OEVs) are discussed in Appendix F. This section provides discussion and characterization of risk estimates for workers, including females of reproductive age and ONUs, for the various OESs and COUs.

Manufacturing

For the manufacture of DBP, dermal exposure to liquids is expected to be the dominant route of exposure. MOEs for high-end acute, intermediate, and chronic inhalation exposure ranged from 15 to 25 for average adult workers and females of reproductive age, while high-end dermal MOEs for the same populations and exposure scenarios ranged from 0.8 to 1.3 (benchmark = 30). The central tendency MOEs for the same populations and exposure scenarios ranged from 30 to 49 for inhalation exposure and 1.7 to 2.7 for dermal exposure. Aggregation of inhalation and dermal exposures led to negligible differences in risk when compared to risk estimates from dermal exposure alone. The MOEs presented in this paragraph are with no use of PPE. Section 4.3.2.4 and Table 4-17 provides more information on PPE that could be used to reduce the MOEs above the benchmark MOE. As noted previously, EPA is interested in public comments that may inform the use of exposure controls and PPE for different COU.

The high-end and central tendency worker inhalation exposure results for this OES are based on data from three different risk evaluations; each presented a single data point to characterize full-shift exposure to workers during DBP manufacturing (ECB, 2008; ECJRC, 2004; SRC, 2001). To determine central tendency and high-end values, EPA used the mid-point and maximum value, respectively, due to limited data points. There is uncertainty about how well these data represent the true distribution of actual inhalation concentrations for worker exposures in a specific facility, and the lack of ONU exposure data, for which EPA used worker data as surrogate data; and that there are only three data points used for the inhalation assessment.

For occupational dermal exposure assessment, EPA assumed a standard 8-hour workday and the chemical is contacted at least once per day. Because DBP has low volatility and relatively low absorption, it is possible that the chemical remains on the surface of the skin after dermal contact until the skin is washed. So, in absence of exposure duration data, EPA has assumed that absorption of DBP from occupational dermal contact with materials containing DBP may extend up to 8 hours per day (U.S. EPA, 1991). However, if a worker uses proper PPE or washes their hands after contact with DBP or DBP-containing materials, dermal exposure may be eliminated. Therefore, the assumption of an 8-hour exposure duration for DBP may lead to overestimation of dermal exposure. Regarding surface area of occupational dermal exposure, EPA assumed a high-end value of 1,070 cm^2 for male workers and 890 cm^2 for female workers. These high-end occupational dermal exposure surface area values are based on the mean two-hand surface area for adults EPA's *Exposure Factors Handbook* (U.S. EPA, 2011a). For central tendency estimates, EPA assumed the exposure surface area was equivalent to only a single hand (or one side of two hands) and used half the mean values for two-hand surface areas (*i.e.*, 535 cm^2 for male workers and 445 cm^2 for female workers).

High-end and central tendency dermal exposures to liquid were determined using data from Doan et al. (2010). The study estimated a dermal absorption rate from experiments on female hairless guinea pigs using a formulation of 7 percent oil-in-water emulsion. Using the study's estimate for DBP absorption in skin, 56.3 percent of the 1 mg/cm^2 dose over 24 hours, EPA estimated the steady-state flux of DBP and the resultant dose based on exposure area. Although EPA determined that all data were of acceptable quality without notable deficiencies and integrated all the data into the final exposure assessment, it's uncertain how representative the use of a 7 percent oil-in-water emulsion formulation is for OESs where the neat form of DBP is used. There is also uncertainty in the use of guinea pigs over human skin, as guinea pig tissue is known to be more permeable than human tissue. Therefore, uncertainties about the difference between human and guinea pigs skin absorption increase uncertainty.

Due to limited inhalation data points, both the central and high-end exposure estimates are expected to be reflective of worker inhalation exposures for this OES. Also, since the dermal exposures are upper-bound estimates, it can be conservatively assumed that the central tendency values of exposure estimates are expected to be most reflective of worker dermal exposures. This applies to COUs covered under the "Manufacturing" OES (*i.e.*, Manufacturing COU: Domestic manufacturing).

Import and Repackaging

For the repackaging of DBP, dermal exposure from liquid contact is expected to be the dominant route of exposure. MOEs for high-end acute, intermediate, and chronic inhalation exposure ranged from 15 to 25 for average adult workers and females of reproductive age, while high-end dermal MOEs for the same populations and exposure scenarios ranged from 0.8 to 1.3 (benchmark = 30). The central tendency MOEs for the same populations and exposure scenarios ranged from 30 to 49 for inhalation exposure and 1.7 to 2.7 for dermal exposure. Aggregation of inhalation and dermal exposures led to negligible differences in risk when compared to risk estimates from dermal exposure alone. The MOEs presented in this paragraph are with no use of PPE. Section 4.3.2.4 and Table 4-17 provides more information on PPE that could be used to reduce the MOEs above the benchmark MOE.

The high-end and central tendency worker inhalation exposure results for this OES are based on surrogate data from three different risk evaluations; each presented a single data point to characterize full-shift exposure to workers during DBP manufacturing (ECB, 2008; ECJRC, 2004; SRC, 2001). To determine central tendency and high-end values, EPA used the mid-point and maximum value, respectively, due to limited data points. There is uncertainty about how well these data represent the true distribution of actual inhalation concentrations for worker exposures in a specific facility, and the lack of ONU exposure data, for which EPA used worker data as surrogate data; and that there are only three data points used for the inhalation assessment.

For occupational dermal exposure assessment, EPA assumed a standard 8-hour workday and the chemical is contacted at least once per day. Because DBP has low volatility and relatively low absorption, it is possible that the chemical remains on the surface of the skin after dermal contact until the skin is washed. Thus, in absence of exposure duration data, EPA has assumed that absorption of DBP from occupational dermal contact with materials containing DBP may extend up to 8 hours per day (U.S. EPA, 1991). However, if a worker uses proper PPE or washes their hands after contact with DBP or DBP-containing materials, dermal exposure may be eliminated. Therefore, the assumption of an 8-hour exposure duration for DBP may lead to overestimation of dermal exposure. Regarding surface area of occupational dermal exposure, EPA assumed a high-end value of 1,070 cm^2 for male workers and 890 cm^2 for female workers. These high-end occupational dermal exposure surface area values are based on the mean two-hand surface area for adults EPA's *Exposure Factors Handbook* (U.S. EPA, 2011a). For central tendency estimates, EPA assumed the exposure surface area was equivalent to only a single hand (or one side of two hands) and used half the mean values for two-hand surface areas (*i.e.*, 535 cm^2 for male workers and 445 cm^2 for female workers).

High-end and central tendency dermal exposures to liquid were determined using data from Doan et al. (2010). The study estimated a dermal absorption rate from experiments on female hairless guinea pigs using a formulation of 7 percent oil-in-water emulsion. Using the study's estimate for DBP absorption in skin, 56.3 percent of the 1 mg/cm^2 dose over 24 hours, EPA estimated the steady-state flux of DBP and the resultant dose based on exposure area. Although EPA determined that all data were of acceptable quality without notable deficiencies and integrated all the data into the final exposure assessment, it's uncertain how representative the use of a 7 percent oil-in-water emulsion formulation is for OESs where the neat form of DBP is used. There is also uncertainty in the use of guinea pigs over human skin, as guinea pig tissue is known to be more permeable than human tissue. Therefore, uncertainties about the difference between human and guinea pigs skin absorption increase uncertainty.

Due to limited inhalation data points, both the central and high-end exposure estimates are expected to be reflective of worker inhalation exposures for this OES. Also, since the dermal exposures are upper-bound estimates, it can be conservatively assumed that the central tendency values of exposure estimates are expected to be most reflective of worker dermal exposures. This applies to COUs covered under the Import and repackaging OES (*i.e.*, Manufacture COU: Importing; processing COU: Repackaging COU [Laboratory chemicals in wholesale and retail trade; plasticizers in wholesale and retail trade; and plastics material and resin manufacturing]).

Incorporation into Formulations, Mixtures, or Reaction Products

For the incorporation of DBP into formulations, mixtures, or reaction products, dermal exposure from liquid contact is expected to be the dominant route of exposure. MOEs for high-end acute, intermediate, and chronic inhalation exposure ranged from 15 to 25 for average adult workers and females of reproductive age, while high-end dermal MOEs for the same populations and exposure scenarios ranged from 0.8 to 1.3 (benchmark = 30). The central tendency MOEs for the same populations and exposure scenarios ranged from 30 to 49 for inhalation exposure and 1.7 to 2.7 for dermal exposure. Aggregation of inhalation and dermal exposures led to negligible differences in risk when compared to risk estimates from dermal exposure alone. The MOEs presented in this paragraph are with no use of PPE. Section 4.3.2.4 and Table 4-17 provides more information on PPE that could be used to reduce the MOEs above the benchmark MOE.

The high-end and central tendency worker inhalation exposure results for this OES are based on surrogate data from three different risk evaluations; each presented a single data point to characterize full-shift exposure to workers during DBP manufacturing (ECB, 2008; ECJRC, 2004; SRC, 2001). To determine central tendency and high-end values, EPA used the mid-point and maximum value, respectively, due to limited data points. There is uncertainty about how well these data represent the true distribution of actual inhalation concentrations for worker exposures in a specific facility, and the lack of ONU exposure data, for which EPA used worker data as surrogate data; and that there are only three data points used for the inhalation assessment.

For occupational dermal exposure assessment, EPA assumed a standard 8-hour workday and the chemical is contacted at least once per day. Because DBP has low volatility and relatively low absorption, it is possible that the chemical remains on the surface of the skin after dermal contact until the skin is washed. Thus, in absence of exposure duration data, EPA has assumed that absorption of DBP from occupational dermal contact with materials containing DBP may extend up to 8 hours per day (U.S. EPA, 1991). However, if a worker uses proper PPE or washes their hands after contact with DBP or DBP-containing materials, dermal exposure may be eliminated. Therefore, the assumption of an 8-hour exposure duration for DBP may lead to overestimation of dermal exposure. Regarding surface area of occupational dermal exposure, EPA assumed a high-end value of 1,070 cm^2 for male workers and 890 cm^2 for female workers. These high-end occupational dermal exposure surface area values are based on the mean two-hand surface area for adults EPA's *Exposure Factors Handbook* (U.S. EPA, 2011a). For central tendency estimates, EPA assumed the exposure surface area was equivalent to only a single hand (or one side of two hands) and used half the mean values for two-hand surface areas (*i.e.*, 535 cm^2 for male workers and 445 cm^2 for female workers).

High-end and central tendency dermal exposures to liquid were determined using data from Doan et al. (2010). The study estimated a dermal absorption rate from experiments on female hairless guinea pigs using a formulation of 7 percent oil-in-water emulsion. Using the study's estimate for DBP absorption in skin, 56.3 percent of the 1 mg/cm^2 dose over 24 hours, EPA estimated the steady-state flux of DBP, and the resultant dose based on exposure area. Although the Agency determined that all data were of acceptable quality without notable deficiencies and integrated all the data into the final exposure assessment, it's uncertain how representative the use of a 7 percent oil-in-water emulsion formulation is for OESs where a higher concentration of DBP is used. There is also uncertainty in the use of guinea pigs over human skin, as guinea pig tissue is known to be more permeable than human tissue. Therefore, uncertainties about the difference between human and guinea pigs skin absorption increase uncertainty.

Due to limited inhalation data points, both the central and high-end exposure estimates are expected to be reflective of worker inhalation exposures for this OES. Also, since the dermal exposures are upper-bound estimates, it can be conservatively assumed that the central tendency values of exposure estimates are expected to be most reflective of worker dermal exposures. This applies to the COUs covered under the "Incorporation into formulations, mixtures, or reaction products" OES (*i.e.*, Processing COU: Processing as a reactant: [Intermediate in plastic manufacturing]; Incorporation into formulation, mixture, or reaction product: [Solvents (which become part of product formulation or mixture) in chemical product and preparation manufacturing; soap, cleaning compound, and toilet preparation manufacturing; adhesive manufacturing; and printing ink manufacturing]; [Plasticizer in paint and coating manufacturing; soap, cleaning compound, and toilet preparation manufacturing; textiles, apparel, and leather manufacturing; printing ink manufacturing; basic organic chemical manufacturing; and adhesive and sealant manufacturing]; and Pre-catalyst manufacturing).

PVC Plastics Compounding

For PVC plastics compounding, dermal contact with liquid DBP before it is incorporated into the formulation is expected to be the dominant route of exposure. MOEs for high-end acute, intermediate, and chronic inhalation exposure ranged from 5.3 to 8.6 for average adult workers and females of reproductive age, while high-end dermal MOEs for the same populations and exposure scenarios ranged from 0.8 to 1.3 (benchmark = 30). The central tendency MOEs for the same populations and exposure scenarios ranged from 44 to 71 for inhalation exposure and 1.7 to 2.6 for dermal exposure. Aggregation of inhalation and dermal exposures led to negligible differences in risk when compared to risk estimates from dermal exposure alone. The MOEs presented in this paragraph are with no use of PPE. Section 4.3.2.4 and Table 4-17 provides more information on PPE that could be used to reduce the MOEs above the benchmark MOE.

EPA did not identify chemical- or OES-specific inhalation monitoring data for DBP from systematic review; however, EPA utilized surrogate vapor inhalation monitoring data from PVC plastics converting to assess worker inhalation exposure to DBP vapors (ECJRC, 2004). To assess the high-end worker exposure to DBP during the compounding process, EPA used the maximum available value (0.75 mg/m^3). EPA assessed the average of the four available values as the central tendency (0.24 mg/m3). EPA estimated worker inhalation exposures to dust using the Generic Model for Central Tendency and High-End Inhalation Exposure to Total and Respirable Particulates Not Otherwise Regulated (PNOR Model) for dust exposures (U.S. EPA, 2021d). For inhalation exposure to PNOR, EPA determined the 50th and 95th percentiles of the surrogate dust monitoring data taken from facilities with NAICS codes starting with 326 (Plastics and Rubber Manufacturing). EPA multiplied these dust concentrations by the industry provided maximum potential DBP concentration in PVC material (*i.e.*, 45%) to estimate DBP particulate concentrations in the air. Therefore, the differences in the central tendency and high-end dust concentrations led to differences between the central tendency and high-end risk estimates.

There is uncertainty about how well the surrogate vapor monitoring data represent the true distribution of vapor inhalation concentrations for actual worker exposures in a specific facility. Also, though the PNOR (*i.e.*, dust) concentration data provides a reliable range of dust concentrations that a worker may experience in the compounding industry, the composition of workplace dust is uncertain. The exposure and risk estimates assume that the concentration of DBP in workplace dust is the same as the concentration of DBP in the PVC material. However, it is likely that workplace dust contains a variety of constituents that do not contain any DBP in addition to particles from DBP-containing plastic materials. The constituents that do not contain DBP would dilute the overall concentration of DBP in the dust, and the concentration of DBP in workplace dust is likely less than the concentration of DBP in the plastic material. Therefore, the estimated inhalation exposures to dust are likely overestimated.

For occupational dermal exposure assessment, EPA assumed a standard 8-hour workday and the chemical is contacted at least once per day. Because DBP has low volatility and relatively low absorption, it is possible that the chemical remains on the surface of the skin after dermal contact until the skin is washed. So, in absence of exposure duration data, EPA has assumed that absorption of DBP from occupational dermal contact with materials containing DBP may extend up to 8 hours per day (U.S. EPA, 1991). However, if a worker uses proper PPE or washes their hands after contact with DBP or DBP-containing materials, dermal exposure may be eliminated. Therefore, the assumption of an 8-hour exposure duration for DBP may lead to overestimation of dermal exposure. Regarding surface area of occupational dermal exposure, EPA assumed a high-end value of 1,070 cm^2 for male workers and 890 cm^2 for female workers. These high-end occupational dermal exposure surface area values are based on the mean two-hand surface area for adults in the *Exposure Factors Handbook* (U.S. EPA, 2011a). For central tendency estimates, the Agency assumed the exposure surface area was equivalent to only a single hand (or one side of two hands) and used half the mean values for two-hand surface areas (*i.e.*, 535 cm^2 for male workers and 445 cm^2 for female workers).

High-end and central tendency dermal exposures to liquid DBP were determined using data from Doan et al. (2010). The study estimated a dermal absorption rate from experiments on female hairless guinea pigs using a formulation of 7 percent oil-in-water emulsion. Using the study's estimate for DBP absorption in skin, 56.3 percent of the 1 mg/cm^2 dose over 24 hours, EPA estimated the steady-state flux of DBP and the resultant dose based on exposure area. Although the Agency determined that all data were of acceptable quality without notable deficiencies and integrated all the data into the final exposure assessment, it is uncertain how representative the use of a 7 percent oil-in-water emulsion formulation is for OESs where a higher concentration of DBP is used. There is also uncertainty in the use of guinea pigs over human skin, as guinea pig tissue is known to be more permeable than human tissue. Therefore, uncertainties about the difference between human and guinea pigs skin absorption increase uncertainty.

For estimating high-end and central tendency occupational dermal exposures to solids, EPA assumed that DBP will first migrate from the solid matrix to a thin layer of moisture on the skin surface. Therefore, absorption of DBP from solid matrices is considered limited by aqueous solubility and is estimated using an aqueous absorption model (U.S. EPA, 2023c, 2004b) as described in Appendix C in the *Draft Environmental Release and Occupational Exposure Assessment for Dibutyl Phthalate (DBP)* (U.S. EPA, 2025q). EPA assumes that absorption of the aqueous material serves as a reasonable upper bound for contact with solid materials and used this to estimate the average absorptive flux of DBP and the resultant dose based on worker exposure area.

The PNOR Model uses conservative assumptions leading to upper-bound inhalation exposure estimates. The dermal exposure estimates are also upper-bound estimates as discussed above. Therefore, the central tendency values of exposure are expected to be most reflective of worker exposures within the COUs covered under the PVC plastics compounding OES (*i.e.*, Processing COUs: Incorporation into formulation, mixture, or reaction product [Plasticizer in plastic material and resin manufacturing]).

PVC Plastics Converting

For PVC plastics converting, inhalation exposure is expected to be the dominant route of exposure. MOEs for high-end acute, intermediate, and chronic inhalation exposure ranged from 5.3 to 8.6 for average adult workers and females of reproductive age, while high-end dermal MOEs ranged from 62 to 98 (benchmark = 30). For central tendency, MOEs for the same population and exposure scenarios ranged from 44 to 71 for inhalation exposure and 124 to 197 for dermal exposures. Aggregation of inhalation and dermal exposures led to negligible differences in risk when compared to risk estimates from inhalation exposure alone. The MOEs presented in this paragraph are with no use of PPE. Section 4.3.2.4 and Table 4-17 provides more information on PPE that could be used to reduce the MOEs above the benchmark MOE.

EPA identified vapor inhalation monitoring data from a risk evaluation completed by the European Commission's Joint Research Centre (ECJRC), which included four data points compiled from two sources (ECJRC, 2004). To assess the high-end worker exposure to DBP during the converting process, EPA used the maximum available value (0.75 mg/m^3). EPA assessed the average of the four available values as the central tendency (0.24 mg/m^3). The Agency estimated worker inhalation exposures to dust using the PNOR Model for dust exposures (U.S. EPA, 2021d). For inhalation exposure to PNOR, EPA determined the 50th and 95th percentiles of the surrogate dust monitoring data taken from facilities with NAICS codes starting with 326 (Plastics and Rubber Manufacturing). EPA multiplied these dust concentrations by the industry provided maximum potential DBP concentration in PVC material (*i.e.*, 45%) to estimate DBP particulate concentrations in the air. Therefore, the differences in the central tendency and high-end dust concentrations led to differences between the central tendency and high-end risk estimates.

There is uncertainty about how well the surrogate vapor monitoring data represent the true distribution of vapor inhalation concentrations for actual worker exposures in a specific facility. Also, although the PNOR Model (*i.e.*, dust) concentration data provides a reliable range of dust concentrations that a worker may experience in the converting industry, the composition of workplace dust is uncertain. The exposure and risk estimates assume that the concentration of DBP in workplace dust is the same as the concentration of DBP in the PVC material. However, it is likely that workplace dust contains a variety of constituents that do not contain any DBP in addition to particles from DBP-containing plastic materials. The constituents that do not contain DBP would dilute the overall concentration of DBP in the dust, and the concentration of DBP in workplace dust is likely less than the concentration of DBP in the plastic material. Therefore, the estimated inhalation exposures to dust are likely overestimated.

For occupational dermal exposure assessment, EPA assumed a standard 8-hour workday and the chemical is contacted at least once per day. Because DBP has low volatility and relatively low absorption, it is possible that the chemical remains on the surface of the skin after dermal contact until the skin is washed. Thus, in absence of exposure duration data, EPA has assumed that absorption of DBP from occupational dermal contact with materials containing DBP may extend up to 8 hours per day (U.S. EPA, 1991). However, if a worker uses proper PPE or washes their hands after contact with DBP or DBP-containing materials, dermal exposure may be eliminated. Therefore, the assumption of an 8-hour exposure duration for DBP may lead to overestimation of dermal exposure. Regarding surface area of occupational dermal exposure, EPA assumed a high-end value of 1,070 cm^2 for male workers and 890 cm^2 for female workers. These high-end occupational dermal exposure surface area values are based on the mean two-hand surface area for adults EPA's *Exposure Factors Handbook* (U.S. EPA, 2011a). For central tendency estimates, EPA assumed the exposure surface area was equivalent to only a single hand (or one side of two hands) and used half the mean values for two-hand surface areas (*i.e.*, 535 cm^2 for male workers and 445 cm^2 for female workers).

For estimating high-end and central tendency occupational dermal exposures to solids, EPA assumed that DBP will first migrate from the solid matrix to a thin layer of moisture on the skin surface. Therefore, absorption of DBP from solid matrices is considered limited by aqueous solubility and is estimated using an aqueous absorption model (U.S. EPA, 2023c, 2004b) as described in Appendix C in the *Draft Environmental Release and Occupational Exposure Assessment for Dibutyl Phthalate (DBP)* (U.S. EPA, 2025q). EPA assumes that absorption of the aqueous material serves as a reasonable upper bound for contact with solid materials and used this to estimate the average absorptive flux of DBP and the resultant dose based on worker exposure area.

The PNOR Model uses conservative assumptions leading to upper-bound inhalation exposure estimates. The dermal exposure estimates are also upper-bound estimates as discussed above. Therefore, the central tendency values of exposure are expected to be most reflective of worker exposures within the COUs covered under the "PVC plastics converting" OES (*i.e.*, Processing COUs: Incorporation into articles [Plasticizer in adhesive and sealant manufacturing; building and construction materials manufacturing; furniture and related product manufacturing; ceramic powders; plastics product manufacturing]).

Non-PVC Materials Manufacturing (Compounding and Converting)

For non-PVC materials manufacturing, dermal exposure from liquid contact to DBP is expected to be the dominant route of exposure. In support of this, MOEs for high-end acute, intermediate, and chronic inhalation exposure ranged from 9.0 to 15 for average adult workers and females of reproductive age, while high-end dermal MOEs for the same populations and exposure scenarios ranged from 0.8 to 1.3 (benchmark = 30). The central tendency MOEs for the same populations and exposure scenarios ranged from 53 to 86 for inhalation exposure and 1.7 to 2.6 for dermal exposure. Aggregation of inhalation and dermal exposures led to negligible differences in risk when compared to risk estimates from dermal exposure alone. The MOEs presented in this paragraph are with no use of PPE. Section 4.3.2.4 and Table 4-17 provides more information on PPE that could be used to reduce the MOEs above the benchmark MOE.

EPA did not identify chemical-specific or OES-specific inhalation monitoring data for DBP from systematic review, however, EPA utilized surrogate vapor inhalation monitoring data from PVC plastics converting to assess worker inhalation exposure to DBP vapors (ECJRC, 2004). To assess the high-end worker exposure to DBP during the converting process, EPA used the maximum available value (0.75 mg/m^3). EPA assessed the average of the four available values as the central tendency (0.24 mg/m^3). EPA estimated worker inhalation exposures using the PNOR Model for dust exposures (U.S. EPA, 2021d). For inhalation exposure to PNOR, EPA determined the 50th and 95th percentiles of the surrogate dust monitoring data taken from facilities with NAICS codes starting with 326 (Plastics and Rubber Manufacturing). EPA multiplied these dust concentrations by the industry provided maximum potential DBP concentration in non-PVC material (*i.e.*, 20%) to estimate DBP particulate concentrations in the air. Therefore, the differences in the central tendency and high-end dust concentrations led to differences between the central tendency and high-end risk estimates.

There is uncertainty about how well the surrogate vapor monitoring data represent the true distribution of vapor inhalation concentrations for actual worker exposures in a specific facility Also, though the PNOR (*i.e.*, dust) concentration data provides a reliable range of dust concentrations that a worker may experience in the converting industry, the composition of workplace dust is uncertain. The exposure and risk estimates assume that the concentration of DBP in workplace dust is the same as the concentration of DBP in the non-PVC material. However, it is likely that workplace dust contains a variety of constituents that do not contain any DBP in addition to particles from DBP-containing non-PVC materials. The constituents that do not contain DBP would dilute the overall concentration of DBP in the dust, and the concentration of DBP in workplace dust is likely less than the concentration of DBP in the non-PVC material. Therefore, the estimated inhalation exposures to dust are likely overestimated.

For occupational dermal exposure assessment, EPA assumed a standard 8-hour workday and the chemical is contacted at least once per day. Because DBP has low volatility and relatively low absorption, it is possible that the chemical remains on the surface of the skin after dermal contact until the skin is washed. So, in absence of exposure duration data, EPA has assumed that absorption of DBP from occupational dermal contact with materials containing DBP may extend up to 8 hours per day (U.S. EPA, 1991). However, if a worker uses proper PPE or washes their hands after contact with DBP or DBP-containing materials, dermal exposure may be eliminated. Therefore, the assumption of an 8-hour exposure duration for DBP may lead to overestimation of dermal exposure. Regarding surface area of occupational dermal exposure, EPA assumed a high-end value of 1,070 cm^2 for male workers and 890 cm^2 for female workers. These high-end occupational dermal exposure surface area values are based on the mean two-hand surface area for adults EPA's *Exposure Factors Handbook* (U.S. EPA, 2011a). For central tendency estimates, the Agency assumed the exposure surface area was equivalent to only a single hand (or one side of two hands) and used half the mean values for two-hand surface areas (*i.e.*, 535 cm^2 for male workers and 445 cm^2 for female workers).

High-end and central tendency dermal exposures to liquid were determined using data from Doan et al. (2010). The study estimated a dermal absorption rate from experiments on female hairless guinea pigs using a formulation of 7 percent oil-in-water emulsion. Using the study's estimate for DBP absorption in skin, 56.3 percent of the 1 mg/cm^2 dose over 24 hours, EPA estimated the steady-state flux of DBP and the resultant dose based on exposure area. EPA defined central tendency exposure as the average surface area of the exposed worker population's hand, while the high-end value is based on the surface area of two hands, therefore, the high-end value is twice that of the central tendency. Although EPA determined that all data were of acceptable quality without notable deficiencies and integrated all the data into the final exposure assessment, it's uncertain how representative the use of a 7 percent oil-in-water emulsion formulation is for OESs where a higher concentration of DBP is used. There is also uncertainty in the use of guinea pigs over human skin, as guinea pig tissue is known to be more permeable than human tissue. Therefore, uncertainties about the difference between human and guinea pigs skin absorption increase uncertainty. For estimating high-end and central tendency occupational dermal exposures to solids, EPA assumed that DBP will first migrate from the solid matrix to a thin layer of moisture on the skin surface. Therefore, absorption of DBP from solid matrices is considered limited by aqueous solubility and is estimated using an aqueous absorption model (U.S. EPA, 2023c, 2004b) as described in Appendix C in the *Draft Environmental Release and Occupational Exposure Assessment for Dibutyl Phthalate (DBP)* (U.S. EPA, 2025q). EPA assumes that absorption of the aqueous material serves as a reasonable upper bound for contact with solid materials and used this to estimate the average absorptive flux of DBP and the resultant dose based on worker exposure area.

The PNOR Model uses conservative assumptions leading to upper-bound inhalation exposure estimates. The dermal exposure estimates are also upper-bound estimates as discussed above. Therefore, the central tendency values of exposure are expected to be most reflective of worker exposures within the COUs covered under the "Non-PVC materials manufacturing" OES (*i.e.*, Processing COUs: Incorporation into formulation, mixture, or reaction product [Plasticizer in plastic material and resin manufacturing; rubber manufacturing]; and Incorporation into articles [Plasticizer in adhesive and sealant manufacturing; building and construction materials manufacturing; furniture and related product manufacturing; ceramic powders; plastics product manufacturing; and rubber product manufacturing]).

Application of Adhesives and Sealants

For application of adhesives and sealants containing DBP, dermal exposure to liquids is expected to be the dominant route of exposure. MOEs for high-end acute, intermediate, and chronic inhalation exposure ranged from 152 to 245 for average adult workers and females of reproductive age, while high-end dermal MOEs for the same populations and exposure scenarios ranged from 0.8 to 1.3 (benchmark = 30). The central tendency MOEs for the same populations and exposure scenarios ranged from 304 to 529 for inhalation exposure and 1.7 to 2.9 for dermal exposure. Aggregation of inhalation and dermal exposures led to negligible differences in risk when compared to risk estimates from dermal exposure alone. The MOEs presented in this paragraph are with no use of PPE. Section 4.3.2.4 and Table 4-17 provides more information on PPE that could be used to reduce the MOEs above the benchmark MOE.

The high-end and central tendency worker inhalation exposure results for this OES are based on 19 monitoring samples in NIOSH's HHE database (NIOSH, 1977). Six of the samples were PBZ samples, and the remaining 13 samples were area samples taken at various locations around an acrylic furniture manufacturing site. The site uses 2-part adhesives where the part B component is 96.5 percent DBP. Two of the area samples recorded values at the limit of detection, and the remaining 17 samples were below the limit of detection. All samples were collected on AA cellulose membrane filters with 0.8µm average pore size and a pump flow rate of 1 LPM. The detection limit was 0.01 mg/m^3 by gas chromatography. With all samples at or below the LOD, EPA assessed inhalation exposures as a range from 0 to the LOD. EPA estimated the high-end exposure as equal to the LOD and the central tendency as the midpoint (*i.e.*, half the LOD). There is uncertainty about how well these data represent the true distribution of actual inhalation concentrations in this scenario at a specific facility. In absence of ONU exposure data, EPA used worker data as analogous data for ONU exposure.

For occupational dermal exposure assessment, EPA assumed a standard 8-hour workday and the chemical is contacted at least once per day. Because DBP has low volatility and relatively low absorption, it is possible that the chemical remains on the surface of the skin after dermal contact until the skin is washed. So, in absence of exposure duration data, EPA has assumed that absorption of DBP from occupational dermal contact with materials containing DBP may extend up to 8 hours per day (U.S. EPA, 1991). However, if a worker uses proper PPE, or washes their hands after contact with DBP or DBP-containing materials, dermal exposure may be eliminated. Therefore, the assumption of an 8-hour exposure duration for DBP may lead to overestimation of dermal exposure. Regarding surface area of occupational dermal exposure, EPA assumed a high-end value of 1,070 cm^2 for male workers and 890 cm^2 for female workers. These high-end occupational dermal exposure surface area values are based on the mean two-hand surface area for adults EPA's *Exposure Factors Handbook* (U.S. EPA, 2011a). For central tendency estimates, EPA assumed the exposure surface area was equivalent to only a single hand (or one side of two hands) and used half the mean values for two-hand surface areas (*i.e.*, 535 cm^2 for male workers and 445 cm^2 for female workers).

High-end and central tendency dermal exposures to liquid were determined using data from Doan et al. (2010). The study estimated a dermal absorption rate from experiments on female hairless guinea pigs using a formulation of 7 percent oil-in-water emulsion. Using the study's estimate for DBP absorption in skin, 56.3 percent of the 1 mg/cm^2 dose over 24 hours, EPA estimated the steady-state flux of DBP and the resultant dose based on exposure area. Although EPA determined that all data were of acceptable quality without notable deficiencies and integrated all the data into the final exposure assessment, it's uncertain how representative the use of a 7 percent oil-in-water emulsion formulation is for OESs where a higher concentration of DBP is used. There is also uncertainty in the use of guinea pigs over human skin, as guinea pig tissue is known to be more permeable than human tissue. Therefore, uncertainties about the difference between human and guinea pigs skin absorption increase uncertainty.

As discussed above, inhalation exposure estimates are based on data which are below the LOD. EPA estimated the high-end exposure as equal to the LOD and the central tendency as the midpoint (*i.e.*, half the LOD). Therefore, the inhalation exposure estimates are upper-bound estimates. Also, as discussed in the paragraph above, the dermal exposure estimates are upper-bound estimates. So, the central tendency values of exposure are expected to be most reflective of worker exposures within the COUs covered under the "Application of adhesives and sealants" OES (*i.e.*, Industrial Use COU: Construction, paint, electrical, and metal products [Adhesives and sealants] and Commercial Use COU: Construction, paint, electrical, and metal products [Adhesives and sealants]).

Application of Paints and Coatings

For the application of paints and coatings containing DBP, dermal and inhalation exposure routes are both expected to significantly contribute to exposures at both the central-tendency and high-end, with dermal exposures expected to be slightly dominant in its contribution. MOEs for high-end acute, intermediate, and chronic inhalation exposure ranged from 2.9 to 4.7 for average adult workers and females of reproductive age, while high-end dermal MOEs for the same populations and exposure scenarios ranged from 0.8 to 1.3 (benchmark = 30). The central tendency MOEs for the same populations and exposure scenarios ranged from 18 to 30 for inhalation exposure and 1.7 to 2.7 for dermal exposure. Aggregation of inhalation and dermal exposures led to lower MOEs compared to either individual route. The MOEs presented in this paragraph are with no use of PPE. Section 4.3.2.4 and Table 4-17 provides more information on PPE that could be used to reduce the MOEs above the benchmark MOE.

To estimate inhalation exposures, EPA relied on monitoring data from OSHA's Chemical Exposure Health Data database from two different inspections, one from 2011 of a fabric coating mill and one from a janitorial services company (OSHA, 2019). EPA additionally found 12 8-hour TWA monitoring samples during systematic review completed by Rohm and Haas Co. which examined worker exposure from painting interior rooms with roller and spray applicators (Rohm & Haas, 1990). With a total of 14 data points, EPA characterized the data by taking the 95th percentile and the 50th percentile of the combined dataset to represent the high end and central tendency. There is uncertainty about how well these data represent the true distribution of actual inhalation concentrations in this scenario at a specific facility. In absence of ONU exposure data, EPA used worker data as analogous data for ONU exposure.

For occupational dermal exposure assessment, EPA assumed a standard 8-hour workday and the chemical is contacted at least once per day. Because DBP has low volatility and relatively low absorption, it is possible that the chemical remains on the surface of the skin after dermal contact until the skin is washed. So, in absence of exposure duration data, EPA has assumed that absorption of DBP from occupational dermal contact with materials containing DBP may extend up to 8 hours per day (U.S. EPA, 1991). However, if a worker uses proper PPE, or washes their hands after contact with DBP or DBP-containing materials, dermal exposure may be eliminated. Therefore, the assumption of an 8-hour exposure duration for DBP may lead to overestimation of dermal exposure. Regarding surface area of occupational dermal exposure, EPA assumed a high-end value of 1,070 cm^2 for male workers and 890

cm^2 for female workers. These high-end occupational dermal exposure surface area values are based on the mean two-hand surface area for adults EPA's *Exposure Factors Handbook* (U.S. EPA, 2011a). For central tendency estimates, EPA assumed the exposure surface area was equivalent to only a single hand (or one side of two hands) and used half the mean values for two-hand surface areas (*i.e.,* 535 cm^2 for male workers and 445 cm^2 for female workers).

High-end and central tendency dermal exposures to liquid were determined using data from Doan et al. (2010). The study estimated a dermal absorption rate from experiments on female hairless guinea pigs using a formulation of 7 percent oil-in-water emulsion. Using the study's estimate for DBP absorption in skin, 56.3 percent of the 1 mg/cm^2 dose over 24 hours, EPA estimated the steady-state flux of DBP and the resultant dose based on exposure area. Although EPA determined that all data were of acceptable quality without notable deficiencies and integrated all the data into the final exposure assessment, it's uncertain how representative the use of a 7 percent oil-in-water emulsion formulation is for OESs where different formulations of DBP are used. There is also uncertainty in the use of guinea pigs over human skin, as guinea pig tissue is known to be more permeable than human tissue. Therefore, uncertainties about the difference between human and guinea pigs skin absorption increase uncertainty.

Due to limited inhalation data points, both the central and high-end exposure estimates are expected to be reflective of worker inhalation exposures for this OES. Also, since the dermal exposures are upper-bound estimates, it can be conservatively assumed that the central tendency values of exposure estimates are expected to be most reflective of worker dermal exposures. This applies to the COUs covered under the "Application of paints and coatings" OES (*i.e.*, Industrial Use COU: Construction, paint, electrical, and metal products [Paints and coatings], Commercial Use COU: Construction, paint, electrical, and metal products [Paints and coatings], and Commercial Use COU: Packaging, paper, plastic, toys, hobby products [Ink, toner, and colorant products]).

Industrial Process Solvent Use

For the use of DBP as an industrial process solvent, dermal exposure from liquid contact is expected to be the dominant route of exposure. MOEs for high-end acute, intermediate, and chronic inhalation exposure ranged from 15 to 25 for average adult workers and females of reproductive age, while high-end dermal MOEs for the same populations and exposure scenarios ranged from 0.8 to 1.3 (benchmark = 30). The central tendency MOEs for the same populations and exposure scenarios ranged from 30 to 49 for inhalation exposure and 1.7 to 2.7 for dermal exposure. Aggregation of inhalation and dermal exposures led to negligible differences in risk when compared to risk estimates from dermal exposure alone. The MOEs presented in this paragraph are with no use of PPE. Section 4.3.2.4 and Table 4-17 provides more information on PPE that could be used to reduce the MOEs above the benchmark MOE.

The high-end and central tendency worker inhalation exposure results for this OES are based on analogous data from three different risk evaluations; each presented a single data point to characterize full-shift exposure to workers during DBP manufacturing (ECB, 2008; ECJRC, 2004; SRC, 2001). To determine central tendency and high-end values, EPA used the mid-point and maximum value, respectively, due to limited data points. There is uncertainty about how well these data represent the true distribution of actual inhalation concentrations in this scenario at a specific facility; the lack of ONU exposure data, for which EPA used worker data as surrogate data; and that there are only three data points used for the inhalation assessment.

For occupational dermal exposure assessment, EPA assumed a standard 8-hour workday and the chemical is contacted at least once per day. Because DBP has low volatility and relatively low absorption, it is possible that the chemical remains on the surface of the skin after dermal contact until the skin is washed. So, in absence of exposure duration data, EPA has assumed that absorption of DBP from occupational dermal contact with materials containing DBP may extend up to 8 hours per day (U.S. EPA, 1991). However, if a worker uses proper PPE, or washes their hands after contact with DBP or DBP-containing materials, dermal exposure may be eliminated. Therefore, the assumption of an 8-hour exposure duration for DBP may lead to overestimation of dermal exposure. Regarding surface area of occupational dermal exposure, EPA assumed a high-end value of 1,070 cm^2 for male workers and 890 cm^2 for female workers. These high-end occupational dermal exposure surface area values are based on the mean two-hand surface area for adults EPA's *Exposure Factors Handbook* (U.S. EPA, 2011a). For central tendency estimates, EPA assumed the exposure surface area was equivalent to only a single hand (or one side of two hands) and used half the mean values for two-hand surface areas (*i.e.*, 535 cm^2 for male workers and 445 cm^2 for female workers).

High-end and central tendency dermal exposures to liquid were determined using data from Doan et al. (2010). The study estimated a dermal absorption rate from experiments on female hairless guinea pigs using a formulation of 7 percent oil-in-water emulsion. Using the study's estimate for DBP absorption in skin, 56.3 percent of the 1 mg/cm^2 dose over 24 hours, EPA estimated the steady-state flux of DBP, and the resultant dose based on exposure area. Although EPA determined that all data were of acceptable quality without notable deficiencies and integrated all the data into the final exposure assessment, it's uncertain how representative the use of a 7 percent oil-in-water emulsion formulation is for OESs where different formulations of DBP are used. There is also uncertainty in the use of guinea pigs over human skin, as guinea pig tissue is known to be more permeable than human tissue. Therefore, uncertainties about the difference between human and guinea pigs skin absorption increase uncertainty.

Due to limited inhalation data points, both the central and high-end exposure estimates are expected to be reflective of worker inhalation exposures for this OES. Also, since the dermal exposures are upper-bound estimates, it can be conservatively assumed that the central tendency values of exposure estimates are expected to be most reflective of worker dermal exposures. This applies to the COUs covered under the "Industrial process solvent use" OES (*i.e.*, Industrial Use (Non-incorporative activities [Solvent, including in maleic anhydride manufacturing technology]).

Use of Laboratory Chemicals (solid)

The use of laboratory chemicals was assessed for solid and liquid products containing DBP. For solid laboratory chemicals, inhalation exposure from dust generation is expected to be the dominant route of exposure for solid lab chemicals. MOEs for high-end acute, intermediate, and chronic inhalation exposure ranged from 28 to 45 for average adult workers and females of reproductive age, while high-end dermal MOEs ranged from 62 to 98 (benchmark = 30). For central tendency, MOEs for the same population and exposure scenarios ranged from 400 to 645 for inhalation exposure and 124 to 197 for dermal exposures. For solid laboratory chemicals exposure, the aggregation of inhalation and dermal exposures led to negligible differences in risk when compared to risk estimates from inhalation exposure alone. The MOEs presented in this paragraph are with no use of PPE. Section 4.3.2.4 and Table 4-17 provides more information on PPE that could be used to reduce the MOEs above the benchmark MOE.

EPA estimated worker inhalation exposures to dust from solid lab chemicals using the PNOR Model for dust exposures (U.S. EPA, 2021d). For inhalation exposure to PNOR, EPA determined the 50th and 95th percentiles of the surrogate dust monitoring data taken from facilities with NAICS codes starting with 54 (Professional, Scientific, and Technical Services). EPA determined the 50th and 95th percentiles of the surrogate dust monitoring data and multiplied these dust concentrations by the industry provided maximum potential DBP concentration in lab chemicals (*i.e.*, 20%) to estimate DBP particulate concentrations in the air. Therefore, the differences in the central tendency and high-end dust concentrations led to differences between the central tendency and high-end risk estimates.

Although the PNOR Model (*i.e.*, dust) concentration data provides a reliable range of dust concentrations that a worker may experience in the laboratory setting, the composition of workplace dust is uncertain. The exposure and risk estimates assume that the concentration of DBP in workplace dust is the same as the concentration of DBP in the laboratory chemical. However, it is likely that workplace dust contains a variety of constituents that do not contain any DBP in addition to particles from DBP-containing laboratory chemical. The constituents that do not contain DBP would dilute the overall concentration of DBP in the dust, and the concentration of DBP in workplace dust is likely less than the concentration of DBP in the laboratory chemical. Therefore, the estimated inhalation exposures to dust are likely overestimated.

For occupational dermal exposure assessment, EPA assumed a standard 8-hour workday and the chemical is contacted at least once per day. Because DBP has low volatility and relatively low absorption, it is possible that the chemical remains on the surface of the skin after dermal contact until the skin is washed. So, in absence of exposure duration data, EPA has assumed that absorption of DBP from occupational dermal contact with materials containing DBP may extend up to 8 hours per day (U.S. EPA, 1991). However, if a worker uses proper PPE, or washes their hands after contact with DBP or DBP-containing materials, dermal exposure may be eliminated. Therefore, the assumption of an 8-hour exposure duration for DBP may lead to overestimation of dermal exposure. Regarding surface area of occupational dermal exposure, EPA assumed a high-end value of 1,070 cm^2 for male workers and 890 cm^2 for female workers. These high-end occupational dermal exposure surface area values are based on the mean two-hand surface area for adults EPA's *Exposure Factors Handbook* (U.S. EPA, 2011a). For central tendency estimates, EPA assumed the exposure surface area was equivalent to only a single hand (or one side of two hands) and used half the mean values for two-hand surface areas (*i.e.*, 535 cm^2 for male workers and 445 cm^2 for female workers).

For estimating high-end and central tendency occupational dermal exposures to solids, EPA assumed that DBP will first migrate from the solid matrix to a thin layer of moisture on the skin surface. Therefore, absorption of DBP from solid matrices is considered limited by aqueous solubility and is estimated using an aqueous absorption model (U.S. EPA, 2023c, 2004b) as described in Appendix C in the *Draft Environmental Release and Occupational Exposure Assessment for Dibutyl Phthalate (DBP)* (U.S. EPA, 2025q). EPA assumes that absorption of the aqueous material serves as a reasonable upper bound for contact with solid materials and used this to estimate the average absorptive flux of DBP and the resultant dose based on worker exposure area.

The PNOR Model uses conservative assumptions leading to upper-bound inhalation exposure estimates. The dermal exposure estimates are also upper-bound estimates as discussed above. Therefore, the central tendency values of exposure are expected to be most reflective of worker exposures within the COUs covered under the "Use of laboratory chemicals" OES (*i.e.*, Commercial Use COU: Other uses: [Laboratory Chemicals]).

Use of Laboratory Chemicals (Liquid)

For the use of liquid laboratory chemicals, dermal exposures to liquids are expected to be the dominant route of exposure. MOEs for high-end acute, intermediate, and chronic inhalation exposure ranged from 152 to 245 for average adult workers and females of reproductive age, while high-end dermal MOEs for the same populations and exposure scenarios ranged from 0.8 to 1.3 (benchmark = 30). The central tendency MOEs for the same populations and exposure scenarios ranged from 304 to 491 for inhalation exposure and 2.2 to 3.6 for dermal exposure. Aggregation of inhalation and dermal exposures led to negligible differences in risk when compared to risk estimates from dermal exposure alone. The MOEs presented in this paragraph are with no use of PPE. Section 4.3.2.4 and Table 4-17 provides more information on PPE that could be used to reduce the MOEs above the benchmark MOE.

For liquid laboratory chemicals, no vapor inhalation exposure data was found from systematic review, and EPA used data from the adhesives and sealants OES as a surrogate data source due to the expected similarity in usage and concentrations. The adhesives and sealant data consists of 19 monitoring samples in a NIOSH HHE (NIOSH, 1977). Six of the samples were PBZ samples, and the remaining 13 samples were area samples taken at various locations around an acrylic furniture manufacturing site. With all samples at or below the LOD, EPA assessed inhalation exposures as a range from zero to the LOD. EPA estimated the high-end exposure as equal to the LOD and the central tendency as the midpoint (*i.e.*, half the LOD). There is uncertainty about how well these data represent the true distribution of actual inhalation concentrations in this scenario at a specific facility. In absence of ONU exposure data, EPA used worker data as analogous data for ONU exposure.

For occupational dermal exposure assessment, EPA assumed a standard 8-hour workday and the chemical is contacted at least once per day. Because DBP has low volatility and relatively low absorption, it is possible that the chemical remains on the surface of the skin after dermal contact until the skin is washed. So, in absence of exposure duration data, EPA has assumed that absorption of DBP from occupational dermal contact with materials containing DBP may extend up to 8 hours per day (U.S. EPA, 1991). However, if a worker uses proper PPE, or washes their hands after contact with DBP or DBP-containing materials, dermal exposure may be eliminated. Therefore, the assumption of an 8-hour exposure duration for DBP may lead to overestimation of dermal exposure. Regarding surface area of occupational dermal exposure, EPA assumed a high-end value of 1,070 cm^2 for male workers and 890 cm^2 for female workers. These high-end occupational dermal exposure surface area values are based on the mean two-hand surface area for adults EPA's *Exposure Factors Handbook* (U.S. EPA, 2011a). For central tendency estimates, EPA assumed the exposure surface area was equivalent to only a single hand (or one side of two hands) and used half the mean values for two-hand surface areas (*i.e.,* 535 cm^2 for male workers and 445 cm^2 for female workers).

High-end and central tendency dermal exposures to liquid were determined using data from Doan et al. (2010). The study estimated a dermal absorption rate from experiments on female hairless guinea pigs using a formulation of 7 percent oil-in-water emulsion. Using the study's estimate for DBP absorption in skin, 56.3 percent of the 1 mg/cm^2 dose over 24 hours, EPA estimated the steady-state flux of DBP and the resultant dose based on exposure area. Although EPA determined that all data were of acceptable quality without notable deficiencies and integrated all the data into the final exposure assessment, it's uncertain how representative the use of a 7 percent oil-in-water emulsion formulation is for OESs where a higher concentration of DBP is used. There is also uncertainty in the use of guinea pigs over human skin, as guinea pig tissue is known to be more permeable than human tissue. Therefore, uncertainties about the difference between human and guinea pigs skin absorption increase uncertainty.
As discussed above, inhalation exposure estimates is based on data which are below the LOD. EPA estimated the high-end exposure as equal to the LOD and the central tendency as the midpoint (*i.e.*, half the LOD). Therefore, the inhalation exposure estimates are upper-bound estimates. Also, as discussed in the paragraph above, the dermal exposure estimates are upper-bound estimates. So, the central tendency values of exposure are expected to be most reflective of worker exposures within the COUs covered under the "Use of laboratory chemicals" OES (*i.e.,* Commercial use COU: Other uses: [Laboratory Chemicals]).

Use of Lubricants and Functional Fluids

For the use of lubricants and functional fluids containing DBP, dermal exposure from liquid contact is expected to be the dominant route of exposure. MOEs for high-end acute, intermediate, and chronic inhalation exposure ranged from 152 to 15,330 for average adult workers and females of reproductive age, while high-end dermal MOEs for the same populations and exposure scenarios ranged from 1.0 to 99 (benchmark = 30). The central tendency MOEs for the same populations and exposure scenarios ranged from 304 to 61,320 for inhalation exposure and 3.0 to 594 for dermal exposure. Aggregation of inhalation and dermal exposures led to negligible differences in risk when compared to risk estimates from dermal exposure alone. The MOEs presented in this paragraph are with no use of PPE. Section 4.3.2.4 and Table 4-17 provides more information on PPE that could be used to reduce the MOEs above the benchmark MOE.

The high-end and central tendency worker inhalation exposure results for this OES are based on 19 analogous adhesive and sealant use monitoring samples in NIOSH's HHE database (NIOSH, 1977). Six of the samples were PBZ samples, and the remaining 13 samples were area samples taken at various locations around an acrylic furniture manufacturing site. The site uses 2-part adhesives where the part B component is 96.5 percent DBP. Two of the area samples recorded values at the limit of detection, and the remaining 17 samples were below the limit of detection. All samples were collected on AA cellulose membrane filters with 0.8µ average pore size and a pump flow rate of 1 LPM. The detection limit was 0.01 mg/m3 by gas chromatography. With all samples at or below the LOD, EPA assessed inhalation exposures as a range from 0 to the LOD. EPA estimated the high-end exposure as equal to the LOD and the central tendency as the midpoint (*i.e.*, half the LOD). There is uncertainty about how well these data represent the true distribution of inhalation concentrations in this scenario at a specific facility and in the lack of ONU exposure data, for which EPA used worker data as surrogate data.

For occupational dermal exposure assessment, EPA assumed a standard 8-hour workday and the chemical is contacted at least once per day. Because DBP has low volatility and relatively low absorption, it is possible that the chemical remains on the surface of the skin after dermal contact until the skin is washed. So, in absence of exposure duration data, EPA has assumed that absorption of DBP from occupational dermal contact with materials containing DBP may extend up to 8 hours per day (U.S. EPA, 1991). However, if a worker uses proper PPE, or washes their hands after contact with DBP or DBP-containing materials, dermal exposure may be eliminated. Therefore, the assumption of an 8-hour exposure duration for DBP may lead to overestimation of dermal exposure. Regarding surface area of occupational dermal exposure, EPA assumed a high-end value of 1,070 cm^2 for male workers and 890 cm^2 for female workers. These high-end occupational dermal exposure surface area values are based on the mean two-hand surface area for adults EPA's *Exposure Factors Handbook* (U.S. EPA, 2011a). For central tendency estimates, EPA assumed the exposure surface area was equivalent to only a single hand (or one side of two hands) and used half the mean values for two-hand surface areas (*i.e.*, 535 cm^2 for male workers and 445 cm^2 for female workers).

High-end and central tendency dermal exposures to liquid were determined using data from Doan et al. (2010). The study estimated a dermal absorption rate from experiments on female hairless guinea pigs using a formulation of 7 percent oil-in-water emulsion. Using the study's estimate for DBP absorption in skin, 56.3 percent of the 1 mg/cm^2 dose over 24 hours, EPA estimated the steady-state flux of DBP and the resultant dose based on exposure area. Although EPA determined that all data were of acceptable quality without notable deficiencies and integrated all the data into the final exposure assessment, it's uncertain how representative the use of a 7 percent oil-in-water emulsion formulation is for OESs where a higher concentration of DBP is used. There is also uncertainty in the use of guinea pigs over human skin, as guinea pig tissue is known to be more permeable than human tissue. Therefore, uncertainties about the difference between human and guinea pigs skin absorption increase uncertainty.

As discussed above, inhalation exposure estimates is based on data which are below the LOD. EPA estimated the high-end exposure as equal to the LOD and the central tendency as the midpoint (*i.e.*, half the LOD). Therefore, the inhalation exposure estimates are upper-bound estimates. Also, as discussed in the paragraph above, the dermal exposure estimates are upper-bound estimates. So, the central tendency values of exposure are expected to be most reflective of worker exposures within the COUs covered under the "Use of lubricants and functional fluids" OES (*i.e.*, Commercial Use COU: Other Uses: [Lubricants and lubricant additives]; Furnishing, cleaning, treatment care products: [Cleaning and furnishing care products]; Automotive, fuel, agriculture, outdoor use products [Automotive care products]; and the Industrial use COU: Other uses: [Lubricants and lubricant additives]).

Use of Penetrants and Inspection Fluids

For the use of penetrants and inspection fluids, dermal and inhalation exposure routes are both expected to significantly contribute to exposures at both the central-tendency and high-end ranges, with dermal exposures expected to be slightly dominant in its contribution. MOEs for high-end acute, intermediate, and chronic inhalation exposure ranged from 2.7 to 4.4 for average adult workers and females of reproductive age, while high-end dermal MOEs for the same populations and exposure scenarios ranged from 0.8 to 1.3 (benchmark = 30). The central tendency MOEs for the same populations and exposure scenarios ranged from 10 to 16 for inhalation exposure and 1.7 to 2.7 for dermal exposure. Aggregation of inhalation and dermal exposures led to lower MOEs compared to either individual route. The MOEs presented in this paragraph are with no use of PPE. Section 4.3.2.4 and Table 4-17 provides more information on PPE that could be used to reduce the MOEs above the benchmark MOE.

EPA based the central tendency and high-end exposure estimates on a near-field/far-field approach (AIHA, 2009) for aerosol modeling, and the product concentration was based on the range provided by the singular surrogate product which contained DINP (*i.e.*, 10–20%) rather than DBP. As a result, calculated central tendency and high-end risk values were similar. Reliance on a single surrogate product for this OES adds uncertainty to the representativeness of the modeled inhalation exposures. Further, although the surrogate product information indicates that the product is aerosol and brush applied, EPA assessed only aerosol application due to limited data for this OES. The aerosolization of DBP-containing fluids generates a mist of droplets in the near-field, resulting in inhalation and dermal exposure to workers, although dermal exposure is the primary contributor to the presented aggregate risk value. Aerosol application may overestimate inhalation exposures for brush application methods. Also, there is uncertainty related to the concentration of DBP in penetrant or inspection fluid products since the only available product data were for DINP. However, central tendency levels of exposure from the near-field/far-field exposure modeling are expected to represent the 50th percentile of worker exposures from the use of aerosols containing DBP. High-end levels of exposure are generally associated with higher product concentrations and use rates. Although most worker exposures to DBP through aerosol application of inspection fluids and penetrants are expected to be closer to the central tendency exposure values for this COU, a confluence of a subset of variables (*e.g.*, low ventilation, high concentration, high use rate) would result in risk below the benchmark. While most workers are not expected to experience these conditions, they may occur and expected for an acute 1-day exposure.

For occupational dermal exposure assessment, EPA assumed a standard 8-hour workday and the chemical is contacted at least once per day. Because DBP has low volatility and relatively low absorption, it is possible that the chemical remains on the surface of the skin after dermal contact until the skin is washed. So, in absence of exposure duration data, EPA has assumed that absorption of DBP from occupational dermal contact with materials containing DBP may extend up to 8 hours per day (U.S. EPA, 1991). However, if a worker uses proper PPE, or washes their hands after contact with DBP or DBP-containing materials, dermal exposure may be eliminated. Therefore, the assumption of an 8-hour exposure duration for DBP may lead to overestimation of dermal exposure. Regarding surface area of occupational dermal exposure, EPA assumed a high-end value of 1,070 cm^2 for male workers and 890 cm^2 for female workers. These high-end occupational dermal exposure surface area values are based on the mean two-hand surface area for adults EPA's *Exposure Factors Handbook* (U.S. EPA, 2011a). For central tendency estimates, EPA assumed the exposure surface area was equivalent to only a single hand (or one side of two hands) and used half the mean values for two-hand surface areas (*i.e.*, 535 cm^2 for male workers and 445 cm^2 for female workers).

High-end and central tendency dermal exposures to liquid were determined using data from Doan et al. (2010). The study estimated a dermal absorption rate from experiments on female hairless guinea pigs using a formulation of 7 percent oil-in-water emulsion. Using the study's estimate for DBP absorption in skin, 56.3 percent of the 1 mg/cm^2 dose over 24 hours, EPA estimated the steady-state flux of DBP and the resultant dose based on exposure area. Although EPA determined that all data were of acceptable quality without notable deficiencies and integrated all the data into the final exposure assessment, it's uncertain how representative the use of a 7 percent oil-in-water emulsion formulation is for OESs where a higher concentration of DBP is used. There is also uncertainty in the use of guinea pigs over human skin, as guinea pig tissue is known to be more permeable than human tissue. Therefore, uncertainties about the difference between human and guinea pigs skin absorption increase uncertainty.

The central tendency values of exposure estimates are expected to be most reflective of worker inhalation exposures to reasonably expected conditions and the high-end values of exposure estimates are expected to be most reflective of workers exposed to potentially elevated (*e.g.*, due to low ventilation, high concentration, high use rate) inhalation exposures. Also, since the dermal exposure estimates are upper-bound estimates, the central tendency values of exposure estimates are expected to be most reflective of worker exposures for dermal exposures. These exposures are experienced by workers within the COUs covered under the "Use of penetrants and inspection fluids" OES (*i.e.*, Commercial Use COU: Other uses: [Inspection penetrant kit]).

Fabrication or Use of Final Product or Articles

For fabrication or use of final product or articles, inhalation exposure was assessed from both vapors generated from materials that contain DBP and activities such as cutting, grinding, or drilling that may generate dust. For this OES, dermal and inhalation exposure routes are both expected to equally contribute to exposures at the central tendency prediction range, but inhalation exposures are expected to be dominant at the high-end range. MOEs for high-end acute, intermediate, and chronic inhalation exposure ranged from 18 to 29 for average adult workers and females of reproductive age, while high-end dermal MOEs for the same populations and exposure scenarios ranged from 62 to 98 (benchmark = 30). For central tendency, MOEs for the same population and exposure scenarios ranged from 152 to 245 for inhalation exposure and 124 to 197 for dermal exposures. Aggregation of inhalation and dermal exposures led to lower MOEs compared to either individual route. The MOEs presented in this paragraph are with no use of PPE. Section 4.3.2.4 and Table 4-17 provides more information on PPE that could be used to reduce the MOEs above the benchmark MOE.

EPA estimated worker inhalation exposures to vapor from one sample that was taken at a facility that melted, shaped, and joined plastics, and two inhalation exposure data points from the machine and manual welding of plastic roofing materials (ECJRC, 2004; Rudel et al., 2001). With the three discrete data points, EPA could not create a full distribution of monitoring results to estimate central tendency and high-end exposures. To assess the high-end worker exposure to DBP during the fabrication process, EPA used the maximum available value (0.03 mg/m^3) and used the median of the three available values as the central tendency (0.01 mg/m^3). EPA estimated worker inhalation exposures to solid particulate using the PNOR Model for dust exposures (U.S. EPA, 2021d). For inhalation exposure to PNOR, EPA determined the 50th and 95th percentiles of the surrogate dust monitoring data taken from facilities with NAICS codes starting with 337 (Furniture and Related Product Manufacturing). EPA multiplied these dust concentrations by the maximum DBP concentration in PVC (*i.e.*, 45%) to estimate DBP particulate concentrations in the air. Therefore, the differences in the central tendency and high-end dust concentrations led to significant differences between the central tendency and high-end risk estimates.

There is uncertainty about how well the surrogate vapor monitoring data represent the true distribution of vapor inhalation concentrations for actual worker exposures in a specific facility the lack of ONU exposure data, for which EPA used worker data as surrogate data, and that there are only three data points used for the inhalation assessment. Also, although the PNOR Model (*i.e.*, dust) concentration data provides a reliable range of dust concentrations that a worker may experience in the fabrication industry, the composition of workplace dust is uncertain. The exposure and risk estimates assume that the concentration of DBP in workplace dust is the same as the concentration of DBP in the material. However, it is likely that workplace dust contains a variety of constituents that do not contain any DBP in addition to particles from DBP-containing materials. The constituents that do not contain DBP would dilute the overall concentration of DBP in the dust, and the concentration of DBP in workplace dust is likely less than the concentration of DBP in the material. Therefore, the estimated inhalation exposures to dust are likely overestimated.

For occupational dermal exposure assessment, EPA assumed a standard 8-hour workday and the chemical is contacted at least once per day. Because DBP has low volatility and relatively low absorption, it is possible that the chemical remains on the surface of the skin after dermal contact until the skin is washed. So, in absence of exposure duration data, EPA has assumed that absorption of DBP from occupational dermal contact with materials containing DBP may extend up to 8 hours per day (U.S. EPA, 1991). However, if a worker uses proper PPE, or washes their hands after contact with DBP or DBP-containing materials, dermal exposure may be eliminated. Therefore, the assumption of an 8-hour exposure duration for DBP may lead to overestimation of dermal exposure. Regarding surface area of occupational dermal exposure, EPA assumed a high-end value of 1,070 cm^2 for male workers and 890 cm^2 for female workers. These high-end occupational dermal exposure surface area values are based on the mean two-hand surface area for adults EPA's *Exposure Factors Handbook* (U.S. EPA, 2011a). For central tendency estimates, EPA assumed the exposure surface area was equivalent to only a single hand (or one side of two hands) and used half the mean values for two-hand surface areas (*i.e.,* 535 cm^2 for male workers and 445 cm^2 for female workers).

For estimating high-end and central tendency occupational dermal exposures to solids, EPA assumed that DBP will first migrate from the solid matrix to a thin layer of moisture on the skin surface. Therefore, absorption of DBP from solid matrices is considered limited by aqueous solubility and is estimated using an aqueous absorption model (U.S. EPA, 2023c, 2004b) as described in Appendix C in the *Draft Environmental Release and Occupational Exposure Assessment for Dibutyl Phthalate (DBP)* (U.S. EPA, 2025q). EPA assumes that absorption of the aqueous material serves as a reasonable upper bound for contact with solid materials and used this to estimate the average absorptive flux of DBP and the resultant dose based on worker exposure area.

The PNOR Model uses conservative assumptions leading to upper-bound inhalation exposure estimates. The dermal exposure estimates are also upper-bound estimates as discussed above. Therefore, the central tendency values of exposure are expected to be most reflective of worker exposures within the COUs covered under the "Fabrication or final use of products or articles" OES (*i.e.*, Industrial Use COU: Other uses: [Automotive articles; Propellants]; and Commercial Use COU: Furnishing, cleaning, treatment care products: [Floor coverings; construction and building materials covering large surface areas including stone, plaster, cement, glass and ceramic articles; fabrics, textiles, and apparel; Furniture and furnishings]; Packaging, paper, plastic, toys, hobby products: [Packaging (excluding food packaging), including rubber articles; plastic articles (hard); plastic articles (soft); other articles with routine direct contact during normal use, including rubber articles; plastic articles (hard), Toys, playground, and sporting equipment]; Other uses: [Automotive articles, Chemiluminescent light sticks].

Recycling and Waste Handling, Treatment and Disposal

The approaches for the recycling OES and the waste handling, treatment and disposal OES are identical and therefore consolidated here. For both OESs, the inhalation exposure from dust generation is expected to be the dominant route of exposure. MOEs for high-end acute, intermediate, and chronic inhalation exposure ranged from 9.7 to 16 for average adult workers and females of reproductive age, while high-end dermal MOEs for the same populations and exposure scenarios ranged from 62 to 98 (benchmark = 30) for both OESs. The central tendency MOEs for the same populations and exposure scenarios ranged from 141 to 227 for inhalation exposure and 124 to 197 for dermal exposure for both OESs. Aggregation of inhalation and dermal exposures led to slight differences in risk when compared to risk estimates from inhalation exposure alone. The MOEs presented in this paragraph are with no use of PPE. Section 4.3.2.4 and Table 4-17 provides more information on PPE that could be used to reduce the MOEs above the benchmark MOE.

EPA estimated worker inhalation exposures using the PNOR Model for dust exposures (U.S. EPA, 2021d). For inhalation exposure to PNOR, EPA determined the 50th and 95th percentiles of the surrogate dust monitoring data taken from facilities with NAICS codes starting with 56 (Administrative and Support and Waste Management and Remediation Services). EPA multiplied these dust concentrations by the industry provided maximum DBP concentration in PVC (*i.e.*, 45%) to estimate DBP particulate concentrations in the air. PVC concentration was used for this estimate because it is expected to be the predominant type of waste containing DBP that is recycled or disposed of. Therefore, the differences in the central tendency and high-end dust concentrations led to significant differences between the central tendency and high-end risk estimates.

Though the PNOR Model (*i.e.*, dust) concentration data provides a reliable range of dust concentrations that a worker may experience in the recycling and disposal industry, the composition of workplace dust is uncertain. The exposure and risk estimates assume that the concentration of DBP in workplace dust is the same as the concentration of DBP in PVC Plastics. However, it is likely that workplace dust contains a variety of constituents that do not contain any DBP in addition to particles from DBP-containing PVC plastics materials. The constituents that do not contain DBP would dilute the overall concentration of DBP in the dust, and the concentration of DBP in workplace dust is likely less than the concentration of DBP in the PVC plastics material. Therefore, the estimated inhalation exposures to dust are likely overestimated.

For occupational dermal exposure assessment, EPA assumed a standard 8-hour workday and the chemical is contacted at least once per day. Because DBP has low volatility and relatively low absorption, it is possible that the chemical remains on the surface of the skin after dermal contact until the skin is washed. So, in absence of exposure duration data, EPA has assumed that absorption of DBP from occupational dermal contact with materials containing DBP may extend up to 8 hours per day (U.S. EPA, 1991). However, if a worker uses proper PPE, or washes their hands after contact with DBP or DBP-containing materials, dermal exposure may be eliminated. Therefore, the assumption of an 8-hour exposure duration for DBP may lead to overestimation of dermal exposure. Regarding surface area of occupational dermal exposure, EPA assumed a high-end value of 1,070 cm^2 for male workers and 890 cm^2 for female workers. These high-end occupational dermal exposure surface area values are based on the mean two-hand surface area for adults EPA's *Exposure Factors Handbook* (U.S. EPA, 2011a). For central tendency estimates, EPA assumed the exposure surface area was equivalent to only a single hand (or one side of two hands) and used half the mean values for two-hand surface areas (*i.e.*, 535 cm^2 for male workers and 445 cm^2 for female workers).

For estimating high-end and central tendency occupational dermal exposures to solids, EPA assumed that DBP will first migrate from the solid matrix to a thin layer of moisture on the skin surface. Therefore, absorption of DBP from solid matrices is considered limited by aqueous solubility and is estimated using an aqueous absorption model (U.S. EPA, 2023c, 2004b) as described in Appendix C in the *Draft Environmental Release and Occupational Exposure Assessment for Dibutyl Phthalate (DBP)* (U.S. EPA, 2025q). EPA assumes that absorption of the aqueous material serves as a reasonable upper bound for contact with solid materials and used this to estimate the average absorptive flux of DBP and the resultant dose based on worker exposure area.

The PNOR Model uses conservative assumptions leading to upper-bound inhalation exposure estimates. The dermal exposure estimates are also upper-bound estimates as discussed above. Therefore, the central tendency values of exposure are expected to be most reflective of worker exposures within the COUs covered under the COUs covered under the "Recycling" and the "Disposal" OESs (*i.e.*, Processing COU: "Recycling" and Disposal COU: "Disposal").

Distribution in Commerce

For purposes of assessment in this draft risk evaluation, distribution in commerce consists of the transportation associated with the moving of DBP or DBP-containing products and/or articles between sites manufacturing, processing, and use COUs, or the transportation of DBP containing wastes to recycling sites or for final disposal. EPA expects all the DBP or DBP-containing products and/or articles to be transported in closed system or otherwise to be transported in a form (*e.g.*, articles containing DBP) such that there is negligible potential for releases except during an incident. Therefore, no occupational exposures are reasonably expected to occur, and no separate assessment was performed for estimating releases and exposures from distribution in commerce.

4.3.2.1 Overall Confidence in Worker Risk Estimates for Individual DBP OES

As described in Section 4.1.1.5 and the *Draft Environmental Release and Occupational Exposure Assessment for Dibutyl Phthalate* (U.S. EPA, 2025q), EPA has moderate to robust confidence in the assessed inhalation exposures, and robust confidence in the non-cancer POD selected to characterize risk from acute, intermediate, and chronic duration exposures to DBP (see Section 4.2). EPA also has moderate to robust confidence that the dermal exposures estimated are upper bound of potential exposures to workers. Overall, EPA has moderate to robust confidence in the risk estimates calculated for worker and ONU inhalation and dermal exposure scenarios. Sources of uncertainty associated with these occupational COUs are discussed above in Section 4.3.2.

4.3.2.2 Effect of Duration of Exposure on Dermal Risk Estimates

Because the dermal flux rate of DBP absorption is insufficient to deplete the loading dose applied to the hands during an 8-hour work shift, and because DBP has low volatility and is not expected to evaporate from the hands, it is possible that the chemical remains on the surface of the skin after dermal contact until the skin is washed. So, in absence of exposure duration data, EPA has assumed that absorption of

DBP from occupational dermal contact with materials containing DBP may extend up to 8 hours per day (U.S. EPA, 1991). However, if a worker uses proper PPE, or washes their hands after contact with DBP or DBP-containing materials, dermal exposure may be eliminated. Therefore, the assumption of an 8-hour exposure duration for DBP may lead to overestimation of dermal exposure. For example, for the Manufacturing OES, if the average adult worker's hand is in contact with DBP for over 25 minutes and female of reproductive age worker's hand is in contact with DBP for over 30 minutes the central tendency MOEs are below the benchmark MOE of 30.

4.3.2.3 Consideration of Personal Protective Equipment (PPE)

Occupational Safety and Health Adminstration (OSHA) and National Institute for Occupational Safety and Health (NIOSH) recommend employers utilize the hierarchy of controls[4] to address hazardous exposures in the workplace. The hierarchy of controls strategy outlines, in descending order of priority, the use of elimination, substitution, engineering controls, administrative controls, and lastly PPE. The hierarchy of controls prioritizes the most effective measures, which eliminate or substitute the harmful chemical (*e.g.*, use a different process, substitute with a less hazardous material), thereby preventing or reducing exposure potential. Following elimination and substitution, the hierarchy recommends engineering controls to isolate employees from the hazard, followed by administrative controls or changes in work practices to reduce exposure potential (*e.g.*, source enclosure, local exhaust ventilation systems). Administrative controls are policies and procedures instituted and overseen by the employer to protect worker exposures. OSHA and NIOSH recommend the use of PPE (*e.g.*, respirators, gloves) as the last means of control, when the other control measures cannot reduce workplace exposure to an acceptable level.

4.3.2.3.1 Respiratory Protection

OSHA's Respiratory Protection Standard (29 CFR 1910.134) requires employers in certain industries to address workplace hazards by implementing engineering control measures and, if these are not feasible, providing respirators that are applicable and suitable for the purpose intended. Respirator selection provisions are provided in section 1910.134(d) and require that appropriate respirators be selected based on the respiratory hazard(s) to which the worker will be exposed, in addition to workplace and user factors that affect respirator performance and reliability. Assigned protection factors (APFs) are provided in Table 1 under section 1910.134(d)(3)(i)(A) (see below in Table 4-15) and refer to the level of respiratory protection that a respirator or class of respirators is expected to provide to employees when the employer implements a respiratory protection program according to the requirements of OSHA's Respiratory Protection Standard.

Workers are required to use respirators that meet or exceed the required level of protection listed in Table 4-15. Based on the APF, inhalation exposures may be reduced by a factor of 5 to 10,000, if respirators are properly worn and fitted.

[4] https://www.osha.gov/sites/default/files/Hierarchy_of_Controls_02.01.23_form_508_2.pdf

Table 4-15. Assigned Protection Factors for Respirators in OSHA Standard 29 CFR 1910.134

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

4.3.2.3.2 Glove Protection

Gloves are selected in industrial settings based on characteristics (permeability, durability, required task etc). Data on the frequency of glove use (*i.e.*, the proper use of effective gloves) in industrial settings is very limited. An initial literature review suggests that there is unlikely to be sufficient data to justify a specific probability distribution for effective glove use for handling of DBP specifically, for a given industry. Instead, EPA explored the impact of effective glove use by considering different percentages of effectiveness (*e.g.*, 25% vs. 50% effectiveness).

Gloves only offer barrier protection until the chemical breaks through the glove material. Using a conceptual model, Cherrie et al. (2004) proposed a glove workplace protection factor, defined as the ratio of estimated uptake through the hands without gloves to the estimated uptake though the hands while wearing gloves. This protection factor is driven by flux, and thus the protection factor varies with time. The ECETOC TRA model v.3.2 represents the glove protection factor as a fixed, assigned value equal to 5, 10, or 20 (Marquart et al., 2017). Like the APR for respiratory protection, the inverse of the protection factor is the fraction of the chemical that penetrates the glove. Table 4-16 presents APFs for different dermal protection characteristics.

Table 4-16. Assigned Protection Factors for Different Dermal Protection Strategies

Dermal Protection Characteristics	Setting	Protection Factor, PF
a. No gloves used, or any glove/gauntlet without permeation data and without employee training	Industrial and Commercial Uses	1
b. Gloves with available permeation data indicating that the material of construction offers good protection for the substance		5
c. Chemically resistant gloves (*i.e.*, as *b* above) with "basic" employee training		10
d. Chemically resistant gloves in combination with specific activity training (*e.g.*, procedure for glove removal and disposal) for tasks where dermal exposure can be expected to occur	Industrial Uses Only	20
Source: (Marquart et al., 2017)		

4.3.2.4 Occupational Risk Estimates and Effect of PPE

Table 4-17 below presents the acute duration risk estimates for female workers of reproductive age and the corresponding PPE that would result in a worker MOE above the benchmark MOE. For occupational risk estimates, Female workers of reproductive age are the most sensitive exposed population with the lowest worker MOEs. Furthermore, the acute exposure duration results in the lowest worker MOEs for this population. This means that PPE that raises the MOE above the benchmark for a female worker of reproductive age in the acute exposure duration will also raise the MOE above the benchmark for all other workers and exposure durations. Risk estimates for other populations, durations, and health effects for all the COUs/OES are included in the *Draft Risk Calculator for Occupational Exposures for Dibutyl Phthalate (DBP) (*U.S. EPA, 2025t*)*. Additionally, the risk calculator contains MOE calculations and PPE information for all the OES.

Table 4-17 includes three main sections according to the route of exposure: inhalation, dermal, and aggregate exposure. For inhalation, typical respirator applied protection factor (APF) values of 10, 25, 50, 1000 and 10,000 were compared to the calculated MOE and the benchmark MOE to determine the level of APF that could be used to bring MOEs above the benchmark MOE. For dermal exposures, typical dermal Protection Factor (PF) values of 5, 10, and 20 were compared to the calculated MOE and the benchmark MOE to determine the level of PF that could be used to bring MOEs above the benchmark MOE. For aggregate exposures, the APF and/or PF that could be used to bring MOEs above the benchmark are also shown. In cases, when it is not possible to raise MOE to above the benchmark with the use of respiratory and/or dermal protection, PPE with maximum APF/PF and the corresponding MOE values are shown in the table. The appropriateness of any protection factor that demonstrates exposures resulting in a worker MOE above the benchmark MOE may require additional consideration. The presented protection factors simply represent a value by which corresponding PPE may theoretically increase the estimated worker MOE above the benchmark MOE. The practicality and feasibility of implementing any PPE corresponding to a protection factor is part of a larger evaluation of effective occupational control strategies. Such an evaluation should take into consideration the hierarchy of hazard control options. The hierarchy of controls from most to least effective are elimination, substitution, engineering controls, administrative controls, and personal protective equipment.

For inhalation, based on the risk characterization in Section 4.3.2, either the central tendency or both the central tendency and high-end exposure estimates may be reflective of worker inhalation exposures depending on the OES. Table 4-17 shows that using PPE for inhalation scenarios when the MOEs are below the benchmark MOE, reduces the exposures to above the benchmark MOE. For dermal, based on the risk characterization in Section 4.3.2, the central tendency exposure estimates are expected to be most reflective of worker dermal exposures for all OESs because the dermal exposure estimates are upper-bounds. Table 4-17Table shows when dermal protection is used, the central tendency MOEs for all OESs are increased to above the benchmark for dermal exposures.

Table 4-17. Occupational Risk Estimation for Acute Exposure for Female of Reproductive Age (Benchmark MOE = 30)

Occupational Scenario	Expos. Level	Inhalation			Dermal			Aggregate	
		Worker MOE No PPE	**Worker MOE with PPE[c]**	**APF[b,c]**	**Worker MOE No PPE**	**Worker MOE with PPE[c]**	**PF[b,c]**	**Worker MOE No PPE**	**Worker MOE with PPE[b,c]**
Manufacturing	CT	30	At benchmark	N/A	**1.8**	36	PF 20	**1.7**	33 (APF 10, PF 20)
	HE	**15**	152	APF 10	**0.9**	**18**	PF 20	**0.9**	**18** (APF 50, PF 20)
Import and repackaging	CT	30	At benchmark	N/A	**1.8**	36	PF 20	**1.7**	33 (APF 10, PF 20)
	HE	**15**	152	APF 10	**0.9**	**18**	PF 20	**0.9**	**18** (APF 50, PF 20)
Incorporation into formulations, mixtures, or reaction product	CT	30	At benchmark	N/A	**1.8**	36	PF 20	**1.7**	33 (APF 10, PF 20)
	HE	**15**	152	APF 10	**0.9**	**18**	PF 20	**0.9**	**18** (APF 50, PF 20)
PVC plastics compounding	CT	44	Above benchmark	N/A	**1.8**	36	PF 20	**1.7**	33 (APF 10, PF 20)
	HE	**5.3**	53	APF 10	**0.9**	**18**	PF 20	**0.8**	**18** (APF 1,000, PF 20)
PVC plastics converting	CT	44	Above benchmark	N/A	135	Above benchmark	N/A	33	Above benchmark
	HE	**5.3**	53	APF 10	67	Above benchmark	N/A	**4.9**	45 (APF 25)
Non-PVC materials manufacturing	CT	53	Above benchmark	N/A	**1.8**	36	PF 20	**1.7**	34 (APF 10, PF 20)
	HE	**9.0**	90	APF 10	**0.9**	**18**	PF 20	**0.8**	**18** (APF 1,000, PF 20)
Application of adhesives and sealants	CT	304	Above benchmark	N/A	**1.8**	36	PF 20	**1.8**	33 (PF 20)
	HE	152	Above benchmark	N/A	**0.9**	**18**	PF 20	**0.9**	**18** (APF 10, PF 20)
Application of paints and coatings	CT	**18**	184	APF 10	**1.8**	36	PF 20	**1.7**	30 (APF 10, PF 20)
	HE	**2.9**	73	APF 25	**0.9**	**18**	PF 20	**0.7**	**18** (APF 1,000, PF 20)
Industrial process solvent use	CT	30	At benchmark	N/A	**1.8**	36	PF 20	**1.7**	33 (APF 10, PF 20)
	HE	**15**	152	APF 10	**0.9**	**18**	PF 20	**0.9**	**18** (APF 50, PF 20)

Occupational Scenario	Expos. Level	Inhalation			Dermal			Aggregate	
		Worker MOE No PPE	Worker MOE with PPE[c]	APF[b c]	Worker MOE No PPE	Worker MOE with PPE[c]	PF[b c]	Worker MOE No PPE	Worker MOE with PPE[b c]
Use of laboratory chemicals (solid)	CT	400	Above benchmark	N/A	135	Above benchmark	N/A	101	Above benchmark
	HE	**28**	282	APF 10	67	Above benchmark	N/A	**20**	54 (APF 10)
Use of laboratory chemicals (liquid)	CT	304	Above benchmark	N/A	**2.4**	49	PF 20	**2.4**	42 (PF 20)
	HE	152	Above benchmark	N/A	**0.9**	**18**	PF 20	**0.9**	**18** (APF 10, PF 20)
Use of lubricants and functional fluids	CT	304	Above benchmark	N/A	**3.3**	33	PF 10	**3.2**	54 (PF 20)
	HE	152	Above benchmark	N/A	**1.1**	**22**	PF 20	**1.1**	**22** (APF 25, PF 20)
Use of penetrants and inspection fluids	CT	**10**	101	APF 10	**1.8**	36	PF 20	**1.5**	32 (APF 25, PF 20)
	HE	**2.7**	68	APF 25	**0.9**	**18**	PF 20	**0.7**	**18** (APF 1,000, PF 20)
Fabrication or use of final product or articles	CT	152	Above benchmark	N/A	135	Above benchmark	N/A	71	Above benchmark
	HE	**18**	181	APF 10	67	Above benchmark	N/A	**14**	49 (APF 10)
Recycling	CT	141	Above benchmark	N/A	135	Above benchmark	N/A	69	Above benchmark
	HE	**9.7**	97	APF 10	67	Above benchmark	N/A	**8.4**	40 (APF 10)
Waste handling, treatment, and disposal	CT	141	Above benchmark	N/A	135	Above benchmark	N/A	69	Above benchmark
	HE	**9.7**	97	APF 10	67	Above benchmark	N/A	**8.4**	40 (APF 10)

[a] Benchmark MOE = 30. **Bold text** in a gray shaded cell indicates an MOE is below the benchmark value of 30.

[b] CT = central tendency; HE = high-end; PPE = personal protective equipment, MOE = margin of exposure, PF = protection factor, APF = assigned protection factor

[c] PPE with the least amount of APF/PF that could be used to reduce MOE values above the benchmark MOE are shown in the table with corresponding MOE values. In cases, when it is not possible to raise MOE to above the benchmark with PPE, PPE with maximum APF/PF and the corresponding MOE values are shown in the table.

[d] The *Draft Risk Calculator for Occupational Exposures for Dibutyl Phthalate (DBP)* (U.S. EPA, 2025t) contains MOE calculations and PPE information for all the OES for all durations (acute, intermediate, and chronic).

3668 **Table 4-18. Occupational Risk Table for DBP**

COU		OES	Worker Population	Exposure Level	Inhalation Risk Estimates (Benchmark MOE = 30)			Dermal Risk Estimates (Benchmark MOE = 30)			Aggregate Risk Estimates (Benchmark MOE = 30)		
Life Cycle Stage – Category	**Subcategory**				**Acute**	**Inter.**	**Chronic**	**Acute**	**Inter.**	**Chronic**	**Acute**	**Inter.**	**Chronic**
Manufacturing – Domestic manufacturing	Domestic manufacturing	Manufacturing	Average Adult Worker	CT	34	46	49	**1.7**	**2.3**	**2.4**	**1.6**	**2.2**	**2.3**
				HE	**17**	**23**	**25**	**0.8**	**1.1**	**1.2**	**0.8**	**1.1**	**1.2**
			Female of Reproductive Age	CT	30	41	44	**1.8**	**2.5**	**2.7**	**1.7**	**2.3**	**2.5**
				HE	**15**	**21**	**22**	**0.9**	**1.2**	**1.3**	**0.9**	**1.2**	**1.3**
			ONU	CT	34	46	49	N/A	N/A	N/A	34	46	49
Manufacturing – Importing	Importing	Import and repackaging	Average Adult Worker	CT	34	46	49	**1.7**	**2.3**	**2.4**	**1.6**	**2.2**	**2.3**
				HE	**17**	**23**	**25**	**0.8**	**1.1**	**1.2**	**0.8**	**1.1**	**1.2**
Processing – Repackaging	Laboratory chemicals in wholesale and retail trade; plasticizers in wholesale and retail trade; and plastics material and resin manufacturing		Female of Reproductive Age	CT	30	41	44	**1.8**	**2.5**	**2.7**	**1.7**	**2.3**	**2.5**
				HE	**15**	**21**	**22**	**0.9**	**1.2**	**1.3**	**0.9**	**1.2**	**1.3**
			ONU	CT	34	46	49	N/A	N/A	N/A	34	46	49
Processing – Processing as a reactant	Intermediate in plastic manufacturing	Incorporation into formulations, mixtures, or reaction product	Average Adult Worker	CT	34	46	49	**1.7**	**2.3**	**2.4**	**1.6**	**2.2**	**2.3**
Processing – Incorporation into formulation, mixture, or reaction product	Solvents (which become part of product formulation or mixture) in chemical product and preparation manufacturing; soap, cleaning compound, and toilet preparation manufacturing; adhesive manufacturing; and printing ink manufacturing			HE	**17**	**23**	**25**	**0.8**	**1.1**	**1.2**	**0.8**	**1.1**	**1.2**
	Plasticizer in paint and coating manufacturing; soap, cleaning compound, and toilet preparation manufacturing; textiles, apparel, and leather manufacturing; printing ink manufacturing; basic organic chemical manufacturing; and adhesive and sealant manufacturing												
	Pre-catalyst manufacturing		Female of Reproductive Age	CT	30	41	44	**1.8**	**2.5**	**2.7**	**1.7**	**2.3**	**2.5**
				HE	**15**	**21**	**22**	**0.9**	**1.2**	**1.3**	**0.9**	**1.2**	**1.3**
			ONU	CT	34	46	49	N/A	N/A	N/A	34	46	49

COU		OES	Worker Population	Exposure Level	Inhalation Risk Estimates (Benchmark MOE = 30)			Dermal Risk Estimates (Benchmark MOE = 30)			Aggregate Risk Estimates (Benchmark MOE = 30)		
Life Cycle Stage – Category	**Subcategory**				**Acute**	**Inter.**	**Chronic**	**Acute**	**Inter.**	**Chronic**	**Acute**	**Inter.**	**Chronic**
Processing – Processing: incorporation into formulation, mixture, or reaction product	Plasticizer in plastic material and resin manufacturing	PVC plastics compounding	Average Adult Worker	CT	49	67	71	**1.7**	**2.3**	**2.4**	**1.6**	**2.2**	**2.3**
				HE	**5.9**	**8.0**	**8.6**	**0.8**	**1.1**	**1.2**	**0.7**	**1.0**	**1.1**
			Female of Reproductive Age	CT	44	60	65	**1.8**	**2.4**	**2.6**	**1.7**	**2.4**	**2.5**
				HE	**5.3**	**7.2**	**7.8**	**0.9**	**1.2**	**1.3**	**0.8**	**1.0**	**1.1**
			ONU	CT	49	67	71	124	169	181	35	48	51
Processing – Processing: incorporation into articles	Plasticizer in adhesive and sealant manufacturing; building and construction materials manufacturing; furniture and related product manufacturing; ceramic powders; plastics product manufacturing	PVC plastics converting	Average Adult Worker	CT	49	67	71	124	169	181	35	48	51
				HE	**5.9**	**8.0**	**8.6**	62	85	90	**5.4**	**7.3**	**7.8**
			Female of Reproductive Age	CT	44	60	65	135	184	197	33	45	49
				HE	**5.3**	**7.2**	**7.8**	67	92	98	**4.9**	**6.7**	**7.2**
			ONU	CT	49	67	71	124	169	181	35	48	51
Processing – Processing: incorporation into formulation, mixture, or reaction product	Plasticizer in plastic material and resin manufacturing; rubber manufacturing	Non-PVC materials manufacturing	Average Adult Worker	CT	59	80	86	**1.7**	**2.3**	**2.4**	**1.6**	**2.2**	**2.3**
				HE	**9.9**	**14**	**15**	**0.8**	**1.1**	**1.2**	**0.8**	**1.0**	**1.1**
			Female of Reproductive Age	CT	53	73	78	**1.8**	**2.4**	**2.6**	**1.7**	**2.4**	**2.5**
Processing – Incorporation into articles	Plasticizer in adhesive and sealant manufacturing; building and construction materials manufacturing; furniture and related product manufacturing; ceramic powders; plastics product manufacturing; and rubber product manufacturing			HE	**9.0**	**12**	**13**	**0.9**	**1.2**	**1.3**	**0.8**	**1.1**	**1.2**
			ONU	CT	59	80	86	124	169	181	40	54	58

COU		OES	Worker Population	Exposure Level	Inhalation Risk Estimates (Benchmark MOE = 30)			Dermal Risk Estimates (Benchmark MOE = 30)			Aggregate Risk Estimates (Benchmark MOE = 30)		
Life Cycle Stage – Category	**Subcategory**				**Acute**	**Inter.**	**Chronic**	**Acute**	**Inter.**	**Chronic**	**Acute**	**Inter.**	**Chronic**
Commercial Use – Construction, paint, electrical, and metal products	Adhesives and sealants	Application of adhesives and sealants	Average Adult Worker	CT	336	458	529	**1.7**	**2.3**	**2.6**	**1.7**	**2.3**	**2.6**
				HE	168	229	245	**0.8**	**1.1**	**1.2**	**0.8**	**1.1**	**1.2**
			Female of Reproductive Age	CT	304	415	479	**1.8**	**2.5**	**2.9**	**1.8**	**2.5**	**2.8**
Industrial Use – Construction, paint, electrical, and metal products	Adhesives and sealants			HE	152	207	222	**0.9**	**1.2**	**1.3**	**0.9**	**1.2**	**1.3**
			ONU	CT	336	458	529	**1.7**	**2.3**	**2.6**	**1.7**	**2.3**	**2.6**
Commercial Use – Packaging, paper, plastic, toys, hobby products	Ink, toner, and colorant products	Application of paints and coatings	Average Adult Worker	CT	**20**	**28**	30	**1.7**	**2.3**	**2.4**	**1.5**	**2.1**	**2.3**
				HE	**3.2**	**4.4**	**4.7**	**0.8**	**1.1**	**1.2**	**0.7**	**0.9**	**1.0**
			Female of Reproductive Age	CT	**18**	**25**	**27**	**1.8**	**2.5**	**2.7**	**1.7**	**2.3**	**2.4**
				HE	**2.9**	**4.0**	**4.2**	**0.9**	**1.2**	**1.3**	**0.7**	**0.9**	**1.0**
Commercial Use – Commercial use – Construction, paint, electrical, and metal products	Paints and coatings		ONU	CT	**20**	**28**	30	**2.2**	**3.1**	**3.3**	**2.0**	**2.8**	**2.9**
Industrial Use – Non-incorporative activities	Solvent, including in maleic anhydride manufacturing technology	Industrial process solvent use	Average Adult Worker	CT	34	46	49	**1.7**	**2.3**	**2.4**	**1.6**	**2.2**	**2.3**
				HE	**17**	**23**	**25**	**0.8**	**1.1**	**1.2**	**0.8**	**1.1**	**1.2**
			Female of Reproductive Age	CT	30	41	44	**1.8**	**2.5**	**2.7**	**1.7**	**2.3**	**2.5**
				HE	**15**	**21**	**22**	**0.9**	**1.2**	**1.3**	**0.9**	**1.2**	**1.3**
			ONU	CT	34	46	49	N/A	N/A	N/A	34	46	49
Commercial Use – Other uses	Laboratory chemicals	Use of laboratory chemicals (solid)	Average Adult Worker	CT	442	603	645	124	169	181	97	132	141
				HE	31	42	45	62	85	90	**21**	**28**	30
			Female of Reproductive Age	CT	400	546	584	135	184	197	101	138	147
				HE	**28**	38	41	67	92	98	**20**	**27**	**29**
			ONU	CT	442	603	645	124	169	181	97	132	141

COU		OES	Worker Population	Exposure Level	Inhalation Risk Estimates (Benchmark MOE = 30)			Dermal Risk Estimates (Benchmark MOE = 30)			Aggregate Risk Estimates (Benchmark MOE = 30)		
Life Cycle Stage – Category	**Subcategory**				**Acute**	**Inter.**	**Chronic**	**Acute**	**Inter.**	**Chronic**	**Acute**	**Inter.**	**Chronic**
Commercial Use – Other uses	Laboratory chemicals	Use of laboratory chemicals (liquid)	Average Adult Worker	CT	336	458	491	**2.2**	**3.1**	**3.3**	**2.2**	**3.0**	**3.3**
				HE	168	229	245	**0.8**	**1.1**	**1.2**	**0.8**	**1.1**	**1.2**
			Female of Reproductive Age	CT	304	415	444	**2.4**	**3.3**	**3.6**	**2.4**	**3.3**	**3.5**
				HE	152	207	222	**0.9**	**1.2**	**1.3**	**0.9**	**1.2**	**1.3**
			ONU	CT	336	458	491	N/A	N/A	N/A	336	458	491
Commercial Use – Other uses	Lubricants and lubricant additives	Use of lubricants and functional fluids	Average Adult Worker	CT	336	5,040	61,320	**3.0**	45	546	**3.0**	44	541
				HE	168	1,260	15,330	**1.0**	**7.5**	91	**1.0**	**7.4**	90
			Female of Reproductive Age	CT	304	4,563	55,514	**3.3**	49	594	**3.2**	48	588
Industrial Use – Other uses	Lubricants and lubricant additives			HE	152	1,141	13,878	**1.1**	**8.1**	99	**1.1**	**8.1**	98
Commercial Use – Automotive, fuel, agriculture, outdoor use products	Automotive care products		ONU	CT	336	5,040	61,320	N/A	N/A	N/A	336	5,040	61,320
Commercial Use – Other uses	Inspection penetrant kit	Use of penetrants and inspection fluids	Average Adult Worker	CT	**11**	**15**	**16**	**1.7**	**2.3**	**2.5**	**1.5**	**2.0**	**2.1**
				HE	**3.0**	**4.1**	**4.4**	**0.8**	**1.1**	**1.2**	**0.7**	**0.9**	**1.0**
			Female of Reproductive Age	CT	**10**	**14**	**15**	**1.8**	**2.5**	**2.7**	**1.5**	**2.1**	**2.3**
				HE	**2.7**	**3.7**	**4.0**	**0.9**	**1.2**	**1.3**	**0.7**	**0.9**	**1.0**
			ONU	CT	329	449	487	**1.7**	**2.3**	**2.5**	**1.7**	**2.3**	**2.5**

COU		OES	Worker Population	Exposure Level	Inhalation Risk Estimates (Benchmark MOE = 30)			Dermal Risk Estimates (Benchmark MOE = 30)			Aggregate Risk Estimates (Benchmark MOE = 30)		
Life Cycle Stage – Category	**Subcategory**				**Acute**	**Inter.**	**Chronic**	**Acute**	**Inter.**	**Chronic**	**Acute**	**Inter.**	**Chronic**
Commercial Use – Furnishing, cleaning, treatment care products	Floor coverings; construction and building materials covering large surface areas including stone, plaster, cement, glass and ceramic articles; fabrics, textiles, and apparel Furniture and furnishings	Fabrication or use of final product or articles	Average Adult Worker	CT	168	229	245	124	169	181	71	97	104
				HE	**20**	**27**	**29**	62	85	90	**15**	**21**	**22**
			Female of Reproductive Age	CT	152	207	222	135	184	197	71	97	104
				HE	**18**	**25**	**26**	67	92	98	**14**	**19**	**21**
Commercial Use – Other uses	Automotive articles Chemiluminescent light sticks Propellants		ONU	CT	168	229	245	124	169	181	71	97	104
Commercial Use – Packaging, paper, plastic, toys, hobby products	Packaging (excluding food packaging), including rubber articles; plastic articles (hard); plastic articles (soft); other articles with routine direct contact during normal use, including rubber articles; plastic articles (hard) Toys, playground, and sporting equipment												
Processing – Recycling	Recycling	Recycling	Average Adult Worker	CT	156	212	227	124	169	181	69	94	101
				HE	**11**	**15**	**16**	62	85	90	**9.1**	**12**	**13**
			Female of Reproductive Age	CT	141	192	206	135	184	197	69	94	101
				HE	**9.7**	**13**	**14**	67	92	98	**8.4**	**12**	**12**
			ONU	CT	156	212	227	124	169	181	69	94	101

COU		OES	Worker Population	Exposure Level	Inhalation Risk Estimates (Benchmark MOE = 30)			Dermal Risk Estimates (Benchmark MOE = 30)			Aggregate Risk Estimates (Benchmark MOE = 30)		
Life Cycle Stage – Category	Subcategory				Acute	Inter.	Chronic	Acute	Inter.	Chronic	Acute	Inter.	Chronic
Disposal – Disposal	Disposal	Waste handling, treatment, and disposal	Average Adult Worker	CT	156	212	227	124	169	181	69	94	101
				HE	**11**	**15**	**16**	62	85	90	**9.1**	**12**	**13**
			Female of Reproductive Age	CT	141	192	206	135	184	197	69	94	101
				HE	**9.7**	**13**	**14**	67	92	98	**8.4**	**12**	**12**
			ONU	CT	156	212	227	124	169	181	69	94	101

[a] The Draft Risk Calculator for Occupational Exposures for Dibutyl Phthalate (DBP) (U.S. EPA, 2025t) contains MOE values with PPE for all the OES for all populations (average adult workers, female of reproductive age, and ONUs) and all durations (acute, intermediate, and chronic).
Bold text in a gray shaded cell indicates an MOE below the benchmark value of 30.

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4.3.3 Risk Estimates for Consumers

Table 4-19 summarizes the dermal, inhalation, ingestion, and aggregate MOEs used to characterize non-cancer risk for acute, intermediate, and chronic exposure to DBP, and presents these values for all lifestages for each COU. A screening level assessment for consumers considers high-intensity exposure scenario risk estimates and relies on conservative assumptions to assess exposures that would be expected to be on the high end of the expected exposure distribution. MOEs for high-intensity exposure scenarios are shown for all consumer COUs, while MOEs for medium-intensity exposure scenarios are shown only for COUs with high-intensity MOEs at, or under the benchmark of 30, see listed COUs below. Further, Table 4-19 provides MOEs for the modeling indoor exposure assessment. The main objective in reconstructing the indoor environment using consumer products and articles commonly present in indoor spaces is to calculate exposure and risk estimates by COU, and by product and article, from indoor dust ingestion and inhalation. EPA identified article-specific information by COU to construct relevant and representative exposure scenarios. Exposure to DBP via ingestion of dust was assessed for all articles expected to contribute significantly to dust concentrations due to high surface area (> ~1 m^2) for either a single article or collection of like articles as appropriate. Articles included in the indoor environment assessment included: adult toys, children's toys (new and legacy), synthetic leather furniture, car mats, shower curtains, vinyl flooring, and wallpaper used in place. COUs associated with articles included in the indoor environment assessment are indicated with footnote c in Table 4-19.

Of note, the risk summary below is based on the most sensitive non-cancer endpoint for all relevant duration scenarios (*i.e.*, developmental toxicity for acute, intermediate, and chronic durations). MOEs for all high-, medium- and low-intensity exposure scenarios for all COUs are described in the *Draft Consumer Risk Calculator for Dibutyl Phthalate (DBP)* (U.S. EPA, 2025e).

COUs with MOEs for High-Intensity Exposure Scenarios Above Benchmark

The screening level assessment for consumers considers high-intensity exposure scenario risk estimates, MOEs, and relies on conservative assumptions to assess exposures that would be expected to be on the high end of the expected exposure distribution. If MOEs are above the benchmark of 30 for the high-intensity use scenario then any exposures with lower intensity use inputs would result in larger MOEs. Consumer COUs that resulted in MOEs for high-intensity exposure scenarios above the benchmark of 30 for acute, chronic and intermediate exposures are summarized in Table 4-19 and in the following list:

- Furnishing, cleaning, treatment care products; floor coverings; construction and building materials covering large surface areas including stone, plaster, cement, glass and ceramic articles; fabrics, textiles, and apparel
- Furnishing, cleaning, treatment care products: fabric, textile, and leather products
- Other uses; automotive articles
- Other uses; chemiluminescent light sticks
- Other uses; novelty articles
- Packaging, paper, plastic, toys, hobby products; packaging (excluding food packaging), including rubber articles; plastic articles (hard); plastic articles (soft); other articles with routine direct contact during normal use, including rubber articles; plastic articles (hard)

Variability in MOEs for these high-intensity exposure scenarios results from use of different exposure factors for each COU and product/article examples that led to different estimates of exposure to DBP. As described in the *Draft Consumer and Indoor Dust Exposure Assessment for Dibutyl phthalate (DBP)* (U.S. EPA, 2025c) and *Draft Non-Cancer Human Health Hazard Assessment for Dibutyl Phthalate*

(DBP) (U.S. EPA, 2024f), EPA has moderate to robust confidence in the exposure estimates and robust confidence in the non-cancer hazard value used to estimate non-cancer risk for these COUs. EPA is confident that the high-intensity use scenarios used in the screening approach represent an upper-bound estimate and provide a health protective estimate for consumer exposures.

COUs with MOEs for Exposure Scenarios Below Benchmark

The screening level assessment for consumers considers high-intensity exposure scenario risk estimates, MOEs, and relies on conservative assumptions to assess exposures that would be expected to be on the high-end of the expected exposure distribution. If MOEs are below the benchmark of 30 for the high-intensity use scenario, EPA reevaluates the approaches and inputs used and determines if refinement of those is needed. In addition, the Agency considers the medium-intensity use scenario as either a possible upper-bound estimate by reevaluating inputs and approaches or endeavors in the refinement of approaches by using other modeling tools or other input parameters within the same modeling tools. See Section 2 in *Draft Consumer and Indoor Dust Exposure Assessment for Dibutyl Phthalate (DBP) (*U.S. EPA, 2025c*)* for details about the consumer modeling approaches, sources of data, model parameterization, and assumptions. After reevaluating approaches and input parameters for each consumer COU with MOEs below the benchmark EPA concludes that further refinement of input parameters is not likely to result in different MOEs than those already presented in Table 4-19. Consumer COUs that resulted in MOEs for high-intensity exposure scenarios below the benchmark of 30 for acute, chronic and intermediate exposures are summarized in Table 4-19 and in the following list:

- Construction, paint, electrical, and metal products: adhesives and sealants
- Construction, paint, electrical, and metal products: paints and coatings
- Furnishing, cleaning, treatment care products: cleaning and furnishing care products
- Packaging, paper, plastic, hobby products; toys, playground, and sporting equipment

The consumer COUs that resulted in MOEs below the benchmark of 30 are discussed in further detail in the subsections below. Each subsection expands on each COU and the aspects driving the MOEs below the benchmark.

Construction, Paint, Electrical, and Metal Products: Adhesives and Sealants

This section summarizes the risk estimates, MOEs, below the benchmark of 30 for the titled COU. Products with similar DBP content and expected use patterns were grouped together for modeling as described below. Some products were not assessed for inhalation exposure due to the small volume of the product which is expected to be used, short durations of use and thus a shorter duration for emissions to air to occur (*e.g.*, adhesives with short working times (less than a few minutes) until solidification and liquids poured directly into a reservoir that is capped after product addition), and/or products used in outdoor conditions where air exchange rates are high and product application is not expected to generate aerosols. Three different product scenarios were assessed under this COU for products with differing use patterns including: adhesives for small repairs, automotive adhesives, and construction adhesives.

- One all-purpose adhesive used for small repairs was identified with DBP content. The reported DBP content was less than 3 percent (Walmart, 2019). Because small volumes of this adhesive are expected to be used and the working time is short (<5 min), this product was evaluated for dermal exposure only.

- Two adhesive products for home repair or construction bonding were identified with DBP content. One anchoring adhesive used for anchoring metal rebar into cured concrete and masonry was reported to have a DBP content of 0.1 to 5 percent (ITW Red Head, 2016), and one paste designed to watertight details in construction was reported to have a DBP content of 10 to 30 percent (Vaproshield, 2018). Both products are used outdoors in relatively small quantities and not applied in a manner expected to generate significant aerosols. As such, these products were modeled for dermal exposure only.

- One metal bonding adhesive used for small to moderately sized automotive repairs was identified with DBP content of 1 to less than 3 percent (Ford Motor Company, 2015b). This product was modeled for dermal and inhalation (because of possible large amount uses) exposure. DBP weight fractions of 0.01, 0.015, and 0.03 w/w in low, medium, and high inhalation exposure scenarios.

Of the three product scenarios assessed for this COU, only the acute doses (24-hour exposure; see Sections 2.2.1 and 2.2.2 and Appendix A in (U.S. EPA, 2025c) for details about acute, intermediate, and chronic dose calculations) for automotive and construction adhesives resulted in MOEs less than the benchmark of 30. The automotive and construction adhesives COU resulted in MOEs less than 30 in the dermal, acute, high- and medium-intensity use exposure scenarios. The MOEs for both automotive and construction adhesives were 7, 8, and 7 respectively for young teen, teenager, and adult in the high-intensity exposure route. For the medium-intensity exposure route the MOEs were 28, 31 and 29 for young teen, teenagers, and adults. For construction adhesives and automotive adhesives, the duration of skin contact used in the high-, medium-, and low-intensity use scenarios were 120, 60, and 30 minutes respectively (Section 2.3.4 in U.S. EPA (2025c)). The contact area for the high-intensity use scenario corresponded to inside of two hands including palms and fingers, for medium-intensity scenario contact area was inside of one hand including palms and fingers, and low intensity scenario used 10 percent of hands (some fingers) (Section 2.3.4 in U.S. EPA (2025c)).

For dermal exposure EPA used the liquid products dermal flux-limited approach, which was estimated based on DBP *in vitro* dermal absorption in guinea pigs. An overall moderate confidence in dermal assessment of adhesives was assigned. The difference between human and guinea pig skin absorption increase uncertainty and due to increased permeability of guinea pig skin as compared to human skin dermal absorption estimates likely overestimate exposures. Other parameters such as frequency and duration of use, and surface area in contact, are well understood and representative, resulting in an overall moderate confidence.

Construction, Paint, Electrical, and Metal Products: Paints and Coatings

This section summarizes the risk estimates, MOEs, below the benchmark of 30 for the titled COU. Three different scenarios were assessed under this COU including: metal coatings, indoor sealing and refinishing sprays, and outdoor sealing and refining sprays. All three scenarios were assessed for dermal and inhalation exposures.

- Outdoor sealing and refinishing sprays: Four waterproofing coating products for roofs, decks, and walkway applications were identified with DBP content. Identified product examples were Hydrostop premium finish coat, Hydrostop premium foundation coat, Hydrostop traffic deck coating, and Lanco seal (roof coating). The combined weight fractions used for the high-, medium-, and low-intensity use inhalation exposure scenarios were 0.0005, 0.017, and 0.1 w/w respectively. Though these products are for outdoor only use, inhalation exposure may be significant due to relatively large volumes of product used and aerosol generation during spray application. As such, these products were modeled for both inhalation and dermal exposures during product application or do-it-yourself (DIY) activities for young teens, teenagers, and adults. Bystanders (infants to middle childhood) were assessed for inhalation exposures while someone else, a DIYer, was using the product. Product application scenarios for inhalation and dermal contact were modeled to occur outside. The duration of skin contact used in the high-, medium-, and low-intensity use scenarios were 480, 240, and 120 minutes respectively, on the account of needing two coats for proper product application and covering a large surface (Section 2.3.4 in U.S. EPA (2025c)). The contact area for the high-, medium-, and low-intensity use scenario corresponded to 10 percent of hands (Section 2.3.4 in U.S. EPA (2025c)). While for other products in this COU it was assumed that users did not wash their hands until the task was completed, these products are very sticky and likely require hand washing or at least wiping hands. EPA assumes that the user can wipe their hands while some of the product remains, therefore a surface area contact of 10 percent of the hands was selected. The dermal MOEs for the acute, high exposure intensity scenario for outdoor sealing and refinishing spray products were 9, 10, and 9 for young teens, teenagers, and adults. The MOE values for the medium-intensity use exposure scenarios were 18, 19, and 18 for young teens, teenagers, and adults.

- Indoor sealing and refinishing sprays: Four waterproofing coating products for roofs, decks, and walkway applications were identified with DBP content. Identified product examples were Franklin side out gym floor finish, crystal floor finish, SWC nature one 100% Acry EN CED, and SWC nature one renew. The combined weight fractions used for the high-, medium-, and low-intensity use inhalation exposure scenarios were 0.01, 0.02, and 0.03 w/w respectively. The products were assessed for inhalation and dermal exposures during product application or DIY activities for young teens, teenagers, and adults. Bystanders (infants to middle childhood) were assessed for inhalation exposures while someone else, a DIYer, was using the product. Product application scenarios for inhalation and dermal contact were modeled to occur indoors (garage). The duration of skin contact used in the high-, medium-, and low-intensity use scenarios were 270, 180, and 90 minutes respectively on the account of needing two coats for proper product application on a semi large surface (smaller than for the outdoor products) (Section 2.3.4 in U.S. EPA (2025c)). The contact area for the high-intensity use scenario corresponded 10 percent of hands for the high-, medium-, and low-intensity use scenarios. These products are very sticky and likely require hand washing or at least wiping hands. EPA assumes that the user can wipe their hands while some of the product remains, therefore a surface area contact of 10 percent of the hands was selected (Section 2.3.4 in U.S. EPA (2025c)). The MOEs for the high exposure intensity scenario for indoor sealing and refinishing sprays were 16, 17 and 16 respectively for young teen, teenage and adult. The medium-intensity MOEs were 23, 26, and 24 for the same lifestage categories.

- Metal coatings: Two metal coating products were assessed for inhalation and dermal exposures during product application or DIY activities for young teens, teenagers, and adults. Bystanders (infants to middle childhood) were assessed for inhalation exposures while someone else, a DIYer, was using the product. Product application scenarios for inhalation and dermal contact were modeled to occur indoors (garage). One anti-fouling boat coating was identified with 2.5 to 10 percent DBP content, and one aluminum primer was identified with 1 to 2.5 percent DBP content. The combined weight fractions were 0.01 w/w, 0.04 w/w, and 0.1 used for the low, medium, and high-intensity use exposure scenarios. The durations of skin contact used in the high-, medium-, and low-intensity use scenarios were 120, 60, and 30 minutes respectively (Section 2.3.4 in U.S. EPA (2025c)). The contact area for the high-intensity use scenario corresponded to the inside of two hands (including palms and fingers), and the medium-intensity use scenario used the inside of one hand (Section 2.3.4 in U.S. EPA (2025c)). For the metal coatings COU, the MOEs for the acute, dermal, high-intensity scenario were 7, 8, and 7 respectively for young teen, teenage, and adult. For the dermal medium-intensity use exposure scenario, the MOEs were 28, 31, and 29.

The MOEs for the chronic, high-intensity, inhalation scenario were 26 and 28 for the infant and toddler lifestages (assessed as bystanders which is a non-user of the product that is in the vicinity). The duration of use per event is the same as the duration of dermal contact for high-, medium-, and low-intensity used exposure scenarios, 120, 60, and 30 minutes. For chronic exposures EPA assumed weekly uses during a year which is 52 events in one year of exposure. The preschoolers and middle childhood children MOE values were above 30. The differences between infants and toddlers with preschoolers and middle childhood is the inhalation rates and body weights ratio. The same exposure concentration is inhaled at a faster rate for the younger lifestages while in a smaller body weight resulting in higher doses and lower MOEs.

For all three product scenarios assessed for this COU, the acute dermal pathway resulted in MOEs less than the benchmark of 30 in both the high and medium-intensity use scenarios for young teens, teenagers, and adults. For dermal exposure, EPA used the liquid products dermal flux-limited approach, which was estimated based on DBP *in vitro* dermal absorption in guinea pigs. EPA determined an overall moderate confidence in the dermal assessment for paints and coatings. The Agency assumes an excess of DBP is in contact with the skin and that the absorptive flux of DBP measured from *in vitro* guinea pig experiments serves as an upper-bound of potential absorptive flux of chemical into and through the skin for dermal contact with all liquid products. Uncertainties about the difference between human and guinea pig skin absorption increase uncertainty and due to increased permeability of guinea pig skin as compared to human skin dermal absorption estimates likely overestimate exposures. Other parameters such as frequency and duration of use, and surface area in contact, are well understood and representative, resulting in a moderate overall confidence.

The overall confidence in this COU's inhalation exposure estimate is robust because the CEM default parameters represent actual use patterns and location of use. Differences in MOEs between the high, medium, and low-intensity inhalation exposure scenarios result from use of different exposure parameters in CEM. Key parameters that differed between high- and medium-intensity scenarios include weight fraction (*i.e.,* 0.1 vs. 0.04 for metal coatings), product mass used (*i.e.,* 1,427 vs. 713 g for metal coatings), and inhalation rates used per lifestage. Inhalation rates for lifestages range from 0.74 to 0.46 m^3/h for adults to infants respectively, with the largest difference between infants and the next lifestage. Other CEM exposure factors were kept constant between high- and medium-intensity inhalation scenarios (*e.g.,* surface layer thickness, volume of use environment, interzone ventilation rate). In these product inhalation scenarios DBP is released into the gas-phase. The product inhalation scenario tracks chemical transport among the source, air, airborne and settled particles, and indoor sinks. The approach accounts for (1) emissions, (2) mixing within the gas phase, (3) transfer to particulates by partitioning, (4) removal due to ventilation, (5) removal due to cleaning of settled particulates and dust to which DBP has partitioned, and (6i) sorption or desorption to/from interior surfaces. The emissions from the product were modeled with a single exponential decay model. This means that chronic and acute exposure duration scenarios use the same emissions/air concentration data based on the weight fraction but have different averaging times for the air concentration used. The acute data uses concentrations for a 24-hour period at the peak, while the chronic data was averaged over the entire 1-year period. Because air concentrations for most of the year are significantly lower than the peak value, the air concentration used in chronic dose calculations is lower than acute. The overall confidence in this COU's inhalation and dust ingestion exposure estimates are robust because the CEM default parameters represent actual use patterns and location of use (see Section 2.2.3.2 in U.S. EPA (2025c)), and the estimated surface area is well characterized and represents a wide range of plausible uses.

Aggregate risk estimates across all evaluated exposure routes (*i.e.*, dermal and inhalation) to DBP for metal coatings was also considered. The chronic high-intensity use aggregate exposure scenario MOE for young teens to adults was below 30. The dermal and ingestion exposures contributed equally to the aggregated MOE values. The MOE values were 49, 54, and 51 for young teens, teenagers, and adults respectively for dermal exposure while the MOE values were 51, 62, and 75 for young teens, teenagers, and adults respectively for inhalation exposure. The aggregated MOEs for young teens, teenagers, and adults were 25, 29, and 30, respectively.

Furnishing, Cleaning, Treatment Care Products: Cleaning and Furnishing Care Products

This section summarizes the risk estimates, MOEs, below the benchmark of 30 for the titled COU. Two different scenarios were assessed under this COU for two product types with differing use patterns: Spray cleaner and waxes and polishes. Both scenarios were assessed for dermal and inhalation exposures, but only the acute dermal high-intensity use scenario resulted in MOEs below the benchmark of 30 for the assessed lifestages: young teens and adults for the spray cleaner, and young teens, teenagers, and adults for the polishes and waxes. The acute dermal high-intensity use MOE values for spray cleaner were 28 and 29 for young teens and adults respectively, and the medium-intensity use scenario MOE values were 110 and 120 for young teens and adults respectively. The acute dermal high-intensity use MOE values for polishes and waxes were 14, 15, and 14 for young teens, teenagers, and adults respectively, and the dermal medium-intensity use scenario MOE values were 56, 62, and 58 for young teens, teenagers, and adults respectively.

Two cleaning and furnishing care products with DBP content were identified from a 2012 study on U.S. consumer products (Dodson et al., 2012). Due to the different format and application, these items were modeled separately. One spray cleaning product used for tub and tile cleaning was identified with reported DBP content. One polish/wax used for floors and furniture was identified with reported DBP content. EPA has a moderate confidence in using these products to generally represent this COU due to the age of the study (10+ years), and that it was only one source.

Key parameters for the dermal model include duration of dermal contact, frequency of dermal contact, total contact area, and dermal flux. An increase in any of these parameters results in an increase in exposure. For liquid and paste products, it was assumed that contact with the product occurs at the beginning of the period of use and the product is not washed off the skin until use is complete. As such, the duration of dermal contact for these products is equal to the duration of use applied in CEM modeling for products assessed for inhalation. The skin contact duration for spray cleaner for the high- and medium-intensity use scenarios were 30 and 15 minutes respectively, and for waxes and polishes 60 and 30 minutes (Section 2.3.4 in U.S. EPA (2025c)). EPA has a robust confidence in the input parameters used for skin contact duration.

For contact area EPA used professional judgment based on product use descriptions from manufacturers. For spray cleaners and polishes and waxes, EPA assumed that these items would be in contact with the skin on the inside of two hands (palms, fingers) for the high-intensity use scenario, and the inside of one hand for the medium-intensity use scenario. EPA has robust confidence in the input parameters used for skin contact surface area.

EPA used a screening dermal flux-limited approach, which was estimated based on DBP *in vitro* dermal absorption in guinea pigs. Though there is uncertainty regarding the magnitude of the difference between dermal absorption through guinea pigs' skin versus human skin for DBP, based on DBP physical and chemical properties (size, solubility), EPA is confident that the *in vitro* dermal absorption data using guinea pigs for (Doan et al., 2010) provides an upper-bound of dermal absorption of DBP. Dermal contact with products or formulations that have low concentrations of DBP may exhibit lower rates of flux since there is less material available for absorption. Conversely, co-formulants or materials within the products or formulations may lead to enhanced dermal absorption, even at lower concentrations. Therefore, it is uncertain whether the dermal exposure to products or formulations containing DBP would result in decreased or increased dermal absorption.

Based on the available dermal absorption data for DBP, EPA has made assumptions that result in exposure assessments that are the most conservative representing upper-bound estimates. Considering the unknown uncertainties from the flux-limited approach and input parameters such as frequency and duration of use, and area of skin in contact, are well understood and representative, the overall confidence in dermal exposure estimates for liquid and paste products is moderate.

Packaging, Paper, Plastic, Hobby Products; Toys, Playground, and Sporting Equipment

This section summarizes the risk estimates, MOEs, below the benchmark of 30 for the titled COU. Four different scenarios were assessed under this COU for various articles with differing use patterns: legacy children's toys, new children's toys, tire crumb and artificial turf, and a variety of PVC articles with potential for routine contact. Children's toy scenarios were included in the indoor assessment for all exposure routes (inhalation, dust ingestion, mouthing, and dermal) with varying use patterns and inputs. Tire crumb was also part of the indoor assessment for all exposure routes except mouthing. Articles of routine contact were only assessed for dermal exposures since they are too small to result in impactful inhalation or ingestion exposures. Aggregate risk estimates for DBP exposure across all evaluated exposure routes for legacy children's toys were the only scenario within this COU with an MOE below the benchmark of 30. The acute, high-intensity use aggregate exposure scenario MOE for legacy toys was 23 for the infants. The high-intensity use scenario dermal, ingestion, and inhalation MOEs were 112, 51, and 69, respectively. The ingestion and inhalation MOEs are the primary contributors to the aggregated MOE value of 23.

Children's toys were assessed for DBP exposure by inhalation, dust ingestion, dermal and mouthing routes. Under the Consumer Product Safety Improvement Act (CPSIA) of 2008 (CPSIA section 108(a), 15 U.S.C. § 2057c(a);16 CFR § 1307.3(a)), Congress permanently prohibited the sale of children's toys or childcare articles containing concentrations of more than 0.1 percent DBP. However, it is possible that some individuals may still have children's toys in the home that were produced before statutory and regulatory limitations. A relatively recent survey, 2020, by the Danish EPA of PVC products purchased from foreign online retailers found that DBP content in a toy bath duck of 1.7 percent exceeded the current Danish regulatory limit of 0.1 percent DBP (Danish EPA, 2020). In the U.S. market, the High Priority Chemicals Data System (HPCDS) database contained data for DBP measurements in 96 toy/game items with reporting dates from 2017 to 2024. While there is some uncertainty about the materials these items are manufactured from, based on the limited descriptions in the database, EPA determined that these items are likely composed primarily of plastic and rubber components. For example, some of the descriptions provided for toys were dolls, puppets, action figures, board games, toy vehicles, soft toys, toy soldiers, glow in the dark plastic bugs, waterproof pouches, pink plastic recorder, and yellow bendy man. One item with DBP content over the statutory and regulatory limit of 0.1 percent was listed as a non-ride toy vehicle (WSDE, 2020).

EPA assessed exposure to DBP in children's toys under two scenarios. In the first exposure scenario, new toys produced for the U.S. market are assumed to comply with statutory and regulatory limits and were therefore assessed with DBP weight fractions of 0.001 w/w in low, medium, and high exposure scenarios. In the second scenario, legacy toys are assessed with weight fractions reported in the HPCDS database, (WSDE, 2020), that are above the statutory and regulatory limit of 0.001 w/w. Based on the reported data, the weight fractions of DBP used in low, medium, and high-intensity use exposure scenarios were 0.005 w/w, 0.0075 w/w, and 0.01 w/w. One new toy in the HPCDS database tested 8 or more years after the CPSIA had components with DBP content above (1 order of magnitude above) the statutory and regulatory limit of 0.01 percent (WSDE, 2020).

Children's toys generally have a small surface area for an individual item, but consumers may have many of the same type of item in a home. As phthalates are ubiquitous in PVC materials, it is reasonable to assume that in a collection of toys all of the items may have DBP content. As such, surface area for these items was estimated by assuming that a home has several of these items rather than one. The surface area of new and legacy toys was varied for the low-, medium-, and high-intensity use exposure scenarios based on EPA's professional judgment of the number and size of toys present in a bedroom. The low intensity use scenario was based on 5 small toys measuring 15 cm × 10 cm × 5 cm, the medium-intensity use scenario was based on 20 medium toys measuring 20 cm × 15 cm × 8 cm, and the high-intensity use scenario was based on 30 large toys measuring 30 cm × 25 cm × 15 cm. EPA used the stay-at-home 20 hour exposure duration and bedroom for location of articles CEM inputs for inhalation and dust ingestion exposure estimates. The overall confidence in this COU's inhalation and dust ingestion exposure estimate is robust because of a good understanding of the CEM model parameter inputs and representativeness of actual use patterns and location of use.

For mouthing exposure, key parameters include the rate of chemical migration from the article to saliva ($\mu g/cm^2/h$), surface area mouthed (cm^2), and duration of mouthing (min/day). The mouthing parameters used, such as duration of use (39.2 min/day EPA *Exposure Factors Handbook* Table 4-23 (U.S. EPA, 2011a)) and surface area for infants (standardized value of 10 cm^2 (Danish EPA, 2010; Niino et al., 2003; Niino et al., 2001)) are very well understood. The chemical migration value is DBP specific, empirically derived, and the main sources of uncertainty are related to a large variability in empirical migration rate data for harsh, medium, and mild mouthing approaches. Additionally, there are uncertainties from the unknown correlation between chemical concentration in articles and chemical migration rates, and no data were reasonably available to compare and confirm selected rate parameters to better understand uncertainties.

Infants skin contact duration for the high-intensity use scenario was 137 minutes and the skin contact area was inside of two hands including palms and fingers (Section 2.3.4 in U.S. EPA (2025c)). Dermal absorption estimates are based on the assumption that dermal absorption of DBP from solid objects will be limited by aqueous solubility of DBP. EPA has moderate confidence for solid objects because the high uncertainty in the assumption of partitioning from solid to liquid and subsequent dermal absorption is not well characterized. Additionally, there are uncertainties associated to the flux-limited approach which likely results in overestimations due to the assumption about excess DBP in contact with skin. Other parameters like frequency and duration of use, and surface area in contact have unknown uncertainties due to lack of information about use patterns, making the overall confidence of moderate.

Indoor Dust

Exposure to DBP via ingestion of dust was assessed for all articles expected to contribute significantly to dust concentrations. The articles are included in the indoor assessment due to high surface area (exceeding ~1 m^2) for either a single article or collection of like articles as appropriate. Articles included in the indoor assessment include in-place wallpaper, vinyl flooring, synthetic leather furniture, car mats, shower curtains, tire crumb, and children's toys (legacy and new). In a screening assessment for indoor dust ingestion, EPA considered the aggregation of chronic dust ingestion doses (Section 4.1.2.3). However, the indoor assessment was further refined to only consider articles assumed to be present in residential indoor environments because of the use of the stay-at-home CEM inputs would result in greater exposures than other non-residential environment options. Articles considered in this indoor assessment include synthetic leather furniture, vinyl flooring, in-place wallpaper, shower curtains, and children's toys (new and legacy). Car mats and tire crumb were considered not to be continuously available in residential indoor environments, as car mats are present in vehicles, and tire crumb is present in gyms and outdoor recreational areas. The highest refined aggregated dose from indoor chronic ingestion of settled dust was for preschoolers, aged 3 to 5 years and resulted in an MOE of 7,500. See *Draft Consumer Risk Calculator for Dibutyl Phthalate (DBP)* (U.S. EPA, 2025e). All other doses were lower and would have resulted in even larger MOEs.

4.3.3.1 Overall Confidence in Consumer Risks

As described in Section 4.1.2 and in more detail in the *Draft Consumer and Indoor Exposure Assessment for Dibutyl Phthalate (DBP)* (U.S. EPA, 2025c), EPA has moderate and robust confidence in the assessed inhalation, ingestion, and dermal consumer exposure scenarios, and robust confidence in the non-cancer POD selected to characterize risk from acute, intermediate, and chronic duration exposures to DBP (see Section 4.2 and (U.S. EPA, 2024f)). The exposure doses used to estimate risk relied on conservative inputs and parameters that are considered representative of a wide selection of use patterns. Overall, EPA has moderate to robust confidence in the risk estimates calculated for consumers inhalation, ingestion, and dermal exposure scenarios. Sources of uncertainty associated with the ten consumer COUs with MOEs less than 30 are discussed above in Section 4.3.3.

Table 4-19. Consumer Risk Summary Table

Life Cycle Stage: COU: Subcategory	Product or Article	Duration	Exposure Route	Exposure Scenario (H, M, L) [a]	Lifestage (years) MOE (Benchmark MOE = 30)						
					Infant (<1 Year)	Toddler (1–2 Years)	Pre-schooler (3–5 years)	Middle Childhood (6–10 years)	Young Teen (11–15 years)	Teenagers (16–20 years)	Adults (21+ years)
Consumer Uses: Automotive, fuel, agriculture, outdoor use products: Automotive care products	Uses were matched with automotive adhesives.										
Consumer Uses: Construction, paint, electrical, and metal products: Adhesives and sealants	Automotive adhesives	Acute	Dermal	H	–	–	–	–	**7**	**8**	**7**
				M	–	–	–	–	**28**	31	**29**
				L	–	–	–	–	140	150	140
			Ingestion	–	–	–	–	–	–	–	–
			Inhalation	H	160 [b]	170 [b]	210 [b]	300 [b]	370	440	540
			Aggregate	H	–	–	–	–	**7**	**8**	**7**
				M	–	–	–	–	**28**	31	**29**
				L	–	–	–	–	140	150	140
		Intermed.	Dermal	H	–	–	–	–	210	230	220
			Ingestion	–	–	–	–	–	–	–	–
			Inhalation	H	4,800 [b]	5,100 [b]	6,200 [b]	9,000 [b]	1.1E04	1.3E04	1.6E04
			Aggregate	H	–	–	–	–	210	230	210
		Chronic	–	–	–	–	–	–	–	–	–
	Construction adhesives	Acute	Dermal	H	–	–	–	–	**7**	**8**	**7**
				M	–	–	–	–	**28**	31	**29**
				L	–	–	–	–	140	150	140
			Ingestion	–	–	–	–	–	–	–	–
			Inhalation	–	–	–	–	–	–	–	–
		Intermed.	Dermal	H	–	–	–	–	210	230	220
			Ingestion	–	–	–	–	–	–	–	–
			Inhalation	–	–	–	–	–	–	–	–
		Chronic	–	–	–	–	–	–	–	–	–
	Adhesives for small repairs	Acute	Dermal	H	–	–	–	–	70	77	72
			Ingestion	–	–	–	–	–	–	–	–
			Inhalation	–	–	–	–	–	–	–	–
		Intermed.	–	–	–	–	–	–	–	–	–
		Chronic	Dermal	H	–	–	–	–	490	540	510
			Ingestion	–	–	–	–	–	–	–	–
			Inhalation	–	–	–	–	–	–	–	–

Life Cycle Stage: COU: Subcategory	Product or Article	Duration	Exposure Route	Exposure Scenario (H, M, L) [a]	Lifestage (years) MOE (Benchmark MOE = 30) Infant (<1 Year)	Toddler (1–2 Years)	Pre-schooler (3–5 years)	Middle Childhood (6–10 years)	Young Teen (11–15 years)	Teenagers (16–20 years)	Adults (21+ years)
Consumer Uses: Construction, paint, electrical, and metal products: Paints and coatings	Metal coatings	Acute	Dermal	H	–	–	–	–	**7**	**8**	**7**
				M	–	–	–	–	**28**	31	**29**
				L	–	–	–	–	140	150	140
			Ingestion	–	–	–	–	–	–	–	–
			Inhalation	H	72 [b]	76 [b]	94 [b]	130 [b]	130	160	190
			Aggregate	H	–	–	–	–	**7**	**7**	**7**
				M	–	–	–	–	**24**	**26**	**26**
				L	–	–	–	–	89	100	100
		Intermed.	–	–	–	–	–	–	–	–	–
		Chronic	Dermal	H	–	–	–	–	49	54	51
			Ingestion	–	–	–	–	–	–	–	–
			Inhalation	H	**26 [b]**	**28 [b]**	34 [b]	49 [b]	51	62	75
				M	130 [b]	140 [b]	170 [b]	250 [b]	290	340	420
			Aggregate	H	–	–	–	–	**25**	**29**	30
				M	–	–	–	–	120	130	140
	Indoor flooring sealing and refinishing products	Acute	Dermal	H	–	–	–	–	**16**	**17**	**16**
				M	–	–	–	–	**23**	**26**	**24**
				L	–	–	–	–	47	51	48
			Ingestion	–	–	–	–	–	–	–	–
			Inhalation	H	100 [b]	110 [b]	140 [b]	190 [b]	260	300	380
			Aggregate	H	–	–	–	–	**15**	**16**	**15**
				M	–	–	–	–	**22**	**24**	**23**
				L	–	–	–	–	45	49	46
		Intermed.	Dermal	H	–	–	–	–	470	510	480
			Ingestion	–	–	–	–	–	–	–	–
			Inhalation	H	3,100 [b]	3,300 [b]	4,100 [b]	5,800 [b]	7,800	9,100	1.1E04
			Aggregate	H	–	–	–	–	440	490	460
		Chronic	–	–	–	–	–	–	–	–	–
	Sealing and refinishing sprays (outdoor use)	Acute	Dermal	H	–	–	–	–	**9**	**10**	**9**
				M	–	–	–	–	**18**	**19**	**18**
				L	–	–	–	–	35	39	36
			Ingestion	–	–	–	–	–	–	–	–
			Inhalation	H	92 [b]	98 [b]	120 [b]	150 [b]	49	66	73
			Aggregate	H	–	–	–	–	**8**	**8**	**8**
				M	–	–	–	–	**15**	**16**	**16**

Life Cycle Stage: COU: Subcategory	Product or Article	Duration	Exposure Route	Exposure Scenario (H, M, L) [a]	Lifestage (years) MOE (Benchmark MOE = 30)						
					Infant (<1 Year)	Toddler (1–2 Years)	Pre-schooler (3–5 years)	Middle Childhood (6–10 years)	Young Teen (11–15 years)	Teenagers (16–20 years)	Adults (21+ years)
Consumer Uses: Construction, paint, electrical, and metal products: Paints and coatings	Sealing and refinishing sprays (outdoor use)			L	–	–	–	–	35	38	36
		Intermed.	Dermal	H	–	–	–	–	260	290	270
			Ingestion	–	–	–	–	–	–	–	–
			Inhalation	H	2,800 [b]	2,900 [b]	3,600 [b]	4,500 [b]	1,500	2,000	2,200
			Aggregate	H	–	–	–	–	220	250	240
		Chronic	–	–	–	–	–	–	–	–	–
Consumer Uses: Furnishing, cleaning, treatment care products: Fabric, textile, and leather products	Synthetic leather clothing	Acute	Dermal	H	–	–	–	–	–	–[d]	–[d]
				M	–	–	–	–	–	76	72
			Ingestion	–	–	–	–	–	–	–	–
			Inhalation	–	–	–	–	–	–	–	–
		Intermed.	–	–	–	–	–	–	–	–	–
		Chronic	Dermal	H	–	–	–	–	–	–[d]	–[d]
				M	–	–	–	–	–	540	510
			Ingestion	–	–	–	–	–	–	–	–
			Inhalation	–	–	–	–	–	–	–	–
Consumer Uses: Furnishing, cleaning, treatment care products: Fabric, textile, and leather products	Synthetic leather furniture	Acute	Dermal	H	–[d]	–[d]	–[d]	–[d]	–[d]	–[d]	–[d]
				M	–[d]	–[d]	41	54	69	76	72
				L	–[d]	140	160	200	250	280	260
			Ingestion [c]	H	83	140	220	2.3E06	4.1E06	5.2E06	12E06
				M	280	380	670	2.3E07	4.1E07	5.2E07	1.2E08
				L	1.1E05	7.6E04	1.4E05	3.4E07	6.1E07	7.7E07	1.7E08
			Inhalation [c]	H	5.7E04	6.0E04	7.4E04	1.1E05	1.5E05	1.8E05	2.2E05
				M	5.8E05	6.1E05	7.5E05	1.1E06	1.5E06	1.8E06	2.2E06
				L	8.8E05	9.3E05	1.1E06	1.6E06	2.3E06	2.7E06	3.4E06
			Aggregate	H	83	140	220	1E05	1.5E05	1.7E05	2.1E05
				M	280	380	39	54	69	76	72
				L	9.7E04	140	160	200	250	280	260
		Intermed.	–	–	–	–	–	–	–	–	–
		Chronic	Dermal	H	–[d]	–[d]	–[d]	–[d]	–[d]	–[d]	–[d]
				M	–[d]	–[d]	41	54	69	76	72
				L	–[d]	140	160	200	250	280	260
			Ingestion [c]	H	83	140	220	2.5E06	4.5E06	5.7E06	1.3E07
				M	280	380	670	2.5E07	4.5E07	5.7E07	1.3E08
				L	1.1E05	7.6E04	1.4E05	3.7E07	6.7E07	8.4E07	1.9E08
			Inhalation [c]	H	5.9E04	6.3E04	7.7E04	1.1E05	1.6E05	1.8E05	2.3E05

Life Cycle Stage: COU: Subcategory	Product or Article	Duration	Exposure Route	Exposure Scenario (H, M, L) [a]	Lifestage (years) MOE (Benchmark MOE = 30) Infant (<1 Year)	Toddler (1–2 Years)	Pre-schooler (3–5 years)	Middle Childhood (6–10 years)	Young Teen (11–15 years)	Teenagers (16–20 years)	Adults (21+ years)
Consumer Uses: Furnishing, cleaning, treatment care products: Fabric, textile, and leather products	Synthetic leather furniture			M	6.0E05	6.4E05	7.9E05	1.1E06	1.6E06	1.9E06	2.3E06
				L	9.2E05	9.7E05	1.2E06	1.7E06	2.4E06	2.8E06	3.5E06
			Aggregate	H	83	140	220	1.1E05	1.5E05	1.8E05	2.2E05
				M	280	380	39	54	69	76	72
				L	120	140	160	200	250	280	260
Consumer uses: Furnishing, cleaning, treatment care products: Floor coverings; construction and building materials covering large surface areas including stone, plaster, cement, glass and ceramic articles; fabrics, textiles, and apparel	Vinyl flooring	Acute	Dermal	H	240	280	320	400	510	550	520
			Ingestion [c]	H	2.4E04	1.9E04	1.7E04	4.8E04	8.6E04	1.1E05	2.4E05
			Inhalation [c]	H	800	850	1,000	1,500	2,100	2,500	3,100
			Aggregate	H	180	210	240	310	410	450	440
		Intermed.	–	–	–	–	–	–	–	–	–
		Chronic	Dermal	H	240	280	320	400	510	550	520
			Ingestion [c]	H	7.9E04	6.4E04	5.7E04	1.6E05	2.9E05	3.6E05	8.1E05
			Inhalation [c]	H	3,800	4,000	4,900	7,100	1.0E04	1.2E04	1.5E04
			Aggregate	H	220	260	300	380	480	530	500
	Wallpaper (in–place)	Acute	Dermal	H	120	140	160	200	250	280	–
			Ingestion [c]	H	1.0E05	8.3E04	7.3E04	2.1E05	3.7E05	4.7E05	1.0E06
			Inhalation [c]	H	3,500	3,700	4,500	6,500	9.2E3	1.1E04	1.3E04
			Aggregate	H	120	130	160	190	250	270	1.3E04
		Chronic	Dermal	H	120	140	160	200	250	280	9.5E04
			Ingestion [c]	H	3.4E05	2.8E05	2.5E05	7.0E05	1.3E06	1.6E06	3.5E06
			Inhalation [c]	H	1.6E04	1.7E04	2.1E04	3.1E04	4.3E04	5.1E04	6.3E04
			Aggregate	H	120	140	160	200	250	280	3.8E04
	Wallpaper (installation)	Acute	Dermal	H	–	–	–	–	130	140	130
			Ingestion	–	–	–	–	–	–	–	–
			Inhalation	–	–	–	–	–	–	–	–

Life Cycle Stage: COU: Subcategory	Product or Article	Duration	Exposure Route	Exposure Scenario (H, M, L) [a]	Lifestage (years) MOE (Benchmark MOE = 30)						
					Infant (<1 Year)	Toddler (1–2 Years)	Pre-schooler (3–5 years)	Middle Childhood (6–10 years)	Young Teen (11–15 years)	Teenagers (16–20 years)	Adults (21+ years)
Consumer uses: Furnishing, cleaning, treatment care products: Cleaning and furnishing care products	Spray cleaner	Acute	Dermal	H	–	–	–	–	**28**	31	**29**
				M	–	–	–	–	110	120	120
			Ingestion	–	–	–	–	–	–	–	–
			Inhalation	H	6.7E04	7.1E04 [b]	8.7E04 [b]	1.3E05 [b]	3.7E04	4.8E04	5.5E04
				M	1.4E05 [b]	1.5E05 [b]	1.8E05 [b]	2.7E05 [b]	7.7E04	9.6E04	1.1E05
			Aggregate	H	6.7E04	7.1E04	8.7E04	1.3E05	**28**	31	**29**
				M	1.4E05	1.5E05	1.8E05	2.7E05	110	120	120
		Chronic	Dermal	H	–	–	–	–	200	220	200
			Ingestion	–	–	–	–	–	–	–	–
			Inhalation	H	1.2E05 [b]	1.2E05 [b]	1.5E05 [b]	2.2E05 [b]	1.3E05	1.7E05	2.0E05
			Aggregate	H	1.2E05	1.2E05	1.5E05	2.2E05	200	220	200
	Waxes and polishes	Acute	Dermal	H	–	–	–	–	**14**	**15**	**14**
				M	–	–	–	–	56	62	58
			Ingestion	–	–	–	–	–	–	–	–
			Inhalation	H	1.0E05 [b]	1.1E05 [b]	1.3E05 [b]	1.9E05 [b]	2.6E05	3.0E05	3.7E05
			Aggregate	H	1.0E05	1.1E05	1.3E05	1.9E05	**14**	**15**	**14**
				M	1.6E05	1.7E05	2.0E05	2.9E05	56	62	58
		Chronic	Dermal	H	–	–	–	–	99	110	100
			Ingestion	–	–	–	–	–	–	–	–
			Inhalation	H	8,500 [b]	9,100 [b]	1.1E04 [b]	1.6E04 [b]	2.0E04	2.4E04	2.9E04
			Aggregate	H	8,500	9,100	1.1E04	1.6E04	98	110	100
Consumer uses: Packaging, paper, plastic, toys, hobby products: Ink, toner, and colorant products	No consumer products identified. Foreseeable uses were matched with adhesives for small repairs because similar use patterns are expected.										

Life Cycle Stage: COU: Subcategory	Product or Article	Duration	Exposure Route	Exposure Scenario (H, M, L) [a]	Lifestage (years) MOE (Benchmark MOE = 30)						
					Infant (<1 Year)	Toddler (1–2 Years)	Pre-schooler (3–5 years)	Middle Childhood (6–10 years)	Young Teen (11–15 years)	Teenagers (16–20 years)	Adults (21+ years)
Consumer uses: Packaging, paper, plastic, toys, hobby products; Packaging (excluding food packaging), including rubber articles; plastic articles (hard); plastic articles (soft); other articles with routine direct contact during normal use, including rubber articles; plastic articles (hard)	Footwear components	Acute	Dermal	H	60	70	81	100	130	140	130
			Ingestion	–	–	–	–	–	–	–	–
			Inhalation	–	–	–	–	–	–	–	–
		Chronic	Dermal	H	60	70	81	100	130	140	130
			Ingestion	–	–	–	–	–	–	–	–
			Inhalation	–	–	–	–	–	–	–	–
	Shower curtains	Acute	Dermal	H	340	400	460	570	720	780	730
			Ingestion [c]	H	1.1E06	9.0E05	8.0E05	2.3E06	4.1E06	5.1E06	1.1E07
			Inhalation [c]	H	1.4E04	1.5E04	1.8E04	2.6E04	3.7E04	4.3E04	5.3E04
			Aggregate	H	330	380	450	550	700	770	720
		Chronic	Dermal	H	340	400	460	570	720	780	730
			Ingestion [c]	H	3.7E06	3.0E06	2.6E06	7.5E06	1.3E07	1.7E07	3.8E07
			Inhalation [c]	H	6.6E04	7.0E04	8.6E04	1.2E05	1.7E05	2.0E05	2.5E05
			Aggregate	H	340	390	450	560	710	780	730
	Small articles with semi routine contact; miscellaneous items including a pen, pencil case, hobby cutting board, costume jewelry, tape, garden hose, disposable gloves, and plastic bags/pouches	Acute	Dermal	H	120	140	160	200	250	280	260
			Ingestion	–	–	–	–	–	–	–	–
			Inhalation	–	–	–	–	–	–	–	–
		Chronic	Dermal	H	120	140	160	200	250	280	260
			Ingestion	–	–	–	–	–	–	–	–
			Inhalation	–	–	–	–	–	–	–	–

Life Cycle Stage: COU: Subcategory	Product or Article	Duration	Exposure Route	Exposure Scenario (H, M, L) [a]	Lifestage (years) MOE (Benchmark MOE = 30)						
					Infant (<1 Year)	Toddler (1–2 Years)	Pre-schooler (3–5 years)	Middle Childhood (6–10 years)	Young Teen (11–15 years)	Teenagers (16–20 years)	Adults (21+ years)
Consumer uses: Packaging, paper, plastic, toys, hobby products: Toys, playground, and sporting equipment	Children's toys (New)	Acute	Dermal	H	110	130	150	190	240	260	–
			Ingestion [c]	H	52	200	380	8.5E04	1.5E05	1.9E05	4.3E05
			Inhalation [c]	H	690	740	900	1,300	1,800	2,200	2,700
			Aggregate	H	34	71	97	160	210	230	2,700
		Chronic	Dermal	H	110	130	150	190	240	260	–
			Ingestion [c]	H	52	200	390	2.8E05	5.1E05	6.4E05	1.4E06
			Inhalation [c]	H	3,300	3,500	4,300	6,200	8,800	1.0E04	1.3E04
			Aggregate	H	35	77	110	180	230	250	1.3E04
	Children's toys (legacy)	Acute	Dermal	H	110	130	150	190	240	260	–
			Ingestion [c]	H	51	190	340	8,500	1.5E04	1.9E04	4.3E04
			Inhalation [c]	H	69	74	90	130	180	220	270
			Aggregate	H	23	38	49	76	100	120	270
			Aggregate	M	64	91	120	180	230	250	1,400
		Chronic	Dermal	H	110	130	150	190	240	260	–
			Ingestion [c]	H	52	190	370	2.8E04	5.1E04	6.4E04	1.4E05
			Inhalation [c]	H	330	350	430	620	880	1,000	1,300
			Aggregate	H	32	64	86	140	190	210	1,300
	Tire crumb	Acute	Dermal	H	–	–	1.1E06	1.2E06	1.6E06	1.8E06	1.7E06
			Ingestion	H	–	–	3.4E08	7.7E08	1.4E09	3.5E09	3.9E09
			Inhalation	H	–	–	2.5E08	3.7E08	1.9E08	3.6E08	3.9E08
			Aggregate	H	–	–	1.1E06	1.2E06	1.5E06	1.8E06	1.7E06
		Chronic	Dermal	H	–	–	5.4E06	5.7E06	4.1E06	4.7E06	8.0E06
			Ingestion	H	–	–	1.6E09	3.6E09	3.6E09	9.1E09	1.8E10
			Inhalation	H	–	–	1.2E09	1.7E09	5.0E08	9.5E08	1.8E09
			Aggregate	H	–	–	5.3E06	5.7E06	4.1E06	4.6E06	8.0E06
	Small articles with semi routine contact; miscellaneous items including a football, balance ball, and pet toys	Acute	Dermal	H	120	140	160	200	250	280	260
			Ingestion	–	–	–	–	–	–	–	–
			Inhalation	–	–	–	–	–	–	–	–
		Chronic	Dermal	H	120	140	160	200	250	280	260
			Ingestion	–	–	–	–	–	–	–	–
			Inhalation	–	–	–	–	–	–	–	–

Life Cycle Stage: COU: Subcategory	Product or Article	Duration	Exposure Route	Exposure Scenario (H, M, L) [a]	Lifestage (years) MOE (Benchmark MOE = 30)						
					Infant (<1 Year)	Toddler (1–2 Years)	Pre-schooler (3–5 years)	Middle Childhood (6–10 years)	Young Teen (11–15 years)	Teenagers (16–20 years)	Adults (21+ years)
Consumer uses: Other v: Chemiluminescent light sticks	Small articles with semi routine contact; glow sticks	Acute	Dermal	H	120	140	160	200	250	280	260
			Ingestion	–	–	–	–	–	–	–	–
			Inhalation	–	–	–	–	–	–	–	–
		Chronic	Dermal	H	120	140	160	200	250	280	260
			Ingestion	–	–	–	–	–	–	–	–
			Inhalation	–	–	–	–	–	–	–	–
Consumer uses: Other uses: Automotive articles	Car mats	Acute	Dermal	H	–	–	–	–	1,800	2,000	1,800
			Ingestion [c]	H	3.8E06	3.1E06	2.8E06	7.7E06	1.3E07	1.7E07	3.4E07
			Inhalation [c]	H	6.1E04	6.5E04	7.9E04	1.1E05	1.6E05	1.9E05	2.4E05
			Aggregate	H	6.0E04	6.3E04	7.7E04	1.1E05	1,800	1,900	1,800
		Chronic	Dermal	H	–	–	–	–	1.3E04	1.4E04	1.3E04
			Ingestion [c]	H	1.3E07	1.1E07	9.5E06	2.6E07	4.5E07	5.7E07	1.2E08
			Inhalation [c]	H	3.0E05	3.1E05	3.9E05	5.6E05	7.9E05	9.2E05	1.1E06
			Aggregate	H	2.9E05	3.1E05	3.7E05	5.4E05	1.2E04	1.4E04	1.3E04
	Synthetic leather seats (see synthetic leather furniture)	Acute	Dermal	H	–[d]	–[d]	–[d]	–[d]	–[d]	–[d]	–[d]
				M	–[d]	–[d]	41	54	69	76	72
				L	–[d]	140	160	200	250	280	260
			Ingestion [c]	H	83	140	220	2.3E06	4.1E06	5.2E06	1.2E07
				M	280	380	670	2.3E07	4.1E07	5.2E07	1.2E08
				L	1.1E05	7.6E04	1.4E05	3.4E07	6.1E07	7.7E07	1.7E08
			Inhalation [c]	H	5.7E04	6.0E04	7.4E04	1.1E05	1.5E05	1.8E05	2.2E05
				M	5.8E05	6.1E05	7.5E05	1.1E06	1.5E06	1.8E06	2.2E06
				L	8.8E05	9.3E05	1.1E06	1.6E06	2.3E06	2.7E06	3.4E06
			Aggregate	H	83	140	220	1.0E05	1.5E05	1.7E05	2.1E05
				M	280	380	39	54	69	76	72
				L	9.7E04	140	160	200	250	280	260
		Chronic	Dermal	H	–[d]	–[d]	–[d]	–[d]	–[d]	–[d]	–[d]
				M	–[d]	–[d]	41	54	69	76	72
				L	–[d]	140	160	200	250	280	260
			Ingestion [c]	H	83	140	220	2.5E06	4.5E06	5.7E06	1.3E07
				M	280	380	670	2.5E07	4.5E07	5.7E07	1.3E08
				L	1.1E05	7.6E04	1.4E05	3.7E07	6.7E07	8.4E07	1.9E08
		Chronic	Inhalation [c]	H	5.9E04	6.3E04	7.7E04	1.1E05	1.6E05	1.8E05	2.3E05
				M	6.0E05	6.4E05	7.9E05	1.1E06	1.6E06	1.9E06	2.3E06
				L	9.2E05	9.7E05	1.2E06	1.7E06	2.4E06	2.8E06	3.5E06

Life Cycle Stage: COU: Subcategory	Product or Article	Duration	Exposure Route	Exposure Scenario (H, M, L) [a]	Lifestage (years) MOE (Benchmark MOE = 30)						
					Infant (<1 Year)	Toddler (1–2 Years)	Pre-schooler (3–5 years)	Middle Childhood (6–10 years)	Young Teen (11–15 years)	Teenagers (16–20 years)	Adults (21+ years)
			Aggregate	H	83	140	220	1.1E05	1.5E05	1.8E05	2.2E05
				M	280	380	39	54	69	76	72
				L	120	140	160	200	250	280	260
Consumer uses: Other uses: Novelty articles	Adult toys	Acute	Dermal	H	–	–	–	–	–	780	730
				M	–	–	–	–	–	1,100	1,000
			Ingestion	H	–	–	–	–	–	–[d]	–[d]
				M	–	–	–	–	–	190	210
			Inhalation	–	–	–	–	–	–	–	–
			Aggregate	H	–	–	–	–	–	–[d]	–[d]
				M	–	–	–	–	–	160	170
		Chronic	Dermal	H	–	–	–	–	–	780	730
				M	–	–	–	–	–	1,100	1,000
			Ingestion	H	–	–	–	–	–	–[d]	–[d]
				M	–	–	–	–	–	190	210
			Inhalation	–	–	–	–	–	–	–	–
			Aggregate	H	–	–	–	–	–	–[d]	–[d]
				M	–	–	–	–	–	160	170
Consumer uses: Other uses: Lubricants and lubricant additives	No consumer products identified. Foreseeable uses were matched with adhesives for small repairs because similar use patterns are expected.										

[a] Exposure scenario intensities include high (H), medium (M), and low (L).
[b] MOE for bystander scenario
[c] Exposure routes evaluated for indoor environments.
[d] Scenario was deemed to be unlikely due to high uncertainties.
Bold text in a gray shaded cell indicates an MOE below the benchmark value of 30.

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4.3.4 Risk Estimates for General Population

As described in the *Draft Environmental Media and General Population Screening for Dibutyl Phthalate (DBP)* (U.S. EPA, 2025p) and Section 4.1.3, EPA employed a screening level approach for general population exposures for DBP releases associated with TSCA COUs. Fenceline communities were considered as part of the general population in proximity to releasing facilities as part of the ambient air exposure assessment by utilizing pre-screening methodology described in EPA's *Draft TSCA Screening Level Approach for Assessing Ambient Air and Water Exposures to Fenceline Communities (Version 1.0)* (U.S. EPA, 2022b). For other exposure pathways, the Agency's screening method assessing high-end exposure scenarios used release data that reflect exposures expected to occur in proximity to releasing facilities, which would include fenceline communities.

EPA evaluated surface water, drinking water, fish ingestion, and ambient air pathways quantitatively. Land pathways (*i.e.,* landfills and application of biosolids) were assessed qualitatively, and were inclusive of down-the-drain disposal of consumer products and landfill disposal of consumer articles (see Section 3.1.4 for details on the qualitative assessment of consumer disposal of DBP-containing products and articles). For pathways assessed quantitatively, high-end estimates of DBP concentration in the various environmental media were used for screening level purposes. EPA used an MOE approach using high-end exposure estimates to determine whether an exposure pathway had potential non-cancer risks. High-end exposure estimates were defined as those associated with the industrial and commercial releases from a COU and OES that resulted in the highest environmental media concentrations. Therefore, if there is no risk for an individual identified as having the potential for the highest exposure associated with a COU for a given pathway of exposure, then that pathway was determined not to be a pathway of concern and not pursued further. If any pathways were identified as a pathway of concern for the general population, further exposure assessments for that pathway would be conducted to include higher tiers of modeling when available and exposure estimates for additional subpopulations and COUs. Based on the screening level approach described in Section 4.1.3 and the qualitative assessment of landfill and biosolids pathways as described above, exposure to DBP through biosolids, landfills, surface water, drinking water, fish ingestion, and ambient air were not determined to be pathways of concern for any COU listed in Table 3-1.

4.3.4.1 Overall Confidence in General Population Risk

As described in Sections 3.3.1.1 and 4.1.3.3 and in more technical detail in the *Draft Environmental Media and General Population and Environmental Exposure for Dibutyl Phthalate (DBP)* (U.S. EPA, 2025p), EPA has robust confidence that modeled releases used for the screening level analysis are appropriately conservative for a screening level analysis. *Therefore, EPA has robust confidence that no exposure scenarios will lead to greater doses than presented in this evaluation.* Despite moderate confidence in the estimated values themselves, confidence in exposure estimates capturing high-end exposure scenarios was robust given the conservative assumptions used for the estimates. Along with EPA's robust confidence in the non-cancer POD selected to characterize risk from acute, intermediate, and chronic duration exposures to DBP (see Section 4.2 and (U.S. EPA, 2024f)), EPA has robust confidence that the risk estimates calculated for the general population were conservative and appropriate for a screening level analysis.

4.3.5 Risk Estimates for Potentially Exposed or Susceptible Subpopulations

EPA considered PESS throughout the exposure assessment and throughout the hazard identification and dose-response analysis supporting the draft DBP risk evaluation.

Some population group lifestages may be more susceptible to the health effects of DBP exposure. As discussed in Section 4.2 and in Section 5.2 of EPA's *Draft Non-cancer Human Health Hazard Assessment for Dibutyl Phthalate (DBP)* (U.S. EPA, 2024f), exposure to DBP leads to adverse effects on the developing male reproductive system consistent with a disruption of androgen action and phthalate syndrome in experimental animal models and therefore females of reproductive age, pregnant women, infants, children and adolescents are considered to be susceptible subpopulations. These susceptible lifestages were considered throughout the draft risk evaluation. For example, females of reproductive age were evaluated for occupational exposures to DBP for each COU (Section 4.3.2) and infants (<1 year), toddlers (1–2 years), and middle school children (6–10 years) were evaluated for exposure to DBP through consumer products and articles (Section 4.3.3). The non-cancer POD for DBP selected by EPA for use in risk characterization is based on the most sensitive developmental effect (*i.e.*, reduced fetal testicular testosterone production) observed and is expected to be protective of susceptible subpopulations. Additionally, EPA used a value of 10 for the UF_H to account for human variability. The Risk Assessment Forum, in *A Review of the Reference Dose and Reference Concentration Processes*, discusses some of the evidence for choosing the default factor of 10 when data are lacking—including toxicokinetic and toxicodynamic factors as well as greater susceptibility of children and elderly populations (U.S. EPA, 2002b).

The available data suggest that some groups or lifestages have greater exposure to DBP. This includes people exposed to DBP at work, those who frequently use consumer products and/or articles containing high-concentrations of DBP, those who may have greater intake of DBP per body weight (*e.g.*, infants, children, and adolescents), and those exposed to DBP through certain age-specific behaviors (*e.g.*, mouthing of toys, wires, and erasers by infants and children) leading to greater exposure. EPA accounted for these populations with greater exposure in the draft DBP risk evaluation as follows:

- EPA evaluated a range of OESs for workers and ONUs, including high-end exposure scenarios for females of reproductive age (a susceptible subpopulation) and average adult workers.
- EPA evaluated a range of consumer exposure scenarios, including high-intensity exposure scenarios for infants and children (susceptible subpopulations). These populations had greater intake per body weight and exposure due to age-specific behaviors (*e.g.*, mouthing of toys by infants and children).
- EPA evaluated a range of general population exposure scenarios, including high-end exposure scenarios for infants and children (susceptible subpopulations). These populations had greater intake per body weight.
- EPA evaluated exposure of children to DBP through use of legacy and new toys.
- EPA evaluated exposure to DBP through fish ingestion for subsistence fishers and Tribal populations.
- EPA aggregated occupational inhalation and dermal exposures for each COU for females of reproductive age (a susceptible subpopulation) and average adult workers.
- EPA aggregated consumer inhalation, dermal, and oral exposures for each COU for infants and children (susceptible subpopulations).
- EPA evaluated cumulative exposure to DEHP, DBP, BBP, DIBP, and DINP for the U.S. civilian population using NHANES urinary biomonitoring data and reverse dosimetry for females of reproductive age (16–49 years) and male children (3–5, 6–11, and 12–15 years of age) (discussed in Section 4.4).
- For females of reproductive age, black non-Hispanic women had slightly higher 95th percentile cumulative exposures to DEHP, DBP, BBP, DIBP, and DINP compared to females of other races (*e.g.*, white non-Hispanic, Mexican America). The 95th percentile cumulative exposure estimate for black non-Hispanic women served as the non-attributable national cumulative exposure

estimate used by EPA to evaluate cumulative risk to workers and consumers (discussed in Section 4.4).

4.4 Cumulative Risk Considerations

EPA developed a *Revised Draft Technical Support Document for the Cumulative Risk Analysis of DEHP, DBP, BBP, DIBP, DCHP, and DINP Under TSCA* (U.S. EPA, 2025x) (revised draft CRA TSD) for the CRA of six toxicologically similar phthalates being evaluated under Section 6 of TSCA: di(2-ethylhexyl) phthalate (DEHP), butyl benzyl phthalate (BBP), dibutyl phthalate (DBP), dicyclohexyl phthalate (DCHP), diisobutyl phthalate (DIBP), and diisononyl phthalate (DINP). EPA previously issued a *Draft Proposed Approach for Cumulative Risk Assessment of High-Priority Phthalates and a Manufacturer-Requested Phthalate under the Toxic Substances Control Act* (draft 2023 approach), which outlined an approach for this assessment (U.S. EPA, 2023d). EPA's proposal was subsequently peer-reviewed by the Science Advisory Committee on Chemicals (SACC) in May 2023 (U.S. EPA, 2023g). In the 2023 draft approach, EPA identified a cumulative chemical group and PESS [15 U.S.C. § 2605(b)(4)]. Based on toxicological similarity and induced effects on the developing male reproductive system consistent with a disruption of androgen action and phthalate syndrome, EPA proposed a cumulative chemical group of DEHP, BBP, DBP, DCHP, DIBP, and DINP, but not diisodecyl phthalate (DIDP). This approach emphasizes a uniform measure of hazard for sensitive subpopulations, namely females of reproductive age and/or male infants and children, however additional health endpoints are known for broader populations and described in the individual non-cancer human health hazard assessments for DEHP (U.S. EPA, 2024h), DBP (U.S. EPA, 2024f), DIBP (U.S. EPA, 2024i), BBP (U.S. EPA, 2024e), DCHP (U.S. EPA, 2024g), and DINP (U.S. EPA, 2024n), including hepatic, kidney, and other developmental and reproductive toxicity.

EPA's approach for assessing cumulative risk is described in detail in the revised draft CRA TSD (U.S. EPA, 2025x) and incorporates feedback from the SACC (U.S. EPA, 2023g) on EPA's 2023 draft proposal (U.S. EPA, 2023d). The Agency is focusing its CRA on acute duration exposures of females of reproductive age, male infants, and male children to six toxicologically similar phthalates (*i.e.,* DEHP, DBP, BBP, DIBP, DCHP, DINP) that induce effects on the developing male reproductive system consistent with a disruption of androgen action and phthalate syndrome. The Agency is further focusing its CRA on acute duration exposures because there is evidence that effects on the developing male reproductive system consistent with a disruption of androgen action can result from a single exposure during the critical window of development (see Section 1.5 of (U.S. EPA, 2025x) for further details). To evaluate cumulative risk, EPA is using a relative potency factor (RPF) approach. RPFs for DEHP, DBP, BBP, DIBP, DCHP, and DINP were developed using a meta-analysis and benchmark dose (BMD) modeling approach based on a uniform measure (*i.e.,* reduced fetal testicular testosterone). EPA is also using NHANES data to supplement, not substitute, evaluations for exposure scenarios for TSCA COUs to provide non-attributable, total exposure for addition to the relevant scenarios presented in the individual risk evaluations.

The analogy of a "risk cup" is used throughout Section 4.4 to describe cumulative exposure estimates. The risk cup term is used to help conceptualize the contribution of various phthalate exposure routes and pathways to overall cumulative risk estimates and serves primarily as a communication tool. The term/concept describes exposure estimates where the full cup represents the total exposure that leads to risk (cumulative MOE) and each chemical contributes a specific amount of exposure that adds a finite amount of risk to the cup. A full risk cup indicates that the cumulative MOE has dropped below the benchmark MOE (*i.e.,* total UF), whereas cumulative MOEs above the benchmark indicate that only a portion of the risk cup is full.

The remainder of this human health CRA section is organized as follows:

- Section 4.4.1 – Describes the approach used by EPA to derive draft RPFs for DEHP, DBP, BBP, DIBP, DCHP, and DINP based on reduced fetal testicular testosterone, which are used by EPA as part of the current CRA and to assess exposures to individual phthalates by scaling to an index chemical (RPF analysis). Section 2 of EPA's draft revised CRA TSD (U.S. EPA, 2025x) provides more details.
- Section 4.4.2 – Briefly describes the approach used by EPA to calculate cumulative non-attributable phthalate exposure for the U.S. population using NHANES urinary biomonitoring and reverse dosimetry. Section 4 of EPA's draft revised CRA TSD (U.S. EPA, 2025x) provides additional details.
- Section 4.4.3 – Describes how EPA combined exposures to DBP from individual consumer and occupational COUs/OES with cumulative non-attributable phthalate exposures from NHANES to estimate cumulative risk. An empirical example is also provided. Section 5 of EPA's draft revised CRA TSD (U.S. EPA, 2025x) provides additional details.
- Sections 4.4.4 through 4.4.6 – Summarize risk estimates for workers, consumers, and the general population based on relative potency assumptions.

For additional details regarding EPA's draft CRA, readers are directed to the following TSDs/reports:

- *Revised Draft Technical Support Document for the Cumulative Risk Analysis of Di(2-ethylhexyl) Phthalate (DEHP), Dibutyl Phthalate (DBP), Butyl Benzyl Phthalate (BBP), Diisobutyl Phthalate (DIBP), Dicyclohexyl Phthalate (DCHP), and Diisononyl Phthalate (DINP) Under the Toxic Substances Control Act (TSCA)* (U.S. EPA, 2025x);
- *Draft Meta-Analysis and Benchmark Dose Modeling of Fetal Testicular Testosterone for Di(2-ethylhexyl) Phthalate (DEHP), Dibutyl Phthalate (DBP), Butyl Benzyl Phthalate (BBP), Diisobutyl Phthalate (DIBP), and Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2024d);
- *Draft Proposed Approach for Cumulative Risk Assessment of High-Priority Phthalates and a Manufacturer-Requested Phthalate under the Toxic Substances Control Act* (U.S. EPA, 2023d);
- *Draft Proposed Principles of Cumulative Risk Assessment under the Toxic Substances Control Act* (U.S. EPA, 2023e); and
- *Science Advisory Committee on Chemicals meeting minutes and final report, No. 2023-01 - A set of scientific issues being considered by the Environmental Protection Agency regarding: Draft Proposed Principles of Cumulative Risk Assessment (CRA) under the Toxic Substances Control Act and a Draft Proposed Approach for CRA of High-Priority Phthalates and a Manufacturer-Requested Phthalate* (U.S. EPA, 2023g).

4.4.1 Hazard Relative Potency

This section briefly summarizes the RPF approach used by EPA to evaluate phthalates for cumulative risk. Section 4.4.1.1 provides a brief overview and background for the RPF approach methodology, while Section 4.4.1.2 provides a brief overview of the draft RPFs derived by EPA for DEHP, DBP, BBP, DIBP, DCHP, and DINP based on decreased fetal testicular testosterone. Further details regarding the draft relative potency analysis conducted by EPA are provided in the following two TSDs:

- *Revised Draft Technical Support Document for the Cumulative Risk Analysis of Di(2-ethylhexyl) Phthalate (DEHP), Dibutyl Phthalate (DBP), Butyl Benzyl Phthalate (BBP), Diisobutyl*

Phthalate (DIBP), Dicyclohexyl Phthalate (DCHP), and Diisononyl Phthalate (DINP) Under the Toxic Substances Control Act (TSCA) (U.S. EPA, 2025x); and

- *Draft Meta-Analysis and Benchmark Dose Modeling of Fetal Testicular Testosterone for Di(2-ethylhexyl) Phthalate (DEHP), Dibutyl Phthalate (DBP), Butyl Benzyl Phthalate (BBP), Diisobutyl Phthalate (DIBP), and Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2024d).

4.4.1.1 Relative Potency Factor Approach Overview

For the RPF approach, chemicals being evaluated require data that support toxicologic similarity (*e.g.*, components of a mixture share a known or suspected common MOA or share a common apical endpoint/effect) and have dose-response data for the effect of concern over similar exposure ranges (U.S. EPA, 2023b, 2000, 1986). RPF values account for potency differences among chemicals in a mixture and scale the dose of one chemical to an equitoxic dose of another chemical (*i.e.*, the index chemical). The chemical selected as the index chemical is often among the best characterized toxicologically and considered to be representative of the type of toxicity elicited by other components of the mixture. Implementing an RPF approach requires a quantitative dose-response assessment for the index chemical and pertinent data that allow the potency of the mixture components to be meaningfully compared to that of the index chemical. In the RPF approach, RPFs are calculated as the ratio of the potency of the individual component to that of the index chemical using either (1) the response at a fixed dose, or (2) the dose at a fixed response (Equation 4-3).

Equation 4-3. Calculating RPFs

$$RPF_i = \frac{BMD_{R-IC}}{BMD_{R-i}}$$

Where:

BMD	=	Benchmark dose (mg/kg/day)
R	=	Magnitude of response (*i.e.*, benchmark response)
I	=	i^{th} chemical
IC	=	Index chemical

After scaling the chemical component doses to the potency of the index chemical, the scaled doses are summed and expressed as index chemical equivalents for the mixture (Equation 4-4).

Equation 4-4. Calculating Index Chemical Equivalents

$$Index\ Chemical\ Equivalents_{MIX} = \sum_{i=1}^{n} d_i \times RPF_i$$

Where:

Index chemical equivalents	=	Dose of the mixture in index chemical equivalents (mg/kg/day)
d_i	=	Dose of the i^{th} chemical in the mixture (mg/kg/day)
RPF_i	=	Relative potency factor of the i^{th} chemical in the mixture (unitless)

Non-cancer risk associated with exposure to an individual chemical or mixture can then be assessed by calculating an MOE, which in this case is the ratio of the index chemical's non-cancer hazard value (*e.g.*, the BMDL) to an estimate of exposure expressed in terms of index chemical equivalents. The MOE is then compared to the benchmark MOE (*i.e.*, the total uncertainty factor associated with the assessment) to characterize risk.

4.4.1.2 Relative Potency Factors

Derivation of Draft RPFs

To derive RPFs for DEHP, DBP, BBP, DIBP, DCHP, and DINP, EPA utilized a meta-analysis and BMD modeling approach similar to that used by NASEM (2017) to model decreased fetal testicular testosterone. As described further in EPA's *Draft Meta-Analysis and Benchmark Dose Modeling of Fetal Testicular Testosterone for DEHP, DBP, BBP, DIBP, and DCHP* (U.S. EPA, 2024d), the Agency evaluated benchmark responses (BMRs) of 5, 10, and 40 percent. For input into the CRA of phthalates, EPA has derived draft RPFs using BMD_{40} estimates (Table 4-20). For further details regarding RPFs derivation, see Section 2 of the draft CRA TSD (U.S. EPA, 2025x).

Selection of the Index Chemical

As described further in Section 2 of (draft CRA TSD) (U.S. EPA, 2025x), *EPA has preliminarily selected DBP as the index chemical*. DBP has a high-quality toxicological database of studies demonstrating effects on the developing male reproductive system consistent with a disruption of androgen action and phthalate syndrome. Furthermore, studies of DBP demonstrate toxicity representative of all phthalates in the cumulative chemical group and DBP is well characterized for the MOA associated with phthalate syndrome. Finally, compared to other phthalates, including well-studied phthalates such as DEHP, DBP has the most dose-response data available in the low-end range of the dose-response curve where the BMD_5 and $BMDL_5$ are derived, which provides a robust and scientifically sound foundation of BMD and BMDL estimates on which the RPF approach is based.

Table 4-20. Draft Relative Potency Factors Based on Decreased Fetal Testicular Testosterone

Phthalate	BMD_{40} (mg/kg-day)	RPF Based on BMD_{40}
DBP (Index chemical)	149	**1**
DEHP	178	**0.84**
DIBP	279	**0.53**
BBP	284	**0.52**
DCHP	90	**1.66**
DINP	699	**0.21**

Index Chemical POD

As with any risk assessment that relies on BMD analysis, the POD is the lower confidence limit used to mark the beginning of extrapolation to determine risk associated with human exposures. As described further in the non-cancer human health hazards of DEHP (U.S. EPA, 2024h), DBP (U.S. EPA, 2024f), BBP (U.S. EPA, 2024e), DIBP (U.S. EPA, 2024i), DCHP (U.S. EPA, 2024g), and DINP (U.S. EPA, 2024n) (see Appendices titled "Considerations for Benchmark Response (BMR) Selection for Reduced Fetal Testicular Testosterone" in each hazard assessment), EPA has reached the conclusion that a BMR of 5 percent is the most appropriate and health protective response level for evaluating decreased fetal testicular testosterone. For the index chemical, DBP, the $BMDL_5$ for the best fitting linear-quadratic model is 9 mg/kg-day for reduced fetal testicular. Using allometric body weight scaling to the ¾- power (U.S. EPA, 2011c), EPA extrapolated an HED of 2.1 mg/kg-day to use as the POD for the index chemical in the CRA.

Selection of the Benchmark MOE

Consistent with Agency guidance (U.S. EPA, 2022c, 2002b), EPA selected an intraspecies uncertainty factor (UF_H) of 10, which accounts for variation in susceptibility across the human population and the possibility that the available data might not be representative of individuals who are most susceptible to the effect. EPA used allometric body weight scaling to the ¾-power to derive an HED of 2.1 mg/kg-day DBP, which accounts for species differences in toxicokinetics. Consistent with EPA Guidance (U.S. EPA, 2011c), the interspecies uncertainty factor (UF_A), was reduced from 10 to 3 to account for remaining uncertainty associated with interspecies differences in toxicodynamics. Overall, a total uncertainty factor of 30 was selected for use as the benchmark margin of exposure for the CRA (based on an interspecies uncertainty factor [UF_A] of 3 and an intraspecies uncertainty factor [UF_H] of 10).

Weight of Scientific Evidence

EPA has preliminary selected an HED of 2.1 mg/kg-day ($BMDL_5$ of 9 mg/kg-day) as the index chemical (DBP) POD. This POD is based on a meta-analysis and BMD modeling of decreased fetal testicular testosterone from eight studies of rats gestationally exposed to DBP. EPA has also derived draft RPFs of 1, 0.84, 0.53, 0.52, 1.66, and 0.21 for DBP (index chemical), DEHP, DIBP, BBP, DCHP, and DINP, respectively, based on a common toxicological outcome (*i.e.*, reduced fetal testicular testosterone). EPA has robust overall confidence in the proposed POD for the index chemical (*i.e.*, DBP) and the derived draft RPFs.

Application of RPF provides a more robust basis for assessing the dose-response to the common hazard endpoint across all assessed phthalates. For a subset of the phthalates with a more limited toxicological data set, scaling by the RPF and application of the index chemical POD provides a more sensitive and robust hazard assessment than the chemical-specific POD. Readers are directed to the revised draft CRA TSD (U.S. EPA, 2025x) for a discussion of the weight of evidence supporting EPA's preliminary conclusions.

4.4.2 Cumulative Phthalate Exposure: Non-Attributable Cumulative Exposure to DEHP, DBP, BBP, DIBP, and DINP Using NHANES Urinary Biomonitoring and Reverse Dosimetry

This section briefly summarizes EPA's approach and results for estimating non-attributable cumulative exposure to phthalates using NHANES urinary biomonitoring data and reverse dosimetry. Readers are directed to Section 4 of EPA's revised draft CRA TSD (U.S. EPA, 2025x) for additional details.

NHANES is an ongoing exposure assessment of the U.S. population's exposure to environmental chemicals using biomonitoring. The NHANES biomonitoring data set is a national, statistical representation of the general, non-institutionalized, civilian U.S. population. CDC's NHANES data set provides an estimate of average aggregate exposure to individual phthalates for the U.S. population. However, exposures measured via NHANES cannot be attributed to specific sources, such as TSCA COUs or other sources. Given the short half-lives of phthalates, neither can NHANES capture acute, low frequency exposures. Instead, as concluded by the SACC review of the draft 2023 approach, NHANES provides a "snapshot" or estimate of total, non-attributable phthalate exposure for the U.S. population and relevant subpopulations (U.S. EPA, 2023g). These estimates of total non-attributable exposure can supplement assessments of scenario-specific acute risk in individual risk evaluations.

Monoester metabolites of BBP, DBP, DEHP, DIBP, and DINP in human urine are regularly measured as part of the NHANES biomonitoring program and are generally detectable in human urine at a high frequency, including during the most recent NHANES survey period (*i.e.*, 2017–2018). One urinary metabolite (*i.e.*, monocyclohexyl phthalate [MCHP]) of DCHP was included in NHANES from 1999 through 2010, but was excluded from NHANES after 2010 due to low detection levels and a low frequency of detection in human urine (detected in <10% of samples in 2009–2010 NHANES survey) (CDC, 2013).Therefore, EPA did not use NHANES urinary biomonitoring data to estimate a daily aggregate intake value for DCHP through reverse dosimetry.

EPA used urinary phthalate metabolite concentrations for DEHP, DBP, BBP, DIBP, and DINP measured in the most recently available NHANES survey (2017–2018) to estimate the average daily aggregate intake of each phthalate through reverse dosimetry for

1. Women of reproductive age (16–49 years);
2. Male children (4 to <6 years, used as a proxy for male infants and toddlers);
3. Male children (6–11 years); and
4. Male children (12 to <16 years).

Since NHANES does not include urinary biomonitoring for infants or toddlers, and other national data sets are not available, EPA used biomonitoring data from male children 3 to less than 6 years of age as a proxy for male infants (<1 year) and male toddlers (1–2 years). See Section 4 of (U.S. EPA, 2025x) for further details regarding the reverse dosimetry approach. Aggregate daily intake estimates for these populations are presented in Table 4-21.[5] Aggregate daily intake values were also calculated for females of reproductive age stratified by race and socioeconomic status (Table 4-22). A similar analysis by race was not done for male children because the NHANES sample size is smaller for this population.

Aggregate daily intake values for each phthalate were then scaled by relative potency using the RPFs in Table 4-20, expressed in terms of index chemical (DBP) equivalents, and summed to estimate cumulative daily intake in terms of index chemical (DBP) equivalents using the approach outlined in Sections 4.4.1 and 4.4.3.

Because EPA is focusing its CRA on acute exposure durations, EPA selected 95th percentile exposure estimates from NHANES to serve as the non-attributable nationally representative exposure estimate for use in its CRA. For females of reproductive age, EPA's analysis indicates that black, non-Hispanic women have slightly higher 95th percentile cumulative phthalate exposure compared to other racial groups; thus, 95th percentile cumulative exposure estimates for black non-Hispanic females of reproductive age was selected for use in the CRA of DBP (Table 4-22).
The 95th percentile of national cumulative exposure serves as the estimate of non-attributable phthalate exposure for its CRA of DBP as follows:

- Women of reproductive age (16–49 years, black non-Hispanic): 5.16 µg/kg-day index chemical (DBP) equivalents. This serves as the non-attributable contribution to worker and consumer females of reproductive age in Section 4.4.4 and Section 4.4.5.
- Males (3–5 years): 10.8 µg/kg-day index chemical (DBP) equivalents. This serves as the non-attributable contribution to consumer male infants (<1 year), toddlers (1–2 years), and preschoolers (3–5 years) in Section 4.4.5. Since NHANES does not include urinary biomonitoring for infants (<1 year) or toddlers (1–2 years), and other national data sets are not available, EPA used biomonitoring data from male children (3 to <6 years) as a proxy for male infants and toddlers.
- Males (6–11 years): 7.35 µg/kg-day index chemical (DBP) equivalents This serves as the non-attributable contribution to consumer male children (6–10 years) in Section 4.4.5.

[5] EPA defines *aggregate exposure* as the "combined exposures to an individual from a single chemical substance across multiple routes and across multiple pathways" (40 CFR section 702.33).

- Males (12–15 years): 4.36 µg/kg-day index chemical (DBP) equivalents. This serves as the non-attributable contribution to consumer male teenagers (11–15 years) in Section 4.4.5.

4.4.2.1 Weight of Scientific Evidence: Non-Attributable Cumulative Exposure to Phthalates

Overall, EPA has robust confidence in the derived estimates of non-attributable cumulative exposure from NHANES urinary biomonitoring using reverse dosimetry. EPA used urinary biomonitoring data from the CDC's national NHANES dataset, which provides a statistical representation of the general, non-institutionalized, civilian U.S. population. To estimate daily intake values from urinary biomonitoring for each phthalate, EPA used reverse dosimetry. The reverse dosimetry approach used by EPA has been used extensively in the literature and has been used by CPSC (2014) and Health Canada (Health Canada, 2020) to estimate phthalate daily intake values from urinary biomonitoring data. However, given the short half-lives of phthalates, NHANES biomonitoring data are not expected to capture low frequency exposures and may be an underestimate of acute phthalate exposure.

4443 **Table 4-21. Cumulative Phthalate Daily Intake (µg/kg-day) Estimates for Women of Reproductive Age, Male Children, and Male**
4444 **Teenagers from the 2017–2018 NHANES Cycle**

Population	Percentile	Phthalate	Aggregate Daily Intake (µg/kg-day)	RPF	Aggregate Daily Intake in DBP Equivalents (µg/kg-day)	% Contribution to Cumulative Exposure	Cumulative Daily Intake (DBP Equivalents, µg/kg-day)	Cumulative MOE (POD = 2,100 µg/kg-day)	% Contribution to Risk Cup (Benchmark = 30)[a]
Females (16–49 years; n = 1,620)	50	DBP	0.21	1	0.210	22.1	0.950	2,211	1.4%
		DEHP	0.53	0.84	0.445	46.9			
		BBP	0.08	0.52	0.042	4.38			
		DIBP	0.2	0.53	0.106	11.2			
		DINP	0.7	0.21	0.147	15.5			
	95	DBP	0.61	1	0.610	17.2	3.55	592	5.1%
		DEHP	1.48	0.84	1.24	35.0			
		BBP	0.42	0.52	0.218	6.15			
		DIBP	0.57	0.53	0.302	8.51			
		DINP	5.6	0.21	1.18	33.1			
Males (3–5 years; n = 267)	50	DBP	0.56	1	0.560	18.4	3.04	690	4.3%
		DEHP	2.11	0.84	1.77	58.2			
		BBP	0.22	0.52	0.114	3.76			
		DIBP	0.57	0.53	0.302	9.93			
		DINP	1.4	0.21	0.294	9.66			
	95	DBP	2.02	1	2.02	18.6	10.8	194	15.5%
		DEHP	6.44	0.84	5.41	49.9			
		BBP	2.46	0.52	1.28	11.8			
		DIBP	2.12	0.53	1.12	10.4			
		DINP	4.8	0.21	1.01	9.30			
Males (6–11 years; n = 553)	50	DBP	0.38	1	0.380	20.1	1.89	1,111	2.7%
		DEHP	1.24	0.84	1.04	55.1			
		BBP	0.16	0.52	0.083	4.40			
		DIBP	0.33	0.53	0.175	9.26			

Population	Percentile	Phthalate	Aggregate Daily Intake (µg/kg-day)	RPF	Aggregate Daily Intake in DBP Equivalents (µg/kg-day)	% Contribution to Cumulative Exposure	Cumulative Daily Intake (DBP Equivalents, µg/kg-day)	Cumulative MOE (POD = 2,100 µg/kg-day)	% Contribution to Risk Cup (Benchmark = 30)[a]
		DINP	1	0.21	0.210	11.1			
	95	DBP	1.41	1	1.41	19.2	7.35	286	10.5%
		DEHP	4.68	0.84	3.93	53.5			
		BBP	0.84	0.52	0.437	5.94			
		DIBP	1.62	0.53	0.859	11.7			
		DINP	3.4	0.21	0.714	9.71			
Males (12–15 years; n = 308)	50	DBP	0.33	1	0.330	27.6	1.19	1,758	1.7%
		DEHP	0.66	0.84	0.554	46.4			
		BBP	0.14	0.52	0.073	6.09			
		DIBP	0.21	0.53	0.111	9.32			
		DINP	0.6	0.21	0.126	10.5			
	95	DBP	0.62	1	0.620	14.2	4.36	482	6.2%
		DEHP	2.51	0.84	2.11	48.3			
		BBP	0.64	0.52	0.333	7.63			
		DIBP	0.59	0.53	0.313	7.17			
		DINP	4.7	0.21	0.987	22.6			

[a] A cumulative exposure of 70 µg DBP equivalents/kg-day would result in a cumulative MOE of 30 (*i.e.*, 2,100 µg DBP-equivalents/kg-day ÷ 70 µg DBP equivalents/kg-day = 30), which is equivalent to the benchmark of 30, indicating that the exposure is at the threshold for risk. Therefore, to estimate the percent contribution to the risk cup, the cumulative exposure expressed in DBP equivalents is divided by 70 µg DBP equivalents/kg-day to estimate percent contribution to the risk cup.

4445

4446 4447 **Table 4-22. Cumulative Phthalate Daily Intake (µg/kg-day) Estimates for Women of Reproductive Age (16–49 years old) by Race and Socioeconomic Status from the 2017–2018 NHANES Cycle**

Race/ Socioeconomic Status (SES)	Percentile	Phthalate	Aggregate Daily Intake (µg/kg-day)	RPF	Aggregate Daily Intake in DBP Equivalents (µg/kg-day)	% Contribution to Cumulative Exposure	Cumulative Daily Intake (DBP Equivalents, µg/kg-day)	Cumulative MOE (POD = 2,100 µg/kg-day)	% Contribution to Risk Cup (Benchmark = 30) [a]
Race: white non-Hispanic (n = 494)	50	DBP	0.22	1	0.22	21.6	1.02	2,058	1.5%
		DEHP	0.59	0.84	0.50	48.6			
		BBP	0.10	0.52	0.05	5.1			
		DIBP	0.20	0.53	0.11	10.4			
		DINP	0.70	0.21	0.15	14.4			
	95	DBP	0.58	1	0.58	17.6	3.30	636	4.7%
		DEHP	1.44	0.84	1.21	36.6			
		BBP	0.29	0.52	0.15	4.6			
		DIBP	0.55	0.53	0.29	8.8			
		DINP	5.10	0.21	1.07	32.4			
Race: black non-Hispanic (n = 371)	50	DBP	0.10	1	0.10	15.0	0.667	3,151	1.0%
		DEHP	0.38	0.84	0.32	47.9			
		BBP	0.04	0.52	0.02	3.1			
		DIBP	0.15	0.53	0.08	11.9			
		DINP	0.70	0.21	0.15	22.1			
	95	DBP	0.48	1	0.48	9.3	5.16	407	7.4%
		DEHP	4.28	0.84	3.60	69.7			
		BBP	0.30	0.52	0.16	3.0			
		DIBP	0.40	0.53	0.21	4.1			
		DINP	3.40	0.21	0.71	13.8			

Race/ Socioeconomic Status (SES)	Percentile	Phthalate	Aggregate Daily Intake (µg/kg-day)	RPF	Aggregate Daily Intake in DBP Equivalents (µg/kg-day)	% Contribution to Cumulative Exposure	Cumulative Daily Intake (DBP Equivalents, µg/kg-day)	Cumulative MOE (POD = 2,100 µg/kg-day)	% Contribution to Risk Cup (Benchmark = 30) [a]
Race: Mexican American (n = 259)	50	DBP	0.19	1	0.19	22.4	0.849	2,474	1.2%
		DEHP	0.49	0.84	0.41	48.5			
		BBP	0.06	0.52	0.03	3.7			
		DIBP	0.17	0.53	0.09	10.6			
		DINP	0.60	0.21	0.13	14.8			
	95	DBP	0.42	1	0.42	11.6	3.61	582	5.2%
		DEHP	1.24	0.84	1.04	28.9			
		BBP	0.39	0.52	0.20	5.6			
		DIBP	0.46	0.53	0.24	6.8			
		DINP	8.10	0.21	1.70	47.1			
Race: Other (n = 496)	50	DBP	0.26	1	0.26	25.3	1.03	2041	1.5%
		DEHP	0.64	0.84	0.54	52.2			
		BBP	0.07	0.52	0.04	3.5			
		DIBP	0.15	0.46	0.07	6.7			
		DINP	0.60	0.21	0.13	12.2			
	95	DBP	0.84	1	0.84	20.7	4.06	517	5.8%
		DEHP	1.37	0.84	1.15	28.3			
		BBP	0.41	0.52	0.21	5.2			
		DIBP	0.46	0.53	0.24	6.0			
		DINP	7.70	0.21	1.62	39.8			

Race/ Socioeconomic Status (SES)	Percentile	Phthalate	Aggregate Daily Intake (µg/kg-day)	RPF	Aggregate Daily Intake in DBP Equivalents (µg/kg-day)	% Contribution to Cumulative Exposure	Cumulative Daily Intake (DBP Equivalents, µg/kg-day)	Cumulative MOE (POD = 2,100 µg/kg-day)	% Contribution to Risk Cup (Benchmark = 30) [a]
SES: Below poverty level (n = 1,056)	50	DBP	0.21	1	0.21	22.0	0.955	2,199	1.4%
		DEHP	0.53	0.84	0.45	46.6			
		BBP	0.09	0.52	0.05	4.9			
		DIBP	0.20	0.53	0.11	11.1			
		DINP	0.70	0.21	0.15	15.4			
	95	DBP	0.82	1	0.82	18.2	4.50	467	6.4%
		DEHP	1.75	0.84	1.47	32.7			
		BBP	0.34	0.52	0.18	3.9			
		DIBP	0.51	0.53	0.27	6.0			
		DINP	8.40	0.21	1.76	39.2			
SES: At or above poverty level (n = 354)	50	DBP	0.20	1.00	0.20	27.9	0.718	2,924	1.0%
		DEHP	0.31	0.84	0.26	36.3			
		BBP	0.06	0.52	0.03	4.3			
		DIBP	0.15	0.53	0.08	11.1			
		DINP	0.70	0.21	0.15	20.5			
	95	DBP	0.48	1.00	0.48	16.3	2.94	713	4.2%
		DEHP	1.07	0.84	0.90	30.5			
		BBP	0.45	0.52	0.23	7.9			
		DIBP	0.65	0.53	0.34	11.7			
		DINP	4.70	0.21	0.99	33.5			

Race/ Socioeconomic Status (SES)	Percentile	Phthalate	Aggregate Daily Intake (µg/kg-day)	RPF	Aggregate Daily Intake in DBP Equivalents (µg/kg-day)	% Contribution to Cumulative Exposure	Cumulative Daily Intake (DBP Equivalents, µg/kg-day)	Cumulative MOE (POD = 2,100 µg/kg-day)	% Contribution to Risk Cup (Benchmark = 30) [a]
SES: Unknown (n = 210)	50	DBP	0.26	1.00	0.26	23.2	1.12	1,870	1.6%
		DEHP	0.67	0.84	0.56	50.1			
		BBP	0.06	0.52	0.03	2.8			
		DIBP	0.23	0.53	0.12	10.9			
		DINP	0.70	0.21	0.15	13.1			
	95	DBP	0.60	1.00	0.60	25.5	2.35	893	3.4%
		DEHP	0.86	0.84	0.72	30.7			
		BBP	0.21	0.52	0.11	4.6			
		DIBP	0.35	0.53	0.19	7.9			
		DINP	3.50	0.21	0.74	31.2			

[a] A cumulative exposure of 70 µg DBP equivalents/kg-day would result in a cumulative MOE of 30 (*i.e.*, 2,100 µg DBP-equivalents/kg-day ÷ 70 µg DBP equivalents/kg-day = 30), which is equivalent to the benchmark of 30, indicating that the exposure is at the threshold for risk. Therefore, to estimate the percent contribution to the risk cup, the cumulative exposure expressed in DBP equivalents is divided by 70 µg DBP equivalents/kg-day to estimate percent contribution to the risk cup.

4.4.3 Estimation of Risk Based on Relative Potency

As described in the revised draft CRA TSD (U.S. EPA, 2025x), EPA is focusing its exposure assessment for the CRA for DBP on evaluation of exposures through individual TSCA consumer and occupational DBP COUs as well as non-attributable cumulative exposure to DEHP, DBP, BBP, DIBP, and DINP using NHANES urinary biomonitoring data and reverse dosimetry. Furthermore, EPA is considering two options for characterizing cumulative risk. The Agency uses the first option to estimate cumulative risk in which all phthalate exposures are scaled by relative potency using the RPFs presented in Table 4-20 to express phthalate exposure in terms of index chemical (DBP) equivalents. Exposures from individual DBP consumer or worker COUs/OES were then combined to estimate cumulative risk. Cumulative risk was estimated using the four-step process outlined below, along with one empirical example of how EPA calculated cumulative risk for one occupational OES for DBP (*i.e.,* PVC plastics converting). In the second option, which is presented in Section 5.2 of revised draft CRA TSD (U.S. EPA, 2025x), individual phthalate exposures for consumer and occupational COUs are not scaled by relative potency factors but use the individual phthalate hazard values and are combined with non-attributable cumulative exposures estimated using NHANES. Both options are compared in Section 5.4 of the revised draft CRA TSD and both options for calculating cumulative risk will be peer reviewed by the SACC in 2025. Following peer review and public comment, EPA will select one option for characterizing cumulative risk in the final DBP risk evaluation.

Step 1: Convert DBP Exposure Estimates from Each Individual Consumer and Occupational COU to Index Chemical Equivalents (i.e., Occupational and Consumer Exposure from Sections 4.1.1 and 4.1.2, Respectively)

In this step, DBP acute duration exposure estimates from each consumer and occupational COU/OES are scaled by relative potency and expressed in terms of index chemical (DBP) equivalents using Equation 4-5. This step is repeated for all individual exposure estimates for each route of exposure being assessed for each COU (*i.e.*, inhalation and dermal exposures for occupational COUs; inhalation, ingestion, and dermal exposure for consumer COUs).

Equation 4-5. Scaling DBP Exposures by Relative Potency

$$DBP\ Exposure\ (in\ DBP\ equivalents) = AD_{Route\ 1} x\ RPF_{DBP}$$

Where:

DBP exposure	=	Acute exposure for a given route of exposure from a single occupational or consumer COU expressed in terms of µg/kg index chemical (DBP) equivalents
$AD_{Route\ 1}$	=	Acute dose in µg/kg from a given route of exposure from a single occupational or consumer COU/OES
RPF_{DIBP}	=	The relative potency factor (unitless) for DBP (index chemical) is 1.0. (Table 4-20).

Example: 50th percentile inhalation, dermal, and aggregate DBP exposures for female workers of reproductive age are 47.4, 15.6, and 63.0 µg/kg for the PVC plastics converting OES (U.S. EPA, 2025q). Using Equation 4-5, inhalation, dermal, and aggregate DBP exposures for this OES can be scaled by relative potency. Because the RPF for DBP (index chemical) is 1.0, the inhalation, dermal, and aggregate DBP exposure estimates do not change.

Step 2: Estimate Non-attributable Cumulative Exposure to DEHP, DBP, BBP, DIBP, and DINP Using NHANES Urinary Biomonitoring Data and Reverse Dosimetry (see Section 4.4.2 for Further Details)

Non-attributable exposure for a national population to DEHP, DBP, BBP, DIBP, and DINP was estimated using Equation 4-6, where individual phthalate daily intake values estimated from NHANES biomonitoring data and reverse dosimetry were scaled by relative potency, expressed in terms of index chemical (DBP) equivalents, and summed to estimate non-attributable cumulative exposure in terms of DBP equivalents. Equation 4-6 was used to calculate the cumulative exposure estimates provided in Table 4-21 and Table 4-22.

Equation 4-6. Estimating Non-attributable Cumulative Exposure to DEHP, DBP, BBP, DIBP, and DINP

$$
\begin{aligned}
&Cumulative\ Exposure\ (Non-attributable) \\
&\quad = (DI_{DEHP}\ x\ RPF_{DEHP}) + (DI_{DBP}\ x\ RPF_{DBP}) + (DI_{BBP}\ x\ RPF_{BBP}) \\
&\quad + (DI_{DIBP}\ x\ RPF_{DIBP}) + (DI_{DINP}\ x\ RPF_{DINP})
\end{aligned}
$$

Where:

Cumulative exposure (non-attributable) is expressed in index chemical (DBP) equivalents (µg/kg-day).

DI is the daily intake value (µg/kg-day) for each phthalate that was calculated using NHANES urinary biomonitoring data and reverse dosimetry. DI values for each phthalate for each assessed population are provided in Table 4-21 and Table 4-22.

RPF is the relative potency factor (unitless) for each phthalate from Table 4-20.

Example: The 95th percentile cumulative exposure estimate of 5.16 µg/kg-day DBP equivalents for black, non-Hispanic females of reproductive age (Table 4-22) is calculated using Equation 4-6 as follows:

$$
\begin{aligned}
&5.16\ \mu g/kg\ DBP\ equivalents \\
&\quad = (4.28\ \mu g/kg\ DEHP\ x\ 0.84) + (0.48\ \mu g/kg\ DBP\ x\ 1) + (0.30\ \mu g/kg\ BBP\ x\ 0.52) \\
&\quad + (0.40\ \mu g/kg\ DIBP\ x\ 0.53) + (3.40\ \mu g/kg\ DINP\ x\ 0.21)
\end{aligned}
$$

Step 3: Calculate MOEs for DBP Exposures and for Each Phthalate Exposure Included in the Cumulative Scenario

Next, MOEs are calculated for each exposure of interest that is included in the cumulative scenario using Equation 4-7. For example, this step involves calculating MOEs for inhalation and dermal DBP exposures for each individual COU/OES in Step 1, and an MOE for non-attributable cumulative phthalate exposure from Step 2 above.

Equation 4-7. Calculating MOEs for Exposures of Interest for Use in the RPF and Cumulative Approaches

$$MOE_1 = \frac{Index\ Chemical\ (DBP)\ POD}{Exposure_1\ in\ DBP\ Equivalents}$$

Where:

MOE_1 (unitless)	=	The MOE calculated for each exposure of interest included in the cumulative scenario
Index Chemical (DBP) POD	=	The POD selected for the index chemical, DBP; the index chemical POD is 2,100 µg/kg (Section4.4.1).

*Exposure*₁ = The exposure estimate in DBP equivalents for the pathway of interest (*i.e.*, from Step 1 or 2 above).

Example: Using Equation 4-7, the MOEs for inhalation and dermal DBP exposure estimates for the PVC plastics converting OES in DBP equivalents from Step 1 and the MOE for the non-attributable cumulative exposure estimate in DBP equivalents from Step 2 are 44, 135, and 407, respectively.

$$MOE_{Cumulative\ Non-attributable} = 407 = \frac{2{,}100\ \mu g/kg}{5.16\ \mu g/kg}$$

$$MOE_{COU-Inhalation} = 44 = \frac{2{,}100\ \mu g/kg}{47.4\ \mu g/kg}$$

$$MOE_{COU-Dermal} = 135 = \frac{2{,}100\ \mu g/kg}{15.6\ \mu g/kg}$$

Step 4: Calculate the Cumulative MOE

For the cumulative MOE approach, MOEs for each exposure of interest in the cumulative scenario are first calculated (Step 3). The cumulative MOE for the cumulative scenario can then be calculated using Equation 4-8, which shows the addition of MOEs for the inhalation and dermal exposures routes from an individual DBP COU as well as the MOE for non-attributable cumulative exposure to phthalates from NHANES urinary biomonitoring and reverse dosimetry. Additional MOEs can be added to the equation as necessary (*e.g.*, for the ingestion route for consumer scenarios).

Equation 4-8. Cumulative Margin of Exposure Calculation

$$Cumulative\ MOE = \frac{1}{\frac{1}{MOE_{COU-Inhalation}} + \frac{1}{MOE_{COU-Dermal}} + \frac{1}{MOE_{Cumulative-Non-attributable}} \ldots}$$

Example: The cumulative MOE for the PVC plastics converting OES is 31 and is calculated by summing the MOEs for each exposure of interest from Step 3 as follows:

$$Cumulative\ MOE = 31 = \frac{1}{\frac{1}{44} + \frac{1}{135} + \frac{1}{407}}$$

4.4.4 Risk Estimates for Workers Based on Relative Potency

This section summarizes RPF analysis risk estimates for female workers of reproductive age from acute duration exposures to DBP. In the RPF analysis, EPA focused its occupational risk assessment on this population and exposure duration because as described in Section 4.4 and (U.S. EPA, 2025x), this population and exposure duration is considered most directly applicable to the common hazard outcome that serves as the basis for the RPF analysis (*i.e.*, reduced fetal testicular testosterone).

To evaluate cumulative risk to female workers of reproductive age, EPA combined inhalation and dermal exposures to DBP from each individual occupational COU/OES with non-attributable cumulative exposure to DEHP, DBP, BBP, DIBP, and DINP (estimated from NHANES urinary biomonitoring using reverse dosimetry). As described in Section 4.4.3, for each individual phthalate exposures were scaled by relative potency per chemical, expressed in terms of index chemical (DBP) equivalents, and summed to estimate cumulative exposure and cumulative risk for each COU. Because DBP is the index chemical and the RPF is 1, scaling has no effect on individual DBP exposure estimates. MOEs in Table 4-23 are shown both with (cumulative MOE) and without (MOEs for individual DBP COU derived using the RPF analysis) the addition of non-attributable cumulative exposure (estimated from NHANES using reverse dosimetry) so that MOEs scaled by relative potency can be compared.

As discussed in Section 4.3.2, high-end aggregate MOEs ranged from 0.7 to 20 for all 16 OES evaluated in the individual DBP risk assessment, while central tendency aggregate MOEs ranged from 1.7 to 3.2 for 11 of the 16 OESs evaluated in the individual DBP risk assessment. Addition of non-attributable cumulative exposure would have no impact on risk conclusions for these OES. For the remaining five OESs (*i.e.,* PVC plastics converting; Use of laboratory chemicals [solids]; Fabrication or use of final products or articles; Recycling; and Waste handling, treatment, and disposal), central tendency aggregate MOEs ranged from 33 to 101 in the individual DBP risk assessment (Section 4.3.2). As can be seen from Table 4-23, for the same five OESs (*i.e.,* PVC plastics converting; Use of laboratory chemicals [solids]; Fabrication or use of final products or articles; Recycling; and Waste handling, treatment, and disposal), the addition of non-attributable cumulative exposure (from NHANES) resulted in central tendency cumulative acute MOEs ranging from 31 to 81 (cumulative benchmark = 30). Therefore, in no case did the addition of non-attributable cumulative exposure (from NHANES) result in MOEs dropping below the benchmark of 30.

4.4.4.1 Overall Confidence in Cumulative Worker Risk Estimates

As described in Section 4.1.1.5 and the *Draft Environmental Release and Occupational Exposure Assessment for Dibutyl Phthalate* (U.S. EPA, 2025q), EPA has moderate to robust confidence in the assessed inhalation and dermal OESs (Table 4-5). The Agency has robust confidence in the RPFs and index chemical POD used to calculate the RPF analysis and cumulative MOEs (Section 4.4.1.2). To derive RPFs and the index chemical POD, the Agency integrated data from multiple studies evaluating fetal testicular testosterone using a meta-analysis approach and conducted BMD modeling. Finally, the Agency has robust confidence in the non-attributable cumulative exposure estimates for DEHP, DBP, BBP, DIBP, and DINP derived from NHANES urinary biomonitoring data using reverse dosimetry (Section 4.4.2.1). Overall, EPA has moderate to robust confidence in the cumulative risk estimates calculated for worker exposure scenarios (Table 4-23).

4614 **Table 4-23. Risk Summary Table for Female Workers of Reproductive Age Using the RPF Analysis**

Life Cycle Stage – Category	Subcategory	OES	Exposure Level	Acute MOEs for Female Workers of Reproductive Age (Benchmark = 30)			
				Inhalation MOE (DBP COU; Exposure to DBP)	Dermal MOE (DBP COU; Exposure to DBP)	Aggregate MOE (DBP COU; Exposure to DBP)	Cumulative MOE (Aggregate DBP MOE + Cumulative Non-Attributable) [a]
Manufacturing – Domestic Manufacturing	Domestic Manufacturing	Manufacturing	CT	30	1.8	1.7	1.7
			HE	15	0.9	0.9	0.9
Manufacturing – Importing	Importing	Import and repackaging	CT	30	1.8	1.7	1.7
Processing – Repackaging	Laboratory chemicals in wholesale and retail trade; plasticizers in wholesale and retail trade; and plastics material and resin manufacturing		HE	15	0.9	0.9	0.9
Processing – Processing as a reactant	Intermediate in plastic manufacturing	Incorporation into formulations, mixtures, or reaction products	CT	30	1.8	1.7	1.7
Processing – Incorporation into formulation, mixture, or reaction product	Solvents (which become part of product formulation or mixture) in chemical product and preparation manufacturing; soap, cleaning compound, and toilet preparation manufacturing; adhesive manufacturing; and printing ink manufacturing		HE	15	0.9	0.9	0.9
	Plasticizer in paint and coating manufacturing; plastic material and resin manufacturing; rubber manufacturing; soap, cleaning compound, and toilet preparation manufacturing; textiles, apparel, and leather manufacturing; printing ink manufacturing; basic organic chemical manufacturing; and adhesive and sealant manufacturing						
	Pre-catalyst manufacturing						

Life Cycle Stage – Category	Subcategory	OES	Exposure Level	Acute MOEs for Female Workers of Reproductive Age (Benchmark = 30)			
				Inhalation MOE (DBP COU; Exposure to DBP)	Dermal MOE (DBP COU; Exposure to DBP)	Aggregate MOE (DBP COU; Exposure to DBP)	Cumulative MOE (Aggregate DBP MOE + Cumulative Non-Attributable) [a]
Processing – Processing: incorporation into formulation, mixture, or reaction product	Plasticizer in paint and coating manufacturing; plastic material and resin manufacturing; rubber manufacturing; soap, cleaning compound, and toilet preparation manufacturing; textiles, apparel, and leather manufacturing; printing ink manufacturing; basic organic chemical manufacturing; and adhesive and sealant manufacturing	PVC plastics compounding	CT	44	1.8	1.7	1.7
			HE	5.3	0.9	0.8	0.8
Processing – Processing: incorporation into articles	Plasticizer in adhesive and sealant manufacturing; building and construction materials manufacturing; furniture and related product manufacturing; ceramic powders; plastics product manufacturing; and rubber product manufacturing	PVC plastics converting	CT	44	135	33	31
			HE	5.3	67	4.9	4.9

Life Cycle Stage – Category	Subcategory	OES	Exposure Level	Acute MOEs for Female Workers of Reproductive Age (Benchmark = 30)			
				Inhalation MOE (DBP COU; Exposure to DBP)	Dermal MOE (DBP COU; Exposure to DBP)	Aggregate MOE (DBP COU; Exposure to DBP)	Cumulative MOE (Aggregate DBP MOE + Cumulative Non-Attributable) [a]
Processing – Processing: incorporation into formulation, mixture, or reaction product	Plasticizer in paint and coating manufacturing; plastic material and resin manufacturing; rubber manufacturing; soap, cleaning compound, and toilet preparation manufacturing; textiles, apparel, and leather manufacturing; printing ink manufacturing; basic organic chemical manufacturing; and adhesive and sealant manufacturing	Non-PVC materials manufacturing (compounding and converting)	CT	53	1.8	1.7	1.7
Processing – Incorporation into articles	Plasticizer in adhesive and sealant manufacturing; building and construction materials manufacturing; furniture and related product manufacturing; ceramic powders; plastics product manufacturing; and rubber product manufacturing		HE	9.0	0.9	0.8	0.8
Commercial Use – Construction, paint, electrical, and metal products	Adhesives and sealants	Application of adhesives and sealants	CT	304	1.8	1.8	1.8
Industrial Use – Construction, paint, electrical, and metal products	Adhesives and sealants		HE	152	0.9	0.9	0.9

Life Cycle Stage – Category	Subcategory	OES	Exposure Level	Acute MOEs for Female Workers of Reproductive Age (Benchmark = 30)			
				Inhalation MOE (DBP COU; Exposure to DBP)	Dermal MOE (DBP COU; Exposure to DBP)	Aggregate MOE (DBP COU; Exposure to DBP)	Cumulative MOE (Aggregate DBP MOE + Cumulative Non-Attributable) [a]
Commercial Use – Packaging, paper, plastic, toys, hobby products	Ink, toner, and colorant products	Application of paints and coatings	CT	18	1.8	1.7	1.7
Commercial Use – Commercial use – Construction, paint, electrical, and metal products; Industrial Use – Construction, paint, electrical, and metal products	Paints and coatings		HE	2.9	0.9	0.7	0.7
Industrial Use – Non-incorporative activities	Solvent, including in maleic anhydride manufacturing technology	Use of Industrial Process Solvents	CT	30	1.8	1.7	1.7
			HE	15	0.9	0.9	0.9
Commercial Use – Other uses	Laboratory chemicals	Use of laboratory chemicals (Solid)	CT	400	135	101	81
			HE	28	67	20	19
Commercial Use – Other uses	Laboratory chemicals	Use of laboratory chemicals (Liquid)	CT	304	2.4	2.4	2.4
			HE	152	0.9	0.9	0.9
Commercial Use – Other uses	Lubricants and lubricant additives	Use of lubricants and functional fluids	CT	304	3.3	3.2	3.2
	Chemiluminescent light sticks		HE	152	1.1	1.1	1.1
Industrial Use – Other uses	Lubricants and lubricant additives						

Life Cycle Stage – Category	Subcategory	OES	Exposure Level	Acute MOEs for Female Workers of Reproductive Age (Benchmark = 30)			
				Inhalation MOE (DBP COU; Exposure to DBP)	**Dermal MOE (DBP COU; Exposure to DBP)**	**Aggregate MOE (DBP COU; Exposure to DBP)**	**Cumulative MOE (Aggregate DBP MOE + Cumulative Non-Attributable) [a]**
Commercial Use – Other uses	Inspection penetrant kit	Use of penetrants and inspection fluids	CT	10	1.8	1.5	1.5
			HE	2.7	0.9	0.7	0.7
Commercial Use – Furnishing, cleaning, treatment care products	Cleaning and furnishing care products	Fabrication or use of final products or articles	CT	152	135	71	61
	Floor coverings; construction and building materials covering large surface areas including stone, plaster, cement, glass and ceramic articles; fabrics, textiles, and apparel;		HE	18	67	14	14
	Furniture and furnishings						
Commercial Use – Automotive, fuel, agriculture, outdoor use products	Automotive care products						
Commercial Use – Other Uses	Automotive articles						
Industrial Use – Other Uses	Automotive articles						
	Propellants						
Commercial Use – Packaging, paper, plastic, toys, hobby products	Packaging (excluding food packaging), including rubber articles; plastic articles (hard); plastic articles (soft); other articles with routine direct contact during normal use, including rubber articles; plastic articles (hard)						
	Toys, playground, and sporting equipment						
Processing – Recycling	Recycling	Recycling	CT	141	135	69	59
			HE	9.7	67	8.4	8.3

Life Cycle Stage – Category	Subcategory	OES	Exposure Level	Acute MOEs for Female Workers of Reproductive Age (Benchmark = 30)			
				Inhalation MOE (DBP COU; Exposure to DBP)	Dermal MOE (DBP COU; Exposure to DBP)	Aggregate MOE (DBP COU; Exposure to DBP)	Cumulative MOE (Aggregate DBP MOE + Cumulative Non-Attributable) [a]
Disposal – Disposal	Disposal	Waste handling, treatment, and disposal	CT	141	135	69	59
			HE	9.7	67	8.4	8.3

[a] The acute cumulative MOE is derived by summing inhalation exposure from each individual DBP COU with dermal exposure from the same DBP COU and the cumulative non–attributable exposure to DEHP, DBP, BBP, DIBP, and DINP. Non-attributable cumulative exposure was estimated from NHANES urinary biomonitoring data using reverse dosimetry. All exposure estimates were (1) scaled by relative potency, (2) expressed in index chemical equivalents (*i.e.*, DBP equivalents), (3) summed to calculate cumulative exposure in index chemical equivalents, and then (4) compared to the index chemical POD (*i.e.*, HED of 2.1 mg/kg-day) to calculate the cumulative MOE.

4.4.5 Risk Estimates for Consumers Based on Relative Potency

This section summarizes cumulative risk estimates for consumers from acute duration exposures to DBP. EPA focused its CRA on females of reproductive age and male infants and children. EPA focused its consumer CRA on these populations for the acute exposure duration because, as described in Section 4.4 and (U.S. EPA, 2025x), these populations and exposure duration are considered most directly applicable to the common hazard outcome that serves as the basis for the cumulative assessment (*i.e.*, reduced fetal testicular testosterone). For consumers, EPA did not specifically evaluate females of reproductive age or male infants and children; however, consumer exposures of teenagers (16–20 years) and adults (21+ years) were considered a proxy for females of reproductive age, while infants (<1 year), toddlers (1–2 years), children (3–5 and 6–10 years), and young teens (11–15 years) were considered a proxy for male infants and children.

To evaluate cumulative risk to consumers, EPA combined inhalation, dermal, and ingestion exposures to DBP from each individual consumer COU and product/article exposure scenario with non-attributable cumulative exposure to DEHP, DBP, BBP, DIBP, and DINP (estimated from NHANES urinary biomonitoring using reverse dosimetry). As described in Section 4.4.3, for each individual phthalate exposures were scaled by relative potency per chemical, expressed in terms of index chemical (DBP) equivalents, and summed to estimate cumulative exposure and cumulative risk for each COU. Because DBP is the index chemical and the RPF is 1, scaling has no effect on individual DBP exposure estimates.

As described in Section 4.3.3, EPA evaluated a number of product or article example exposure scenarios associated with five consumer COUs. Of the evaluated product or article examples, 14 (associated with 5 COUs) have high-intensity cumulative MOEs ranging 46 to 482 (cumulative benchmark = 30) (listed below). Seven product or article examples (associated with 3 COUs) have high-intensity aggregate MOEs less than 30 (listed below). For these seven product or article examples, the addition of non-attributable cumulative exposure from NHANES has no effect on risk conclusions, and these seven product or articles examples are not further discussed. Two product or article examples (associated with 2 COUs) have high-intensity cumulative MOEs ranging from 27 to 29 (benchmark = 30). Notably, one of these product or article examples also had high-intensity MOEs less than 30 for several consumer age groups in the individual DBP consumer risk characterization (Section 4.3.3; Table 4-19). However, for this one product or article example, several new consumer age groups have cumulative MOEs below 30 that were above 30 in the individual DBP consumer risk characterization (Table 4-24). The newly identified consumer age groups for this product or article example are discussed further below.

Product or Article Examples with Acute High-Intensity Cumulative Moes Ranging from 46 to 482

As can be seen from Table 4-24, cumulative MOEs for high-intensity scenarios ranged from 46 to 482 for all consumer age groups evaluated for 14 product or articles examples (associated with 5 COUs), including the following:

- Construction, paint, electrical, and metal products: adhesives for small repairs (cumulative MOEs: 61−65);
- Furnishing, cleaning, treatment/care products: vinyl flooring (cumulative MOEs: 94−221);
- Furnishing, cleaning, treatment/care products: wallpaper (in-place) (cumulative MOEs: 72−395);
- Furnishing, cleaning, treatment/care products: wallpaper (installation) (cumulative MOEs: 98−103);
- Other uses: car mats (cumulative MOEs: 194−379);
- Other uses: small articles with semi routine contact; glow sticks (cumulative MOEs: 74−166);

- Other uses: novelty articles: adult toys (cumulative MOEs: 262–268);
- Furnishing, cleaning, treatment care products: synthetic leather clothing (cumulative MOEs: 61–64);
- Furnishing, cleaning, treatment care products: synthetic leather furniture (cumulative MOEs: 58–406);
- Packaging, paper, plastic, hobby products: footwear components (cumulative MOEs: 46−103);
- Packaging, paper, plastic, hobby products: shower curtains (cumulative MOEs: 122−286);
- Packaging, paper, plastic, hobby products: tire crumb (cumulative MOEs: 194−482);
- Packaging, paper, plastic, hobby products: small articles with semi routine contact; miscellaneous items including a pen, pencil case, hobby cutting board, costume jewelry, tape, garden hose, disposable gloves, and plastic bags/pouches (cumulative MOEs: 74−166); and
- Packaging, paper, plastic, hobby products: small articles with semi routine contact; miscellaneous items including a football, balance ball, and pet toy (cumulative MOEs: 74−166).

Product or Article Examples with Acute High-Intensity Aggregate from the Individual DBP Assessment and Cumulative Moes Less than 30

As can be seen from Table 4-19 and Table 4-24, aggregate and cumulative MOEs for high-intensity scenarios were less than 30 for the same consumer age groups evaluated for seven product or article examples (associated with 3 COUs), including:

- Construction, paint, electrical, and metal products: metal coatings;
- Construction, paint, electrical, and metal products: indoor flooring sealing and refinishing products;
- Construction, paint, electrical, and metal products: sealing and refinishing sprays (outdoor use);
- Construction, paint, electrical, and metal products: automotive adhesives;
- Construction, paint, electrical, and metal products: construction adhesives;
- Furnishing, cleaning, treatment care products: waxes and polishes; and
- Packaging, paper, plastic, hobby products: children’s toys (legacy).

Product or Article Examples with Acute Cumulative Moes Ranging from 27 to 29

As can be seen from Table 4-24, cumulative MOEs for high-intensity scenarios ranged from 27 to 29 for two product or articles examples (associated with 2 COUs). One of these product or article examples also had MOEs less than 30 in the individual DBP consumer risk assessment (Section 4.3.3); however, at least one new consumer age group had a cumulative MOEs below 30 that was above 30 in the individual DBP consumer risk characterization (Table 4-19). These include the following:

- Furnishing, cleaning, treatment/care products: spray cleaner. Acute high-intensity cumulative MOEs ranged from 27 to 29 for young teens (11−15 years), teenagers (16−20 years), and adults (21+ years), while medium-intensity cumulative MOEs ranged from 90 to 95 for these same age groups (Table 4-24). All of these age groups, except teenagers (16−20 years) (high-intensity aggregate MOE = 31), also had high-intensity MOEs below 30 in the individual DBP consumer risk assessment (Table 4-19).

- Packaging, paper, plastic, hobby products: children's toys (new). The acute high-intensity cumulative MOE was 29 for infants (<1 year), while the medium-intensity cumulative MOE was 55 for the age group (Table 4-24). Comparatively, the acute high-intensity aggregate MOE was 34 for infants (<1 year) in the individual DBP consumer risk assessment (Table 4-19). Acute high-intensity cumulative MOEs ranged from 52 to 353 for other evaluated age groups.

EPA characterizes consumer COUs and product or article examples as part of the individual DBP assessment in Section 4.3.3, while these consumer COUs are characterized for cumulative risk above in this section. One factor contributes to the lower cumulative MOEs compared to the MOEs in the individual DBP consumer risk assessment—that is the addition of non-attributable cumulative phthalate exposure from NHANES. Because DBP is the index chemical and the RPF is 1, scaling by relative potency has no effect on DBP exposure estimates. Similarly, the same POD (HED of 2.1 mg/kg-day) based on reduced fetal testicular testosterone is used to calculate MOEs in the individual DBP assessment and in the cumulative risk assessment. EPA calculated non-attributable cumulative exposure to DEHP, DBP, BBP, DIBP, and DINP using NHANES urinary biomonitoring data from the 2017 to 2018 survey (most recent data set available) and reverse dosimetry (see Section 4.4.2 and (U.S. EPA, 2025x) for further details), representing exposure to a national population.

Non-attributable cumulative exposure estimates were scaled by relative potency and expressed in index chemical (DBP) equivalents. Non-attributable cumulative exposure was then combined with acute inhalation, dermal, and ingestion DBP exposures for each individual product or article example exposure scenario scaled by relative potency. For infants, toddlers, and preschoolers, EPA added a non-attributable cumulative exposure of 10.8 µg/kg index chemical (DBP) equivalents to calculate the cumulative MOE, which contributes 15.5 percent to the risk cup with a benchmark MOE of 30. For middle-aged children, EPA added a non-attributable cumulative exposure of 7.35 µg/kg index chemical (DBP) equivalents to calculate the cumulative MOE, which contributes 10.5 percent to the risk cup with a benchmark MOE of 30. For young teens (11−15 years), EPA added a non-attributable cumulative exposure of 4.36 µg/kg index chemical (DBP) equivalents to calculate the cumulative MOE, which contributes 6.2 percent to the risk cup with a benchmark MOE of 30. For teenagers (16−20 years) and adults (21+ years), EPA added a non-attributable cumulative exposure of 5.15 µg/kg index chemical (DBP) equivalents to calculate the cumulative MOE, which contributes 7.4 percent to the risk cup with a benchmark MOE of 30.

4.4.5.1 Overall Confidence in Cumulative Consumer Risks

As described in Section 4.1.2, and in more technical details in the *Draft Consumer and Indoor Exposure Assessment for Dibutyl Phthalate (DBP)* (U.S. EPA, 2025c), EPA has moderate or robust confidence in the assessed inhalation, ingestion, and dermal consumer exposure scenarios. The Agency has robust confidence in the RPFs and index chemical POD used to calculate the cumulative MOEs (Section 4.4.1.2). To derive RPFs and the index chemical POD, EPA integrated data from multiple studies evaluating fetal testicular testosterone using a meta-analysis approach and conducted BMD modeling. Finally, EPA has robust confidence in the non-attributable cumulative exposure estimates because they were calculated from CDC's NHANES biomonitoring dataset, which provides a statistically representative sampling of the U.S. civilian population (Section 4.4.2.1). Furthermore, the Agency used a well-established reverse dosimetry approach to calculate phthalate daily intake values from urinary biomonitoring data. Overall, EPA has moderate to robust confidence in the cumulative risk estimates calculated for consumer exposure scenarios (Table 4-24).

Table 4-24. Consumer Cumulative Risk Summary Table

Life Cycle Stage: COU: Subcategory	Product or Article	Exposure Level (H, M, L) [a]	Exposure Scenario	Lifestage (Years) MOE (Based on All Exposures in Index Chemical Equivalents) (Benchmark MOE = 30)						
				Infant (<1 Year)	Toddler (1–2 Years)	Preschooler (3–5 years)	Middle Childhood (6–10 years)	Young Teen (11–15 years)	Teenager (16–20 years)	Adult (21+ years)
Automotive, Fuel, Agriculture, Outdoor Use Products: Automotive care products	Uses were matched with automotive adhesives.									
Construction, Paint, Electrical, and Metal Products: Adhesives and sealants	Automotive adhesives	H	Cumulative (Aggregate COU + Cumulative Non-attributable)	88	90	100	146	7 [c]	7 [c]	7 [c]
	Construction adhesives	H	Cumulative (Aggregate COU + Cumulative Non-attributable)	–	–	–	–	7 [c]	8 [c]	7 [c]
	Adhesives for small repairs	H	Cumulative (Aggregate COU + Cumulative Non-attributable)	–	–	–	–	61	65	61
Construction, Paint, Electrical, and Metal Products: Paints and coatings	Metal coatings	H	Cumulative (Aggregate COU + Cumulative Non-attributable)	194	194	194	286	7 [c]	8 [c]	7 [c]
	Indoor flooring sealing and refinishing products	H	Cumulative (Aggregate COU + Cumulative Non-attributable)	68	70	80	116	14 [c]	16 [c]	15 [c]
	Sealing and refinishing sprays (outdoor use)	H	Cumulative (Aggregate COU + Cumulative Non-attributable)	62	65	74	98	7 [c]	8 [c]	8 [c]
Furnishing, Cleaning, Treatment Care Products: Fabric, textile, and leather products	Synthetic leather clothing	H	Cumulative (Aggregate COU + Cumulative Non-attributable)	–	–	–	–	–	– [e]	– [e]
		M	Cumulative (Aggregate COU + Cumulative Non-attributable)	–	–	–	–	–	64	61
	Synthetic leather furniture	H	Cumulative (Aggregate COU + Cumulative Non-attributable)	58	82	103	285	480	406	406
Furnishing, Cleaning, Treatment/Care Products: Floor coverings; construction and building materials covering large surface areas including stone, plaster, cement, glass, and ceramic articles; fabrics, textiles, and apparel	Vinyl flooring	H	Cumulative (Aggregate COU + Cumulative Non-attributable)	94	100	108	150	221	214	212
	Wallpaper (in-place)	H	Cumulative (Aggregate COU + Cumulative Non-attributable)	72	79	86	116	163	162	395
	Wallpaper (installation)	H	Cumulative (Aggregate COU + Cumulative Non-attributable)	–	–	–	–	100	103	98

Life Cycle Stage: COU: Subcategory	Product or Article	Exposure Level (H, M, L) [a]	Exposure Scenario	Lifestage (Years) MOE (Based on All Exposures in Index Chemical Equivalents) (Benchmark MOE = 30)						
				Infant (<1 Year)	Toddler (1–2 Years)	Preschooler (3–5 years)	Middle Childhood (6–10 years)	Young Teen (11–15 years)	Teenager (16–20 years)	Adult (21+ years)
Furnishing, Cleaning, Treatment/Care Products: Cleaning and furnishing care products	Spray cleaner	H	Dermal (COU alone)	–	–	–	–	28	31	29
			Inhalation (COU alone)	66,922 [d]	71,040 [d]	87,390 [d]	125,504 [d]	37,467	47,754	55,143
			Aggregate (COU alone)	–	–	–	–	28	31	29
			Cumulative (NHANES)	194	194	194	286	482	407	407
			Cumulative (Aggregate COU + Cumulative NHANES)	194	194	194	285	27 [c]	29 [b]	27 [c]
		M	Dermal (COU alone)	–	–	–	–	113	123	115
			Inhalation (COU alone)	141,507 [d]	150,215 [d]	184,788 [d]	265,379 [d]	77,062	95,900	113,066
			Aggregate (COU alone)	–	–	–	–	113	123	115
			Cumulative (NHANES)	194	194	194	286	482	407	407
			Cumulative (Aggregate COU + Cumulative NHANES)	194	194	194	285	91	95	90
	Waxes and polishes	H	Cumulative (Aggregate COU + Cumulative Non-attributable)	194	194	194	285	14 [c]	15 [c]	14 [c]
Packaging, paper, plastic, toys hobby products: Ink, toner, and colorant products	No consumer products identified. Foreseeable uses were matched with adhesives for small repairs because similar use patterns are expected.									
Packaging, Paper, Plastic, Hobby Products: Packaging (excluding food packaging), including rubber articles; plastic articles (hard); plastic articles (soft)	Footwear components	H	Cumulative (Aggregate COU + Cumulative Non-attributable)	46	51	57	74	100	103	98
	Shower curtains	H	Cumulative (Aggregate COU + Cumulative Non-attributable)	122	129	135	189	286	266	261
	Small articles with semi routine contact; miscellaneous items including a pen, pencil case, hobby cutting board, costume jewelry, tape, garden hose, disposable gloves, and plastic bags/pouches	H	Cumulative (Aggregate COU + Cumulative Non-attributable)	74	81	88	118	166	165	159

Life Cycle Stage: COU: Subcategory	Product or Article	Exposure Level (H, M, L) [a]	Exposure Scenario	Lifestage (Years) MOE (Based on All Exposures in Index Chemical Equivalents) (Benchmark MOE = 30)						
				Infant (<1 Year)	Toddler (1–2 Years)	Preschooler (3–5 years)	Middle Childhood (6–10 years)	Young Teen (11–15 years)	Teenager (16–20 years)	Adult (21+ years)
Packaging, Paper, Plastic, Hobby Products: Toys, Playground, and Sporting Equipment	Children's toys (new)	H	Dermal (COU alone)	112	131	151	188	237	260	–
			Ingestion (COU alone)	52	197	382	84,935	151,691	191,207	427,072
			Inhalation (COU alone)	693	735	904	1,299	1,841	2,150	2,678
			Aggregate (COU alone)	34	71	97	164	210	231	2,661
			Cumulative (NHANES)	194	194	194	286	482	407	407
			Cumulative (Aggregate COU + Cumulative NHANES)	29 [b]	52	65	104	146	148	353
		M	Dermal (COU alone)	140	163	189	234	296	324	–
			Ingestion (COU alone)	177	444	1,323	344,795	615,767	776,168	1,733,372
			Inhalation (COU alone)	2,821	2,994	3,683	5,290	7,499	8,758	10,908
			Aggregate (COU alone)	76	115	158	224	285	312	10,840
			Cumulative (NHANES)	194	194	194	286	482	407	407
			Cumulative (Aggregate COU + Cumulative NHANES)	55	72	87	126	179	177	392
	Children's toys (legacy)	H	Cumulative (Aggregate COU + Cumulative Non-attributable)	21 [c]	31	39	60	85	91	161
	Tire crumb	H	Cumulative (Aggregate COU + Cumulative Non-attributable)	–	–	194	286	482	407	407
	Small articles with semi routine contact; miscellaneous items including a football, balance ball, and pet toy	H	Cumulative (Aggregate COU + Cumulative Non-attributable)	74	81	88	118	166	165	159
Other Uses: Chemiluminescent light sticks	Small articles with semi routine contact; glow sticks	H	Cumulative (Aggregate COU + Cumulative Non-attributable)	74	81	88	118	166	165	159
Other Uses: Automotive products, other than fluids	Car mats	H	Cumulative (Aggregate COU + Cumulative Non-attributable)	194	194	194	285	379	336	333
	Synthetic leather seats (see synthetic leather furniture)	H	Cumulative (Aggregate COU + Cumulative Non-attributable)	58	82	103	285	480	406	406
Other Uses: Novelty articles	Adult toys	H	Cumulative (Aggregate COU + Cumulative NHANES)	–	–	–	–	–	268	262

Life Cycle Stage: COU: Subcategory	Product or Article	Exposure Level (H, M, L) [a]	Exposure Scenario	Lifestage (Years) MOE (Based on All Exposures in Index Chemical Equivalents) (Benchmark MOE = 30)						
				Infant (<1 Year)	Toddler (1–2 Years)	Preschooler (3–5 years)	Middle Childhood (6–10 years)	Young Teen (11–15 years)	Teenager (16–20 years)	Adult (21+ years)
Other uses: Lubricants and lubricant additives	No consumer products identified. Foreseeable uses were matched with adhesives for small repairs because similar use patterns are expected.									

[a] Exposure scenario intensities include high (H), medium (M), and low (L).
[b] MOEs for this age group are <30 in the cumulative assessment, but not the individual DBP risk assessment.
[c] MOEs for this age group are <30 in both the cumulative and individual DBP risk assessment.
[d] MOE for bystander scenario.
[e] Scenario was deemed to be unlikely due to high uncertainties.

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4.4.6 Cumulative Risk Estimates for the General Population

For DBP, EPA did not evaluate cumulative risk for the general population from environmental releases. As discussed in Section 4.1.3, the Agency employed a screening level approach to assess risk from exposure to DBP for the general population from environmental releases. However, as discussed in Section 4.4.2, EPA did evaluate cumulative exposure and risk from exposure to phthalates DEHP, DBP, BBP, DIBP, and DINP using NHANES urinary biomonitoring data. As noted previously, the NHANES biomonitoring dataset is a national, statistical representation of the general, non-institutionalized, civilian U.S. population and provides estimates of average aggregate exposure to individual phthalates. As can be seen from Table 4-21, and as discussed in more detail in the *Revised Draft Technical Support Document for the Cumulative Risk Analysis of DEHP, DBP, BBP, DIBP, DCHP, and DINP Under TSCA* (U.S. EPA, 2025x), 95th percentile cumulative MOEs ranged from 194 to 592 (cumulative benchmark = 30) for females of reproductive age and male children. These MOEs indicate both that the risk cup is 6.2 to 15.5 percent full and that cumulative exposure to DEHP, DBP, DIBP, BBP, and DINP, based on the most recent NHANES survey data (2017–2018), does not currently pose a risk to most male children or pregnant women within the U.S. civilian population.

4.5 Comparison of Single Chemical and Cumulative Risk Assessments

In support of the developed CRA, EPA has relied substantially on existing CRA-related work by the Agency's Risk Assessment Forum (RAF), EPA Office of Pesticide Programs (OPP), the Organisation for Economic Co-operation and Development (OECD), the European Commission, and the World Health Organization (WHO) and International Programme on Chemical Safety (IPCS):

- *Guidelines for the Health Risk Assessment of Chemical Mixtures* (U.S. EPA, 1986);
- *Guidance for Identifying Pesticide Chemicals and Other Substances that Have a Common Mechanism of Toxicity* (U.S. EPA, 1999);
- *Supplementary Guidance for Conducting Health Risk Assessment of Chemical Mixtures* (U.S. EPA, 2000);
- *General Principles for Performing Aggregate Exposure and Risk Assessments* (U.S. EPA, 2001);
- *Guidance on Cumulative Risk Assessment of Pesticide Chemicals that Have a Common Mechanism of Toxicity* (U.S. EPA, 2002a);
- *Framework for Cumulative Risk Assessment* (U.S. EPA, 2003);
- *Concepts, Methods and Data Sources for Cumulative Health Risk Assessment of Multiple Chemicals, Exposures, and Effects: A Resource Document* (U.S. EPA, 2007a);
- *Pesticide Cumulative Risk Assessment: Framework for Screening Analysis Purpose* (U.S. EPA, 2016b);
- *Advances in Dose Addition For Chemical Mixtures: A White Paper* (U.S. EPA, 2023b).
- *Phthalates and Cumulative Risk Assessment: The Tasks Ahead* (NRC, 2008);
- *State of the Art Report on Mixture Toxicity* (Kortenkamp et al., 2009);
- *Risk Assessment of Combined Exposure to Multiple Chemicals: A WHO/IPCS Framework* (Meek et al., 2011); and
- *Considerations for Assessing the Risks of Combined Exposure to Multiple Chemicals* (OECD, 2018).

EPA has evaluated risks for workers (Section 4.3.2), consumers (Section 4.3.3), and the general population (Section 4.3.4) from exposure to DBP alone, as well as cumulative risks for workers (Section 4.4.4) and consumers (Section 4.4.5) that take into account differences in relative potency and cumulative non-attributable exposure to DEHP, DBP, BBP, DIBP, and DINP from NHANES biomonitoring and reverse dosimetry.

There are several notable differences between the individual DBP assessment (Section 4.3) and the CRA (Section 4.4). As part of the individual DBP assessment (Section 4.3), EPA considered all human health hazards of DBP and selected a POD based on a $BMDL_5$ for reduced fetal testicular testosterone to characterize risk from exposure to DBP. As part of its exposure assessment in the individual DBP assessment, EPA considered acute, intermediate, and chronic exposures durations for a broad range of populations—including female workers of reproductive age, average adult workers, ONUs, the general population, and consumers of various lifestages (*e.g.*, infants, toddlers, children, adults). Furthermore, in the individual DBP assessment, EPA evaluated inhalation and dermal exposures to workers, as well as consumer exposure to DBP via the inhalation, dermal, and ingestion exposure routes. In contrast, the CRA is more focused in scope (Section 4.4). First, the CRA is based on a uniform measure of hazard (*i.e.*, reduced fetal testicular testosterone) that serves as the basis for deriving RPFs and the index chemical (DBP) POD, which were derived via meta-analysis and BMD modeling (Section 4.4.1). Second, the CRA is focused on acute duration exposures and the most sensitive populations (*i.e.*, females of reproductive age, male infants, male children) (Section 4.4). Finally, for the CRA, DBP exposures from individual consumer and worker COUs were combined with non-attributable cumulative exposure to DEHP, DBP, BBP, DIBP, and DINP from NHANES.

Both the individual DBP assessment (Section 4.3) and the CRA (Section 4.4) led to the same conclusions regarding risk estimates for workers (Section 4.4.4). For consumers, the individual DBP assessment (Section 4.3) and the CRA (Section 4.4) led to similar conclusions regarding risk for 21 out of 23 product or article examples evaluated (Section 4.4.5). As discussed in Section 4.4.5, high-intensity, acute, cumulative MOEs were less than 30 for several age groups for two product or articles example exposure scenarios, whereas high-intensity, acute, aggregate MOEs were equal to or greater than 30 for these age groups in the individual DBP assessment. Overall, one factor influenced differences in risk estimates between the individual DBP assessment (Section 4.3) and the CRA (Section 4.4); that is, addition of non-attributable cumulative exposure to DEHP, DBP, BBP, DIBP, and DINP from NHANES. Overall, this non-attributable cumulative exposure contributes 6.2 to 15.5 percent to the risk cup, depending on the population and age group.

EPA has robust confidence in its CRA and moderate to robust confidence in its individual assessment of DBP for workers (Section 4.3.2.1), consumers (Section 4.3.3.1), and the general population (Section 4.3.4). RPFs used to scale for relative potency were calculated based on a common hazard endpoint (*i.e.*, reduced fetal testicular testosterone) using data from multiple studies evaluating effects of phthalates on fetal testicular testosterone using a meta-analysis and BMD modeling approach for each of the six phthalates included in the cumulative chemical group (U.S. EPA, 2025x). This analysis provides a robust basis for assessing the dose-response for the common hazard endpoint (*i.e.*, reduced fetal testicular testosterone) across the six toxicologically similar phthalates included in the CRA.

5 ENVIRONMENTAL RISK ASSESSMENT

DBP – Environmental Risk Assessment (Section 5):
Key Points

EPA considered all reasonably available information identified through the systematic review process under TSCA to characterize environmental risk for DBP. The following bullets summarize the key points.

- Aquatic species:
  - RQs greater than 1 were identified with robust overall confidence from water releases from the Waste handling, treatment, and disposal OES and the associated Disposal COU for chronic exposure to DBP in aquatic vertebrates (RQ = 9.23) and aquatic invertebrates (RQ = 1.18).
    - This COU had robust overall confidence because the surface water release estimate (and associated surface water concentrations of DBP) for its associated OES was derived from data reported to DMR.
  - RQs greater than 1 were identified for the PVC plastics compounding OES and associated COUs for chronic exposure to DBP in aquatic vertebrates (RQ = 1.04). The same RQ was also identified for the PVC plastics converting and recycling OES, which used the PVC plastics compounding OES releases as a surrogate.
    - These OESs and associated COUs had robust overall confidence because the surface water release estimates (and associated surface water concentrations of DBP) for its associated OES was derived from data reported to TRI. EPA does not use RQ values as a bright-line to determine the unreasonable risk.
  - No RQs greater than 1 were identified for other OESs/COUs for aquatic species from releases to water.
- Benthic (sediment-dwelling) species:
  - No RQs greater than 1 were identified for chronic exposures to DBP in benthic organisms from releases to sediment.
- Terrestrial species:
  - No RQs greater than 1 were identified for exposures to DBP in terrestrial mammals through trophic transfer.
  - No RQs greater than 1 were identified for exposures to DBP soil invertebrates from releases to soil.
  - No RQs greater than 1 were identified for exposures to DBP in terrestrial plants from releases to soil.

5.1 Summary of Environmental Exposures

EPA assessed environmental concentrations of dibutyl phthalate (DBP) in air, water, and land for use in environmental exposure (Table 5-1). The environmental exposures are described in the *Draft Physical Chemistry and Fate and Transport Assessment for Dibutyl Phthalate (DBP)* (U.S. EPA, 2024j) and the *Draft Environmental Media, General Population, and Environmental Exposure Assessment for Dibutyl Phthalate (DBP)* (U.S. EPA, 2025p). DBP will preferentially sorb into sediments, soils, particulate matter in air, and in wastewater solids during wastewater treatment. High-quality studies of DBP biodegradation rates and physical and chemical properties indicate that DBP will have limited persistence and mobility in soils receiving biosolids. Surface water, pore water, and sediment concentrations of DBP were modeled using VVWM-PSC. The Waste handling, treatment, and disposal OES (refer to Table 3-2 for a crosswalk of COUs to each OES) resulted in the highest surface water concentrations of DBP from reported releases, up to 14.40 µg/L in both chronic (>60 days) and acute (1–7 day) scenarios. Sediment concentrations from this OES ranged from 0.178 mg DBP/kg dry sediment (mg/kg) in chronic scenarios to 0.334 mg/kg sediment in acute scenarios. These DMR-reported releases are based on releases to surface water at the external outfall of a POTW; therefore, no additional wastewater treatment removal efficiency was applied.

For the Use of lubricants and functional fluids OES, reported releases were not obtained by EPA and a generic release to water was modeled. Based on comparison with reported scenarios for DBP wastewater release, the Agency does not expect high releases of DBP to the lowest-flow generic condition (P50 7Q10) water bodies. For this reason, EPA had higher confidence in the use of the P90 7Q10 flow rate for this scenario, and this rate was used in the environmental assessment for the Use of lubricants and functional fluids OES and corresponding COUs. The use of the P90 flow rate resulted in modeled surface water concentrations that ranged from 0.03 µg/L in chronic (>60-day) scenarios to 2.42 µg/L in acute (1 to 7-day) scenarios. Sediment concentrations from this OES at the P90 flow rate ranged from 0.00065 mg/kg in chronic scenarios to 0.006 mg/kg in acute scenarios. Because all water and sediment concentrations were below concentrations of concern for this OES and associated COUs, the P90 flow was used without consideration of wastewater treatment removal efficiency.

Five OESs (Manufacturing, Application of adhesives and sealants, Application of paints and coatings, Use of laboratory chemicals, and Use of penetrants and inspection fluids) had modeled releases from generic scenarios for multimedia discharges to combinations of multiple of the following parameters: water, wastewater (POTW), incineration, landfill, and air. For these OESs, there was insufficient information to determine the fraction of the release going to each of the reported media types, including to surface water. For these OESs, surface water, pore water, and sediment concentrations of DBP were estimated using VVWM-PSC and assuming a conservative scenario in which all of the multimedia releases were to surface water. Based on comparison with reported scenarios for DBP wastewater release, EPA does not expect high releases of DBP to the lowest-flow generic condition (P50 7Q10) water bodies. For this reason, the Agency had higher confidence in the use of the P90 7Q10 flow rate for this scenario and this rate was used in the environmental assessment. The use of the P90 flow rate resulted in modeled surface water concentrations for the highest OES (Manufacturing) that were up to 4.00 µg/L in both chronic (>60-day) and acute (1 to 7-day) scenarios without wastewater treatment. Because these generic scenarios did not include wastewater treatment and some water concentrations were above concentrations of concern, as an additional refinement wastewater treatment removal efficiency was applied. Concentrations ranged between 0.080 µg/L and 1.40 µg/L with wastewater treatment based on estimated wastewater treatment removal efficiency of 65 to 98 percent (U.S. EPA, 1982) (Table 2-2). Sediment concentrations from these OESs at the P90 flow rate ranged from 0.0499 mg/kg in chronic scenarios to 0.093 mg/kg in acute scenarios.

There are uncertainties in the relevance of limited monitoring data for biosolids and landfill leachate to the COUs considered. However, based on high-quality physical and chemical property data, EPA determined that DBP will have low persistence potential and mobility in soils. Therefore, groundwater concentrations resulting from releases to the landfill or to agricultural lands via biosolids applications were not quantified but were discussed qualitatively. Air releases of DBP from fugitive and stack emissions with deposition to soil were estimated using IIOAC, as described in Section 8.1.3 of the *Draft Environmental Media, General Population, and Environmental Exposure Assessment for Dibutyl Phthalate (DBP)* (U.S. EPA, 2025p). The highest annual deposition rate to soil, 1.78 µg/kg/year

(0.00178 mg/kg/year), was based on a combination of fugitive emissions from the Application of paints, coatings, adhesives, and sealants OES and stack emissions from the Waste handling, treatment, and disposal OES and was located 100 m from the point of release. These releases were combined to form a single highest-emissions scenario for the screening analysis (see Section 4.1.3). Based on the half-life of DBP in soil, equilibrium soil concentrations from air releases are expected to be lower than this deposition rate (see Section 5.3.2).

Limited measured data were reasonably available from the scientific literature on DBP concentrations in soils, biosolids, soils receiving biosolids, and landfills. No monitoring data of DBP in these environments were reasonably available. Limited reasonably available information was available related to the uptake and bioavailability of DBP in soils. DBP is expected to have minimal air to soil deposition. Based on estimated water solubility (11.2 mg/L) and hydrophobicity (log Kow = 4.5; log Koc = 3.14–3.94), DBP is expected to have low bioavailability in soil. Based on the reasonably available evidence, trophic transfer of DBP in aquatic or terrestrial organisms is not expected and DBP has low bioaccumulation and biomagnification potential.

Table 5-1. DBP Concentrations Used in Environmental Risk Characterization

OES [a]	Release Media	Environmental Media	DBP Concentration		Data Source
			Acute (1–7 days)	Chronic (>60 days)	
Waste handling, treatment, and disposal	Water	Total water column (7Q10) [b]	14.40 µg/L	14.40 µg/L	DMR (reported release)
	Sediment	Benthic sediment (7Q10)	0.334 mg/kg	0.178 mg/kg	
PVC plastics compounding	Water	Total water column (7Q10)	1.63 µg/L	1.63 µg/L	
	Sediment	Benthic sediment (7Q10)	0.038 mg/kg	0.022 mg/kg	
Use of lubricants and functional fluids	Water	Total water column (7Q10), P50 flow [c]	703 µg/L	7.38 µg/L	Generic release (wastewater)
		P75 flow	41 µg/L	0.57 µg/L	
		P90 flow	2.42 µg/L	0.03 µg/L	
	Sediment	Benthic sediment (7Q10), P50 flow	1.71 mg/kg	0.188 mg/kg	
		P75 flow	0.146 mg/kg	0.015 mg/kg	
		P90 flow	0.006 mg/kg	0.00065 mg/kg	
Manufacturing	Water	Total water column (7Q10), P50 flow [c]	1,160 µg/L	1,160 µg/L	Generic release (multimedia)
		P75 flow	67.80 µg/L	67.80 µg/L	
		P90 flow, no wastewater treatment	4.00 µg/L	4.00 µg/L	
		P90 flow, 65% wastewater treatment efficiency	1.40 µg/L	1.40 µg/L	
		P90 flow, 98% wastewater treatment efficiency	0.080 µg/L	0.080 µg/L	
	Sediment	Benthic sediment (7Q10), P50 flow	27.0 mg/kg	14.5 mg/kg	
		P75 flow	1.57 mg/kg	0.839 mg/kg	
		P90 flow	0.093 mg/kg	0.0499 mg/kg	

OES [a]	Release Media	Environmental Media	DBP Concentration		Data Source
			Acute (1–7 days)	Chronic (>60 days)	
Application of paints and coatings (no spray control)	Water	Total water column (7Q10), P50 flow [c]	920 µg/L	920 µg/L	Generic release (multimedia)
		P75 flow	53.6 µg/L	53.6 µg/L	
		P90 flow, no wastewater treatment	3.17 µg/L	3.17 µg/L	
		P90 flow, 65% wastewater treatment efficiency	1.11 µg/L	1.11 µg/L	
		P90 flow, 98% wastewater treatment efficiency	0.063 µg/L	0.063 µg/L	
	Sediment	Benthic sediment (7Q10), P50 flow	21.3 mg/kg	11.4 mg/kg	
		P75 flow	1.24 mg/kg	0.664 mg/kg	
		P90 flow	0.073 mg/kg	0.039 mg/kg	
Fugitive: application of paints, coatings, adhesives, and sealants; stack: waste handling, treatment, and disposal	Air deposition to soil	Annual deposition rate to soil	1.78 µg/kg/yr (0.00178 mg/kg/yr)		NEI/TRI (Reported release)

[a] Table 3-1 provides the crosswalk of OES to COUs.
[b] 7Q10 is the 7 consecutive days of lowest flow over a 10-year period.
[c] The P50, P75, and P90 flows refer to the 50th, 75th, and 90th percentiles of the distribution of water body flow rates in generic release scenarios; see Appendix B of the *Draft Environmental Media, General Population, and Environmental Exposure Assessment for Dibutyl Phthalate (DBP)* (U.S. EPA, 2025p).

5.2 Summary of Environmental Hazards

EPA evaluated the reasonably available information for environmental hazard endpoints associated with DBP exposure to ecological receptors in aquatic and terrestrial ecosystems. The Agency reviewed a total of 98 references for DBP environmental hazard. Nine references included toxicity information for more than one taxonomic group; therefore, the number of studies considered by taxonomic group sums to more than 98. These references included acute and chronic exposures via water, soil, sediment, and food. EPA reviewed 68 studies for toxicity to aquatic organisms. Of these aquatic studies, 55 met the criteria for consideration for development of hazard thresholds. EPA reviewed 35 studies for toxicity to terrestrial wildlife organisms, including plants. Of these terrestrial studies, 30 met the criteria for consideration for development of hazard thresholds. In addition to the 30 high or medium quality terrestrial wildlife studies, EPA considered 13 terrestrial vertebrate studies for toxicity to DBP in human health using animal model rodent species that contained ecologically relevant reproductive endpoints. Studies that were excluded from consideration either (1) received a data quality determination of low or uninformative, (2) demonstrated no acute or chronic effects up to the highest dose tested, (3) did not demonstrate any apical health effects, or (4) did not demonstrate any health effects up to the limit of DBP solubility in water as determined by EPA at 11.2 mg/L (U.S. EPA, 2024l). Overall confidence in the hazard values for each taxonomic group and duration is provided in this section; for more information on the weight of scientific evidence, including the strengths and limitations of the data that led to these overall confidence conclusions, see Section 2.4 of the *Draft Environmental Hazard Assessment for Dibutyl Phthalate (DBP)* (U.S. EPA, 2024c).

Acute Aquatic Vertebrates, Aquatic Invertebrates, and Benthic Invertebrates

EPA has robust confidence that DBP has acute effects on aquatic vertebrates, aquatic invertebrates, and benthic invertebrates in the environment. This robust confidence is supported by a species sensitivity distribution (SSD) incorporating 9 empirical studies with mortality endpoints, supplemented by 53 estimated acute toxicity values from Web-ICE version 4.0. EPA estimated the HC_{05} to obtain a concentration that would protect 95 percent of aquatic species from acute effects. Based on the HC_{05} derived from the SSD, the acute concentration of concern (COC) for acute effects on aquatic vertebrates and invertebrates is 347.6 µg/L DBP.

Chronic Aquatic Vertebrates

EPA has robust confidence that DBP has chronic effects on aquatic vertebrates in the environment. This robust confidence is supported by eleven studies in which effects on mortality, growth, reproduction, and development were observed in five fish species and two amphibian species. The COC was derived from a multigenerational study in Japanese medaka (*Oryzias latipes*) (EAG Laboratories, 2018). In this study, the growth of the F1 and F2 generations of fish was significantly affected by exposure to DBP. There was a significant inhibition of bodyweight in F1 generation males at the lowest concentration studied after exposure of the F0 generation through spawning, plus 112 days of exposure in the F1 generation, with an unbounded lowest-observed-effect concentration (LOEC) value of 15.6 µg/L DBP. After applying an assessment factor (AF) of 10 (U.S. EPA, 2016c, 2014, 2012a), the chronic COC for aquatic vertebrates is 1.56 µg/L DBP.

Chronic Aquatic Invertebrates

EPA has robust confidence that DBP has chronic effects on aquatic invertebrates in the environment. This robust confidence is supported by 8 studies in which effects on mortality, growth, reproduction, and development were observed in 10 species. The COC was derived from a 14-day study in the marine amphipod crustacean *Monocorophium acheruscicum* (Tagatz et al., 1983). In this study, a 14-day chronic value (ChV) of 122.3 µg/L DBP was observed for reduction in population abundance. Populations were reduced by 91 percent at the LOEC, which was 340 µg/L DBP. Higher doses resulted in a complete loss of amphipods in the aquaria. This study was rated medium quality. Based on the presence of a clear dose-response relationship and a population-level fitness endpoint, the 14-day ChV for reduction in population abundance in the marine amphipod crustacean was selected to derive the chronic COC for aquatic invertebrates. After applying an AF of 10 (U.S. EPA, 2016c, 2014, 2012a), the chronic COC for aquatic invertebrates is 12.23 µg/L DBP.

Chronic Benthic Invertebrates

EPA has robust confidence that DBP has chronic effects on benthic invertebrates in the environment. This robust confidence is supported by five studies in which effects on mortality, growth, and development were observed in six species. The COC was derived from a 10-day study in the midge (*Chironomus tentans*) (Lake Superior Research Institute, 1997). In this study, a 10-day ChV at 1,143.3 mg DBP/kg dry sediment in medium total organic carbon (TOC) sediments (4.80% TOC) was observed for population loss. This study was rated high quality. This ChV was the middle of three for the midge; the experiment was repeated with low, medium, and high TOC sediments and toxicity decreased with the increase in TOC, as expected for a relatively hydrophobic compound like DBP based on equilibrium partitioning theory. The chosen endpoint for deriving the COC, medium-TOC, was selected because it is the closest to the assumed TOC level (4%) used in Point Source Calculator to estimate DBP exposure in benthic organisms. Population was reduced by 76.7 percent at the LOEC, which was 3,090 mg DBP/kg dry sediment. Higher doses resulted in a similar degree of population loss in the medium-TOC treatment; however, all population losses were significantly different from controls ($p < 0.05$, one-way

ANOVA with Dunnett's test). This endpoint was considered acceptable to derive a COC because of population-level relevance and a demonstrated dose-response relationship. After applying an AF of 10 to the ChV at 1,143.3 mg/kg (U.S. EPA, 2016c, 2014, 2012a), the chronic COC for benthic invertebrates is 114.3 mg DBP/kg dry sediment.

Aquatic Plants and Algae

EPA has moderate confidence that DBP has adverse effects on aquatic plants and algae in the environment. This moderate confidence is supported by seven high/medium quality studies, of which three identified hazard values below the DBP limit of water solubility, for one species of green algae (*Selenastrum capricornutum*). The COC was derived from a 96-hour study in green algae (Adachi et al., 2006). In this study, a 96-hour ChV of 316 µg/L DBP was observed for reduced population abundance. This study was rated medium quality. There was significant reduction in the algal population at the LOEC, which was 1,000 µg/L DBP, relative to an increase in the algal population at the NOEC of 100 µg/L DBP and in controls. The population reduction was increased with a higher dose of DBP. Therefore, this endpoint was considered acceptable to derive a COC because of population-level relevance and a demonstrated dose-response relationship. After applying an AF of 10 (U.S. EPA, 2016c, 2014, 2012a), the COC for aquatic plants and algae is 31.6 µg/L DBP.

Terrestrial Vertebrates

EPA has moderate confidence that DBP has adverse effects on terrestrial vertebrates in the environment. This moderate confidence is supported by thirteen studies in which effects on reproduction were observed in rats (*Rattus norvegicus*) and mice (*Mus musculus*). Two additional studies examined DBP exposure to eggs in the chicken (*Gallus gallus*) and the Japanese quail (*Coturnix japonica*), but no adverse effects were observed at any dose. The hazard value (HV) was derived from a three-generation reproduction study (NTP, 1995) in the Sprague-Dawley rat. In this study, a 17-week LOAEL was observed for significant reduction in number of live pups per litter at 80 mg/kg-bw/day DBP intake in dams. This study was rated high quality. The above referenced study also found a LOAEL for reduced bodyweight in F2 pups at the same dose (80 mg/kg-bw/day). The lowest bounded NOAEL/LOAEL pair for which a ChV could be calculated was significantly reduced bodyweight in F1 pups at a ChV of 115.4 mg/kg-bw/day, but this effect was not as sensitive as reduced number of live pups per litter. Other effects of DBP exposure included significantly decreased (1) female body weight in dams, (2) male sex ratio (percentage of male pups), (3) mating index and pregnancy index in the F1 generation, and (4) reduced male pup weight gain. Based on reduction in live pups per litter, the results found in NTP (1995) indicated that the HV for toxicity in terrestrial vertebrates is 80 mg/kg-bw/day DBP.

Soil Invertebrates

EPA has robust confidence that DBP has adverse effects on soil invertebrates in the environment. This robust confidence is supported by two studies in which effects on mortality and reproduction were observed in two species. The HV was derived from a 21-day study in the springtail (*Folsomia fimetaria*) (Jensen et al., 2001), with an EC10 of 14 mg DBP/kg dry soil for reduced reproduction. This study was rated high quality. Reproduction was reduced by approximately 60 percent at the lowest concentration tested, which was 100 mg DBP/kg dry soil, with reproduction completely eliminated at higher doses. Based on an EC10 for reduced reproduction in the springtail, the HV for soil invertebrates is 14 mg DBP/kg dry soil.

Terrestrial Plants

EPA has moderate confidence that DBP has adverse effects on terrestrial plants in the environment. This moderate confidence is supported by 12 studies, of which 6 contained acceptable endpoints below the limit of water solubility for DBP that identified effects on growth in 10 species. The HV was derived from a 40-day exposure in bread wheat (*Triticum aestivum*) (Gao et al., 2019). The lowest-observed-adverse-effect-level (LOAEL) in this study for reduction in leaf and root biomass in bread wheat seedlings was 10 mg/kg dry soil. There was a clear dose-response observed, with biomass reduction increasing as the dose of DBP increased. At the highest dose (40 mg/kg), root and leaf biomass were reduced by 29.93 and 32.10 percent, respectively. Because the most sensitive endpoint in this study was an unbounded LOAEL, the actual threshold dose might have been lower than the lowest dose studied. However, no information was available in the study to adjust the value to account for this uncertainty. The HV for terrestrial plants for DBP derived from this study is 10 mg/kg dry soil.

5.3 Environmental Risk Characterization

5.3.1 Risk Assessment Approach

The environmental risk characterization of DBP was conducted to evaluate whether the potential releases and resultant exposures of DBP in water, air, or soil will exceed the DBP concentrations observed to result in hazardous effects to aquatic or terrestrial organisms. In evaluating the DBP exposure concentrations, monitored and modeled DBP concentrations in surface water were used quantitatively. Concentrations of DBP in soil (biosolids, landfills, air deposition) and air is limited or is not expected to be bioavailable and were used qualitatively. In evaluating the environmental hazard of DBP, a weight of evidence approach (U.S. EPA, 2021a) was used to select hazard threshold concentrations for the derivation of risk quotients for aquatic organisms. The weight of evidence approach was also used to select hazard threshold concentrations for a description of risk for terrestrial organisms.

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

Equation 5-1. Calculating the Risk Quotient

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

For aquatic organisms, the "effect level" is a derived COC based on a hazard effects concentration. The COC used to calculate RQs for aquatic organisms was derived from hazard values resulting from acute and chronic exposures to DBP. The benchmark value for RQs in environmental risk characterization is 1. An RQ equal to 1 indicates that the exposures are the same as the concentration that causes effects. If the RQ exceeds 1, the exposure is greater than the effect concentration. If the RQ is less than 1, the exposure is less than the effect concentration.

In addition to modeled environmental concentrations from releases of DBP (Section 3.3), environmental monitoring and biomonitoring data were reviewed to assess wildlife exposure to DBP (U.S. EPA, 2025p). EPA qualitatively assessed the potential for trophic transfer of DBP through food webs to wildlife using the available environmental monitoring information and physical and chemical properties. DBP is not expected to be persistent in the environment as it is expected to degrade rapidly under most environmental conditions (although there is delayed biodegradation in low-oxygen media); and DBP's bioavailability is expected to be limited (U.S. EPA, 2024j). DBP is expected to have low bioaccumulation potential, biomagnification potential, and low potential for uptake based on estimated log BCF (bioconcentration factor) of 2.02 to 2.35 and a log BAF (bioaccumulation factor) of 2.20 to 2.37.

5.3.2 Risk Estimates for Aquatic and Terrestrial Species

EPA expects the main environmental exposure pathways for DBP to be releases to surface water and subsequent deposition to sediment, and limited dispersal from fugitive and stack air release deposition to soil. The Agency calculated an RQ for aquatic and benthic organisms based on modeled environmental surface water and sediment DBP concentrations and for terrestrial organisms based on modeled soil concentrations via air deposition near facilities releasing DBP. A summary of relevant exposure pathways to receptors and resulting qualitative risk estimates is presented in Table 5-2. EPA used a screening approach, followed by refinement if appropriate, to characterize environmental risk; an RQ for the highest reference environmental concentration was first calculated for each receptor group, and if the RQ did not exceed the benchmark value of 1 then no further RQs were calculated. If the RQ exceeded the benchmark, then refinements were applied to the screening environmental concentration if appropriate. The risk characterization proceeded to the next-highest releasing COU/OES until the resulting RQs were less than 1 or all COU/OESs were characterized. Wastewater treatment removal was applied as a refinement to the approach for generic scenario COU/OES where such treatment was not already reflected in estimated surface water releases if RQs greater than 1 were identified without treatment. For non-POTW TRI Form R or DMR-reported COU/OES, reported surface water releases are based on releases offsite (TRI Form R) or monitoring at the outfall to surface water (DMR) and already reflect any applicable pretreatment and wastewater treatment, and no additional wastewater treatment removal was applied (see Section 2.3.3.1 of the *Draft Environmental Release and Occupational Exposure Assessment for Dibutyl Phthalate (DBP)* (U.S. EPA, 2025q).

Table 5-2. Exposure Pathway to Receptors and Corresponding Risk Assessment for the DBP Environmental Risk Characterization

Exposure Pathway	Receptor	Risk Assessment
Surface water	Acute exposure to aquatic and benthic organisms (aquatic and benthic vertebrates and invertebrates)	No RQ >1 identified
	Chronic exposure to aquatic vertebrates	RQ 9.23 for Waste handling, treatment, and disposal; 1.04 for PVC plastics compounding
	Chronic exposure to aquatic invertebrates	RQ 1.18 for Waste handling, treatment, and disposal
	Chronic exposure to benthic invertebrates	No RQ >1 identified
	Aquatic plants and algae	No RQ >1 identified
Sediment	Benthic organisms	No RQ >1 identified
Air deposition to soil	Soil invertebrates; terrestrial plants	No RQ >1 identified
Trophic transfer	Aquatic and terrestrial organisms	Qualitative; No RQ calculated
Biosolids	Terrestrial mammal	Qualitative; No RQ calculated
Landfills	Terrestrial mammal	Qualitative; No RQ calculated

Surface Water

COCs were derived for several aquatic receptors in surface water for DBP, including acute and chronic exposures to aquatic vertebrates, aquatic invertebrates, and benthic invertebrates, and aquatic plants and algae.

Acute Exposure to Aquatic and Benthic Organisms: The COC for acute exposure to aquatic organisms, including aquatic and benthic vertebrates and invertebrates, was derived from an SSD containing empirical and modeled hazard data for more than 50 organisms (U.S. EPA, 2024c) and is 347.6 µg/L DBP. This acute COC for mortality is based on 96 hours of exposure. The reference value for water concentration, based on the high-end release in the Waste handling, treatment, and disposal OES, is 14.40 µg/L over a 4-day averaging time, and the resulting RQ is 0.04. Risk quotients did not exceed 1 for acute exposures to aquatic and benthic organisms for this OES and all others with lower estimated water concentrations.

Chronic Exposure to Aquatic Vertebrates: The COC for chronic exposure to aquatic vertebrates was derived from a 112-day exposure in a multigenerational study in Japanese medaka (*Oryzias latipes*) (EAG Laboratories, 2018) and is 1.56 µg/L DBP. EPA calculated RQs exceeding 1 for chronic exposure to aquatic vertebrates at the high end of estimated releases for the Waste handling, treatment, and disposal, Application of paints and coatings, and PVC plastics compounding OESs, with RQ of 9.23 and 1.04, respectively. RQs also exceeded 1 for the PVC plastics converting OES and Recycling OES, which used the PVC plastics compounding OES releases as a surrogate.

Chronic Exposure to Aquatic Invertebrates: The COC for chronic exposure to aquatic invertebrates was derived from a 14-day study in the marine amphipod crustacean *Monocorophium acheruscicum* (Tagatz et al., 1983) and is 12.23 µg/L DBP. EPA calculated RQs exceeding 1 for chronic exposure to aquatic invertebrates at the high end of estimated releases for the Waste handling, treatment, and disposal OES, with an RQ of 1.18.

Aquatic Plants and Algae: The COC for exposure to aquatic plants and algae was derived from a 96-hour study in green algae (*Selenastrum capricornutum*) (Adachi et al., 2006) and is 31.6 µg/L DBP. The reference value for water concentration, based on the high-end release in the Waste handling, treatment, and disposal OES, is 14.40 µg/L over a 4-day averaging time, and the resulting RQ is 0.46. Risk quotients did not exceed 1 for exposures to aquatic plants and algae for this OES and all others with lower estimated water concentrations.

Table 5-3. Environmental Risk Quotients (RQs) for Aquatic Organisms Associated with Surface Water Releases of DBP

OES	DBP Concentration (µg/L)	Receptor	Exposure Duration	Hazard Value (µg/L)	Risk Quotient	Overall Confidence
Waste handling, treatment, and disposal[a]; high-end	14.40 (4-day average)	SSD[b]; Acute aquatic and benthic organisms	4 days	347.6	0.04	Robust
Waste handling, treatment, and disposal; High-end	14.40 (286-day average)	Japanese medaka (*Oryzias latipes*), Chronic aquatic vertebrates	112 days	1.56	9.23	Robust
Manufacturing[c d]; high-end	1.40 (286-day average), 65% wastewater treatment efficiency				0.90	Moderate
Application of paints and coatings[c e]; high end	1.11 (286-day average), 65% wastewater treatment efficiency				0.71	Moderate
PVC plastics compounding; PVC plastics compounding [f g]; high-end	1.63 (246-day average)				1.04	Robust
Waste handling, treatment, and disposal; high-end	14.40 (21-day average)	Marine amphipod (*Monocorophium acheruscicum*), chronic aquatic invertebrates	14 days	12.23	1.18	Robust
Waste handling, treatment, and disposal; high-end	14.40 (4-day average)	Green algae (*Selenastrum capricornutum*), aquatic plants and algae	4 days	31.6	0.46	Robust

[a] The associated COU for this OES is "Disposal."
[b] Species sensitivity distribution; see Section 5.2.
[c] These OES had multimedia releases; the RQs presented here assume all multimedia releases are to surface water; see Section 5.1.
[d] The associated COU for this OES is Manufacturing; domestic manufacturing.
[e] The associated COUs for this OES are Industrial uses; construction, paint, electrical, and metal products; paints and coatings; Commercial uses; construction, paint, electrical, and metal products; paints and coatings; and Commercial uses; packaging, paper, plastic, hobby products; Ink, toner and colorant products.
[f] The associated COU for this OES is Processing; incorporation into formulation, mixture, or reaction product; plasticizer in paint and coating manufacturing; plastic material and resin manufacturing; rubber manufacturing; soap, cleaning compound, and toilet preparation manufacturing; textiles, apparel, and leather manufacturing; printing ink manufacturing; basic organic chemical manufacturing; and adhesive and sealant manufacturing.
[g] The PVC plastics compounding OES release was used as a surrogate for the PVC plastics converting and Recycling OESs. The associated COUs for these OESs are Processing; incorporation into articles; plasticizer in adhesive and sealant manufacturing; building and construction materials manufacturing; furniture and related product manufacturing; ceramic powders; plastics product manufacturing; and rubber product manufacturing; and Recycling, respectively.

Sediment

DBP is expected to partition primarily to soil and sediment, regardless of the compartment of environmental release (U.S. EPA, 2024j). DBP is not expected to undergo long-range transport and is expected to be found predominantly in sediments near point sources, with a decreasing trend in sediment concentrations downstream due to DBP's strong affinity and sorption potential for organic carbon in sediment. EPA's reference sediment concentrations under low flow conditions of 0.334 mg DBP/kg sediment (U.S. EPA, 2025p), corresponding to the Waste handling, treatment, and disposal OES, reflect the physical and chemical properties of DBP and its predicted affinity for sediment (U.S. EPA, 2024j), but may be overestimated due to conservative parameters and use of the VVM-PSC three compartment model. DBP is not expected to be persistent in the environment as it is expected to degrade rapidly under most environmental conditions with delayed biodegradation in low-oxygen media (U.S. EPA, 2024j).

EPA derived a COC for chronic exposure to benthic organisms from a 10-day study in the midge (*Chironomus tentans*) (Lake Superior Research Institute, 1997) of 114.3 mg DBP/kg sediment. Because the screening value for sediment concentration, based on the Waste handling, treatment, and disposal OES, is 0.334 mg/kg and the associated RQ is 0.003, EPA did not identify RQs exceeding 1 for chronic exposure to benthic organisms in sediment.

Table 5-4. Environmental Risk Quotients (RQs) for Benthic Organisms Associated with Sediment Releases of DBP

OES	Sediment Concentration (mg/kg)	Organism	Exposure Duration	Hazard Value (mg/kg)	RQ	Overall Confidence
Waste handling, treatment, and disposal[a], high-end	0.334 (7-day average)	Midge (*Chironomus tentans*); benthic organism	10 days	114.3 mg/kg	0.003	Robust

[a] The associated COU for this OES is Disposal.

Air Deposition to Soil

Modeling results indicate a rapid decline in DBP concentrations from air deposition to soil. The Application of paints, coatings, adhesives and sealants and Waste handling, treatment, and disposal OES resulted in the highest fugitive and stack releases of DBP, respectively, with annual average deposition rates to soil at 100 m of 0.268 and 0.033 mg/m^2, respectively, for a total annual deposition rate of 0.302 mg/m^2. This annual deposition rate corresponds to an annual contribution to average soil concentration of 1.78 µg/kg/yr (0.00178 mg/kg/yr). Because the biodegradation half-life of DBP in aerobic soils is on the order of days to weeks (U.S. EPA, 2024j) and the half-life in anaerobic soils is up to 65 days (Shanker et al., 1985; Inman et al., 1984), use of this annual rate as the reference soil concentration likely overestimates the equilibrium soil concentration in the environment. Because DBP has low bioaccumulation potential and experiences biodilution across trophic levels (U.S. EPA, 2024j; Mackintosh et al., 2004), the transfer of DBP through a food web is expected to dilute in each trophic level and will be less than the amount deposited to soil. For soil invertebrates and terrestrial plants, the hazard value is four orders of magnitude higher than the estimated soil concentration, with RQ values of 1.27×10^{-4} and 1.87×10^{-4}, respectively. EPA did not identify RQs exceeding 1 for terrestrial animals and plants.

Table 5-5. Environmental Risk Quotients (RQs) for Terrestrial Organisms Associated with Air Deposition to Soil Releases of DBP

<table>
<tr><th>Release</th><th>Soil Concentration</th><th>Organism</th><th>Exposure Duration</th><th>Hazard Value</th><th>RQ</th><th>Overall Confidence</th></tr>
<tr><td rowspan="2">Fugitive: Application of paints, coatings, adhesives and sealants[a]
Stack: Waste handling, treatment, and disposal[b]</td><td rowspan="2">0.00178 mg/kg (365-day release)</td><td>Springtail (Folsomia fimetaria); soil invertebrate</td><td>21 days</td><td>14 mg/kg</td><td>1.27E−04</td><td>Robust</td></tr>
<tr><td>Bread wheat (Triticum aestivum); terrestrial plant</td><td>40 days</td><td>10 mg/kg</td><td>1.78E−04</td><td>Robust</td></tr>
</table>

[a] The associated COU for this OES is Industrial/commercial use; construction, paint, electrical, and metal products; adhesives and sealants/paints and coatings.
[b] The associated COU for this OES is Disposal.

Landfill (to Surface Water, Sediment)

Due to its high affinity for organic carbon and organic media (log K_{OC} = 3.14–3.94; log K_{OW} = 4.5), DBP is expected to be present at low concentrations in landfill leachate. No studies have directly evaluated the presence of DBP in landfill or waste leachate. DBP that may present in landfill leachates is not expected to be mobile in receiving soils and sediments due to its high affinity for organic carbon. No studies were identified which reported the concentration of DBP in landfills or in the surrounding areas. There is limited information regarding DBP in dewatered biosolids, which may be sent to landfills for disposal. DBP has been identified in U.S.-based and international surveys of wastewater sludge. A 2012 survey of North American wastewater plants (Canada and United States) identified DBP in sludge at concentrations ranging from 1.7 to 1,260 ng/g dry weight (Ikonomou et al., 2012). These concentrations were well below hazard values for benthic organisms (114.3 mg/kg; 1 ng/g is equivalent to 0.001 mg/kg) and below concentrations that might be expected to transfer up the food web via trophic transfer and potentially affect terrestrial organisms. DBP is not likely to be persistent in groundwater/subsurface environments unless anoxic conditions exist. As a result, the qualitative evidence indicates that DBP migration from landfills to surface water and sediment is limited and not likely to lead to environmental concentrations that exceed hazard values for aquatic and terrestrial organisms. For the same reasons, DBP from down-the-drain disposal of consumer products or landfill disposal of consumer articles is not likely lead to environmental concentrations that exceed hazard values for aquatic and terrestrial organisms (see Section 3.1.4 for further details on the qualitative assessment of consumer disposal of DBP-containing products and articles).

Biosolids

A 2012 survey of North American wastewater plants (Canada and United States) identified DBP in wastewater sludge at concentrations ranging from 1.7 to 1,260 ng/g dry weight (Ikonomou et al., 2012). Post-aerobic treatment of activated sludges has been shown to reduce the concentration of DBP (100% removal) and other phthalates (11–100% removal) (Tomei et al., 2019). There are currently no U.S.-based studies reporting DBP concentration in biosolids or in soil following land application. DBP containing sludge and biosolids have not been reported for uses in surface land disposal or agricultural application.

DBP is not expected to be persistent in topsoil if it is applied to land through biosolids applications. Several academic studies have reported on degradation of DBP in aerobic soils. The half-life of DBP in anaerobic soils range from less than 1 day to 19 days (Cheng et al., 2018; Zhao et al., 2016; Yuan et al., 2011; Xu et al., 2008; Wang et al., 1997; Russell et al., 1985; Shanker et al., 1985). In mixed aerobic and anaerobic conditions in which oxygen or terminal electron acceptors may not be readily replaced, the degradation of DBP may be slower. Current research suggests that the half-life of DBP may be extended to as long as 65 days under evolving aerobic conditions (Inman et al., 1984). In strictly anaerobic soil conditions, DBP appears to degrade under comparable rates to aerobic or evolutionary conditions with half-lives reported from 19 to 36 days (Shanker et al., 1985; Inman et al., 1984). Based on the solubility (11.2 mg/L) and hydrophobicity (log K_{OC} = 3.14–3.94; log K_{OW} = 4.5), DBP is not expected to have potential for significant bioaccumulation, biomagnification, or bioconcentration in exposed organisms.

High-end releases from industrial facilities are unlikely to be released directly to municipal wastewater treatment plants without pretreatment or to be directly land applied following on-site treatment at the industrial facility itself. The highest reported DBP concentrations within biosolids from reasonably available literature (1.7–1,260 ng/g; 1 ng/g is equivalent to 0.001 mg/kg) and estimated DBP soil concentrations following the application of biosolids to agricultural lands (up to 0.03 mg/kg; see Table 3-2 of the *Draft Environmental Media, General Population, and Environmental Exposure for Dibutyl Phthalate (DBP)* (U.S. EPA, 2025p)) are several orders of magnitude below the hazard values for benthic organisms (114.3 mg/kg), soil organisms (14 mg/kg), or terrestrial plants (10 mg/kg). These comparisons support the qualitative assessment that potential DBP concentrations in biosolids are not likely to lead to environmental concentrations that exceed hazard values for environmental organisms.

5.3.3 Environmental Risk Characterization Summary

Table 5-6 summarizes the environmental risk characterization for DBP. In summary, EPA's environmental risk characterization indicates that environmental concentrations of DBP exceed hazard values (*i.e.*, RQ >1) for environmental organisms based on the following COUs:

- Processing; incorporation into formulation, mixture, or reaction product; plasticizer in plastic material and resin manufacturing;
- Processing; incorporation into articles; plasticizer in adhesive and sealant manufacturing; building and construction materials manufacturing; furniture and related product manufacturing; ceramic powders; plastics product manufacturing; and rubber product manufacturing;
- Recycling; and
- Disposal.

Table 5-6. Environmental Risk Summary Table for DBP

Life Cycle Stage; Category	Subcategory	OES	Organism	RQ (Benchmark = 1)	Overall Confidence
Manufacturing; Domestic manufacturing	Domestic manufacturing	Manufacturing	Aquatic vertebrates, aquatic invertebrates, benthic invertebrates, aquatic plants and algae	RQ < 1 based on application of wastewater treatment efficiency (Table 2-2)	Moderate
			Terrestrial vertebrates, soil invertebrates, terrestrial plants	RQ < 1 based on screening assessment[a]	Robust
Manufacturing; Importing	Importing	Import and repackaging	All	RQ < 1 based on screening assessment[a]	Robust
Processing; Repackaging	Laboratory chemicals in wholesale and retail trade; plasticizers in wholesale and retail trade; and plastics material and resin manufacturing				
Processing; Processing as a reactant	Intermediate in plastic manufacturing	Incorporation into formulations, mixtures, or reaction product	All	RQ < 1 based on screening assessment[a]	Robust
Processing; Incorporation into formulation, mixture, or reaction product	Solvents (which become part of product formulation or mixture) in chemical product and preparation manufacturing; soap, cleaning compound, and toilet preparation manufacturing; adhesive manufacturing; and printing ink manufacturing				
	Plasticizer in paint and coating manufacturing; soap, cleaning compound, and toilet preparation manufacturing; textiles, apparel, and leather manufacturing; printing ink manufacturing; basic organic chemical manufacturing; and adhesive and sealant manufacturing				
	Pre-catalyst manufacturing				

Life Cycle Stage; Category	Subcategory	OES	Organism	RQ (Benchmark = 1)	Overall Confidence
Processing; Processing: incorporation into formulation, mixture, or reaction product	Plasticizer in plastic material and resin manufacturing	PVC plastics compounding	Aquatic vertebrates, chronic	**1.04**	Robust
			All others	RQ < 1 based on screening assessment[a]	
Processing; Processing: incorporation into articles	Plasticizer in adhesive and sealant manufacturing; building and construction materials manufacturing; furniture and related product manufacturing; ceramic powders; plastics product manufacturing	PVC plastics converting	Aquatic vertebrates, chronic	**1.04 (Surrogate from PVC plastics compounding OES)**	Robust
			All others	RQ < 1 based on screening assessment[a]	
Processing; Processing: incorporation into formulation, mixture, or reaction product	Plasticizer in plastic material and resin manufacturing; rubber manufacturing	Non-PVC materials manufacturing	All	RQ < 1 based on screening assessment[a]	Robust
Processing; Incorporation into articles	Plasticizer in adhesive and sealant manufacturing; building and construction materials manufacturing; furniture and related product manufacturing; ceramic powders; plastics product manufacturing; and rubber product manufacturing				
Commercial Use; Construction, paint, electrical, and metal products	Adhesives and sealants	Application of adhesives and sealants	All	RQ < 1 based on screening assessment[a]	Robust
Industrial Use; Construction, paint, electrical, and metal products	Adhesives and sealants				

Life Cycle Stage; Category	Subcategory	OES	Organism	RQ (Benchmark = 1)	Overall Confidence
Commercial Use; Packaging, paper, plastic, toys, hobby products	Ink, toner, and colorant products	Application of paints and coatings	Aquatic vertebrates, aquatic invertebrates, benthic invertebrates, aquatic plants and algae	RQ < 1 based on application of wastewater treatment efficiency (Table 2-2)	Moderate
Commercial Use; Commercial use: construction, paint, electrical, and metal products	Paints and coatings		Terrestrial vertebrates, soil invertebrates, terrestrial plants	RQ < 1 based on screening assessment[a]	Robust
Industrial Use; Construction, paint, electrical, and metal products					
Industrial Use; Non-incorporative activities	Solvent, including in maleic anhydride manufacturing technology	Industrial process solvent use	All	RQ less than 1 based on screening assessment[a]	Robust
Commercial Use; Other uses	Laboratory chemicals	Use of laboratory chemicals (solid)	All	RQ less than 1 based on screening assessment[a]	Robust
Commercial Use; Other uses	Laboratory chemicals	Use of laboratory chemicals (liquid)	All	RQ less than 1 based on screening assessment[a]	Robust
Commercial Use; Other uses	Lubricants and lubricant additives	Use of lubricants and functional fluids	All	RQ less than 1 based on screening assessment[a]	Robust
Industrial Use; Other uses	Lubricants and lubricant additives				
Commercial Use; Automotive, fuel, agriculture, outdoor use products	Automotive care products				
Commercial Use; Furnishing, cleaning, treatment care products	Cleaning and furnishing care products				

Life Cycle Stage; Category	Subcategory	OES	Organism	RQ (Benchmark = 1)	Overall Confidence
Commercial Use; Other uses	Inspection penetrant kit	Use of penetrants and inspection fluids	All	RQ < 1 based on screening assessment[a]	Robust
Commercial Use; Furnishing, cleaning, treatment care products	Floor coverings; construction and building materials covering large surface areas including stone, plaster, cement, glass and ceramic articles; fabrics, textiles, and apparel	Fabrication or use of final product or articles	All	Addressed qualitatively[b]	Robust
	Furniture and furnishings				
Commercial Use; Other uses	Automotive articles				
	Chemiluminescent light sticks				
Industrial Use; Other uses	Automotive articles				
	Propellants				
Commercial Use; Packaging, paper, plastic, toys, hobby products	Packaging (excluding food packaging), including rubber articles; plastic articles (hard); plastic articles (soft); other articles with routine direct contact during normal use, including rubber articles; plastic articles (hard)				
	Toys, playground, and sporting equipment				
Processing; Recycling	Recycling	Recycling	Aquatic vertebrates, chronic	**1.04 (Surrogate from PVC plastics compounding OES)**	Robust
			All others	RQ < 1 based on screening assessment[a]	
Disposal; Disposal	Disposal	Waste handling, treatment and disposal	Aquatic vertebrates, chronic	**9.23**	Robust
			Aquatic invertebrates, chronic	**1.18**	
			All others	RQ < 1 based on screening assessment[a]	

Life Cycle Stage; Category	Subcategory	OES	Organism	RQ (Benchmark = 1)	Overall Confidence
Distribution in Commerce	Multiple	Multiple	All	Addressed qualitatively [c]	Robust
Consumer Use (All Uses, Disposal)	Multiple	Multiple	All	Addressed qualitatively [d]	Robust

[a] See Section 5.3.1.
[b] See Section 3.2.1. EPA did not quantitatively assess environmental releases for this COU due to the lack of process-specific and DBP-specific data; however, EPA expects releases from this COU to be small and dispersed in comparison to other upstream COU.
[c] See Section 4.3.2. EPA expects all DBP or DBP-containing products and/or articles to be transported in closed systems or otherwise to be transported in a form (*e.g.*, articles containing DBP) such that there is negligible potential for releases except during an incident. Therefore, no environmental exposures are reasonably expected to occur, and no separate assessment was performed for estimating releases and exposures from distribution in commerce.
[d] see Section 3.1.4 for further details on the qualitative assessment of consumer disposal of DBP-containing products and articles; disposal is the only pathway for environmental exposure to DBP from consumer COUs
Bold text in a gray shaded cell indicates an RQ exceeding the benchmark value of 1.

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5.3.4 Overall Confidence and Remaining Uncertainties in Environmental Risk Characterization

The overall confidence in the environmental risk characterization synthesizes confidence from environmental exposures and environmental hazards. Exposure confidence is detailed in the *Draft Environmental Media, General Population, and Environmental Exposure Assessment for Dibutyl Phthalate (DBP)* (U.S. EPA, 2025p). Hazard confidence is detailed in the *Draft Environmental Hazard Assessment for Dibutyl Phthalate (DBP)* (U.S. EPA, 2024c). Confidence determinations for each group of environmental organisms characterized are provided in Table 5-7.

Environmental Exposure Confidence

EPA modeled environmental exposure due to various exposure scenarios resulting from different pathways of exposure. Exposure estimates used high-end inputs for the purpose of a screening level analysis as demonstrated within the land pathway for modeled concentrations of DBP in biosolids-amended soils at relevant COUs and air to soil deposition of DBP. EPA has robust confidence in its qualitative assessment and conclusions pertaining to exposures from biosolids and landfills.

For the water pathway, relevant flow data from the associated receiving water body were collected for facilities reporting to TRI. Quantified release estimates to surface water were evaluated with PSC modeling. For each COU with surface water releases, the highest estimated release to surface water was modeled as a conservative reference concentration for a screening assessment. Releases were evaluated for resulting environmental media concentrations at the point of release (*i.e.*, in the immediate receiving water body receiving the effluent). Wastewater treatment removal was applied as a refinement to the approach for generic scenario COU/OES where such treatment was not already reflected in estimated surface water releases if RQs greater than 1 were identified without treatment. For DMR-reported COU/OES, reported surface water releases are based on monitoring at the outfall to surface water and already reflect any applicable pretreatment and wastewater treatment, and no additional wastewater treatment removal was applied (see Section 2.3.3.1 of the *Draft Environmental Release and Occupational Exposure Assessment for Dibutyl Phthalate (DBP)* (U.S. EPA, 2025q).

Within the water pathway, monitoring data were compared to modeled estimates to evaluate overlap, magnitude, and trends. Differences in magnitude between modeled and measured concentrations may be due to measured concentrations not being geographically or temporally close to known releasers of DBP. For reported releases, the high-end modeled concentrations in the surface water are the same order of magnitude as the high-end monitored concentrations found in surface water. This confirms EPA's expectation that a tiered screening approach beginning with high-end modeled reported releases is appropriate. Reported release estimates were modeled from data reported to the TRI and DMR databases. As such, EPA has moderate to robust confidence in the release data and the resulting modeled surface water concentrations at the point of release in the receiving water body. Despite slight to moderate confidence in the estimated absolute values themselves, confidence in exposure estimates capturing high-end exposure scenarios was robust given the many conservative assumptions which yielded modeled values exceeding those of monitored values. For those COUs in which surrogate water release data were used, EPA has moderate confidence in the applicability of the release data and the resulting modeled surface water concentrations. For those COUs in which generic scenario water release data were used (including those with multimedia releases), EPA has slight confidence in the applicability of the release data and the resulting modeled surface water concentrations. The Agency has robust confidence that DBP has limited bioaccumulation and bioconcentration potential based on physical, chemical, and fate properties, biotransformation, and empirical metrics of bioaccumulation metrics. For further information on confidence in environmental exposure, see the *Draft Environmental*

Media, General Population, and Environmental Exposure Assessment for Dibutyl Phthalate (DBP) (U.S. EPA, 2025p).

Aquatic Species Overall Confidence

The overall confidence in the risk characterization for the aquatic assessment is robust for COUs characterized by reported releases and those COUs that use reported releases as a surrogate, and moderate for those COUs that use generic releases. EPA has robust confidence that the release estimates modeled from TRI and DMR databases captures high-end exposure scenarios given the many conservative assumptions which yielded modeled values exceeding those of monitored values. EPA has moderate confidence that the full range of release estimates for generic scenarios capture high-end exposure scenarios because (1) these release estimates are based on generic industrial release scenarios rather than reported release data, and (2) EPA is not as confident in generic modeled estimates of receiving water body flows as it is less clear where generic releases occur relative to reported releases. EPA has slight confidence in the application of individual estimates of surface water and sediment concentrations from release estimates based on generic scenarios (including those with multimedia releases) because they are based on generic industrial release scenarios rather than reported release data and it is unclear whether individual estimates of media releases (to water, landfills, air, etc) are an overestimate. Hazard confidence in the COCs for acute aquatic and benthic organisms, chronic aquatic vertebrates, and chronic aquatic invertebrates was robust, while hazard confidence in the COCs for chronic benthic invertebrates and aquatic plants and algae was moderate. For more information on the confidence values for hazard, see Section 2.4 in the *Draft Environmental Hazard Assessment for Dibutyl Phthalate (DBP)* (U.S. EPA, 2024c).

Terrestrial Species Overall Confidence

The overall confidence in the risk characterization for terrestrial mammals, soil invertebrates, and terrestrial plants is robust. EPA has robust confidence in its qualitative assessment and conclusions pertaining to exposures from biosolids and landfills, and robust confidence in risk characterization conclusions based on its estimates of DBP air deposition to soil. Hazard confidence in the HV for soil invertebrates was robust, while hazard confidence in the HVs for terrestrial mammals and terrestrial plants was moderate. For terrestrial mammals, the HV was based on human health animal model rodent studies (Sprague-Dawley rat, *Rattus norvegicus*) because no reasonably available information was identified for exposures of DBP to mammalian wildlife. This resulted in moderate confidence in the HV due to extrapolation from laboratory rats to mammalian wildlife. For terrestrial plants, the HV was based on cultivated agricultural strains, and this resulted in moderate confidence in the HV due to extrapolation from agricultural plants to wild-type plants. For more information on the confidence values for hazard, see Section 2.4 in the *Draft Environmental Hazard Assessment for Dibutyl Phthalate (DBP)* (U.S. EPA, 2024c). Overall, because terrestrial concentrations of DBP are expected to be low and because DBP has low bioaccumulation and biomagnification potential in aquatic and terrestrial organisms, and thus low potential for trophic transfer through food webs, EPA has robust confidence in its screening level assessment that there is low potential for DBP exposures to terrestrial mammals and plants. The Agency has assessed that despite having moderate confidence in terrestrial mammalian and terrestrial plant hazard values, EPA has robust confidence that environmental DBP exposures to terrestrial organisms will be far below those hazard values. Furthermore, EPA has robust confidence that soil exposures to DBP as estimated by a conservative screening approach are far below hazard values for soil invertebrates. EPA thus has robust confidence in its risk characterization for terrestrial organisms.

Trophic Transfer Overall Confidence

EPA did not conduct a quantitative analysis of DBP trophic transfer. Due to the physical and chemical properties, environmental fate, and exposure parameters of the DBP, it is not expected to persist in surface water, groundwater, or air. DBP has a water solubility of 11.2 mg/L, a log K_{OC} value of 3.69, an estimated BCF value of 159.4 L/kg, monitored fish BAF values between 110 and 1,247 L/kg, monitored aquatic invertebrate BAF values between 500 and 6,600 L/kg, and a terrestrial biota-sediment accumulation factor (BSAF) between 0.35 and 11.8 kg/kg. DBP is expected to have low bioaccumulation potential, no apparent biomagnification potential, and thus low potential for uptake overall. For further information on the sources of these values, please see *the Draft Chemistry, Fate, and Transport Assessment for Dibutyl Phthalate (DBP)* (U.S. EPA, 2024j). Given the reasonably available data, EPA has robust confidence that that DBP is found in relatively low concentrations (or not at all) in aquatic organism tissues, especially at higher trophic levels. Furthermore, DBP has low bioaccumulation and biomagnification potential in aquatic and terrestrial organisms and therefore low potential for trophic transfer through food webs. For these reasons, EPA does not expect risk from trophic transfer in wildlife at environmentally relevant concentrations of DBP.

Table 5-7. DBP Evidence Table Summarizing Overall Confidence Derived for Environmental Risk Characterization

Types of Evidence	**Exposure**	**Hazard**	**Trophic Transfer**	**Risk Characterization Confidence**
Aquatic				
Acute aquatic assessment	+ + + VVWM-PSC, TRI/DMR Releases [a] + + VVWM-PSC, Surrogate [b] + VVWM-PSC, Generic [c] + + + AERMOD [d]	+ + +	+ + +	Robust for TRI/DMR releases and surrogates, Moderate for generic releases
Chronic aquatic vertebrate assessment		+ + +	+ + +	
Chronic aquatic invertebrate assessment		+ + +	+ + +	
Chronic benthic assessment		+ +	+ + +	
Aquatic plants and algae assessment		+ +	+ + +	
Terrestrial				
Chronic mammalian assessment	N/A (Not quantified)	+ +	+ + +	Robust
Soil invertebrate assessment	+ + + AERMOD	+ + +	+ + +	Robust
Terrestrial plant assessment	+ + + AERMOD	+ +	+ + +	Robust

[a] EPA conducted modeling VVWM-PSC tool to estimate concentrations of DBP within surface water and sediment.
[b] For some OESs with no identified releases from TRI/DMR, surrogates from other OESs were used. EPA has moderate confidence in the use of these surrogates for environmental risk characterization.
[c] For some OESs, generic release scenarios (including those with multimedia releases) were used. EPA has slight confidence in the use of these generic releases for environmental risk characterization.
[d] EPA used AERMOD to estimate ambient air concentrations and air deposition of DBP from EPA-estimated releases.
+ + + Robust confidence suggests thorough understanding of the scientific evidence and uncertainties. The supporting weight of scientific evidence outweighs the uncertainties to the point where it is unlikely that the uncertainties could have a significant effect on the risk estimate.
+ + Moderate confidence suggests some understanding of the scientific evidence and uncertainties. The supporting scientific evidence weighed against the uncertainties is reasonably adequate to characterize risk estimates.
+ Slight confidence is assigned when the weight of scientific evidence may not be adequate to characterize the scenario, and when the assessor is making the best scientific assessment possible in the absence of complete information. There are additional uncertainties that may need to be considered.

6 UNREASONABLE RISK DETERMINATION

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

EPA is preliminarily determining that DBP presents unreasonable risk of injury to human health and the environment based on (1) identified risk to workers from 20 COUs, (2) risk to consumers from 4 COUs, and (3) on identified risk to the environment from 1 COU. The unreasonable risk results from risk identified for 25 out of 44 total COUs of DBP. Of the 31 occupational COUs, 9 have risk due to dermal exposure and 11 have risk due to dermal, inhalation, and aggregate exposure. Of the 13 consumer COUs, 4 have risk due to dermal exposure. Of the 44 COUs, only 1 (Disposal) had environmental risk due to chronic exposure to DBP based on releases to surface water. This preliminary unreasonable risk determination is based on the information provided in previous sections of this draft risk evaluation, the appendices, and technical support documents for this draft risk evaluation in accordance with TSCA section 6(b). This preliminary unreasonable risk determination and the underlying evaluation are consistent with the best available science (TSCA section 26(h)) and based on the weight of scientific evidence (TSCA section 26(i)).

As noted in the Executive Summary, DBP is primarily used as a plasticizer in polyvinyl chloride (PVC) in consumer, commercial, and industrial applications—although it is also used in adhesives, sealants, paints, coatings, rubbers, and non-PVC plastics, as well as for other applications.

EPA notes that human or environmental exposure to DBP through non-TSCA uses (*e.g.*, cosmetics, use of shells and cartridges as identified in 26 U.S.C. § 4181, and food additives such as food contact materials) were not specifically evaluated by the Agency because these uses are explicitly excluded from TSCA's definition of chemical substance. Thus, it is not appropriate to extrapolate from this preliminary risk determination to form conclusions about uses of DBP that are not subject to TSCA and that EPA did not evaluate.

Additionally, where relevant, the Agency conducted analyses on aggregate exposures and cumulative risk. Aggregate exposure analyses consider effects on populations that are exposed to DBP via multiple routes (*e.g.*, dermal contact, ingestion, and inhalation). Cumulative risk analyses consider human health risks related to exposures to multiple chemicals. EPA included DBP in its draft cumulative risk analysis TSD along with five other toxicologically similar phthalate chemicals (*i.e.*, DEHP, DINP, DIBP, BBP, and DCHP) that are also being evaluated under TSCA (U.S. EPA, 2025x). Based on the revised draft CRA TSD, the Agency has considered the draft cumulative risk (*i.e.*, human health risks related to exposures to multiple phthalates) and the NHANES biomonitoring data in this preliminary DBP unreasonable risk determination and concluded that aggregate MOEs for at least one consumer group dropped below the benchmark in the cumulative analysis for two product scenarios associated with two different COUs: Consumer use – packaging, paper, plastic, hobby products – toys, playground, sporting equipment and Consumer use – furnishing, cleaning, treatment/care products – cleaning and furnishing care products. Additional discussion about EPA's preliminary unreasonable risk determination for consumer uses is provided in Section 6.1.5 while information about the cumulative risk considerations and analysis is provided in Section 4.4.

EPA has preliminarily determined that the following 24 COUs may significantly contribute to unreasonable risk to human health:

- Manufacturing – domestic manufacturing (dermal and inhalation)
- Manufacturing – importing (dermal and inhalation)
- Processing – processing as a reactant – intermediate in plastic manufacturing (dermal and inhalation)
- Processing – incorporation into formulation, mixture, or reaction product – solvents (which become part of product formulation or mixture) in chemical product and preparation manufacturing; soap, cleaning compound, and toilet preparation manufacturing; adhesive manufacturing; and printing ink manufacturing (dermal and inhalation)
- Processing – incorporation into formulation, mixture, or reaction product – pre-catalyst manufacturing (dermal and inhalation)
- Processing – incorporation into formulation, mixture, or reaction product – plasticizer in paint and coating manufacturing; plastic material and resin manufacturing; rubber manufacturing; soap, cleaning compound, and toilet preparation manufacturing; textiles, apparel, and leather manufacturing; printing ink manufacturing; basic organic chemical manufacturing; and adhesive and sealant manufacturing (dermal)
- Processing – incorporation into article – plasticizer in adhesive and sealant manufacturing; building and construction materials manufacturing; furniture and related product manufacturing; ceramic powders; plastics product manufacturing; and rubber product manufacturing (dermal)
- Processing – repackaging – laboratory chemicals in wholesale and retail trade; plasticizers in wholesale and retail trade; and plastics material and resin manufacturing (dermal and inhalation)
- Industrial use – non-incorporative activities – solvent, including in maleic anhydride manufacturing technology (dermal and inhalation)
- Industrial use – construction, paint, electrical, and metal products – adhesives and sealants (dermal)
- Industrial use – construction, paint, electrical, and metal products – paints and coatings (dermal and inhalation)
- Industrial use – other uses – lubricants and lubricant additives (dermal)
- Commercial use – automotive, fuel, agriculture, outdoor use products – automotive care products (dermal)
- Commercial use – construction, paint, electrical, and metal products – adhesives and sealants (dermal)
- Commercial use – construction, paint, electrical, and metal products – paints and coatings (dermal and inhalation)
- Commercial use – furnishing, cleaning, treatment care products – cleaning and furnishing care products (dermal)
- Commercial use – packaging, paper, plastic, toys, hobby products – ink, toner, and colorant products (dermal and inhalation)
- Commercial use – other uses – laboratory chemicals (dermal)
- Commercial use – other uses – inspection penetrant kit (dermal and inhalation)
- Commercial use – other uses – lubricants and lubricant additives (dermal)
- Consumer use – automotive, fuel, outdoor use products – automotive care products (dermal)
- Consumer use – construction, paint, electrical and metal products – adhesives and sealants (dermal)
- Consumer use – construction, paint, electrical and metal products – paints and coatings (dermal)
- Consumer use – furnishing, cleaning, treatment/care products – cleaning and furnishing care products (dermal)

EPA has preliminarily determined that the following COU may significantly contribute to unreasonable risk to the environment:

- Disposal (aquatic vertebrates)

EPA did not preliminarily identify an unreasonable risk of injury to human health or the environment from the following 19 COUs:

- Processing – recycling
- Distribution in commerce
- Industrial use – other uses – automotive articles
- Industrial use – other uses – propellants
- Commercial use – furnishing, cleaning, treatment care products – floor coverings; construction and building materials covering large surface areas including stone, plaster, cement, glass and ceramic articles; fabrics, textiles, and apparel
- Commercial use – furnishing, cleaning, treatment care products – furniture and furnishings
- Commercial use – packaging, paper, plastic, toys, hobby products – packaging (excluding food packaging), including rubber articles; plastic articles (hard); plastic articles (soft); other articles with routine direct contact during normal use, including rubber articles; plastic articles (hard)
- Commercial use – packaging, paper, plastic, toys, hobby products – toys, playground, and sporting equipment
- Commercial use – other uses – automotive articles
- Commercial use – other uses – chemiluminescent light sticks
- Consumer use – furnishing, cleaning, treatment/care products – fabric, textile, and leather products
- Consumer use – furnishing, cleaning, treatment/care products – floor coverings; construction and building materials covering large surface areas including stone, plaster, cement, glass and ceramic articles; fabrics, textiles, and apparel
- Consumer use – packaging, paper, plastic, hobby products – ink, toner, and colorant products
- Consumer use – packaging, paper, plastic, hobby products – packaging (excluding food packaging), including rubber articles; plastic articles (hard); plastic articles (soft); other articles with routine direct contact during normal use, including rubber articles; plastic articles (hard)
- Consumer use – packaging, paper, plastic, hobby products – toys, playground, and sporting equipment
- Consumer use – other uses – automotive articles
- Consumer use – other uses – chemiluminescent light sticks
- Consumer use – other uses – lubricants and lubricant additives
- Consumer use – other uses – novelty articles

For some COUs, the Agency has limited information to derive risk estimates (such as MOEs or RQs) to support a determination of whether the COU contributes to unreasonable risk of injury to human health or the environment. In such cases, EPA integrates reasonably available information (*e.g.*, read-across evidence, p-chem properties, available monitoring data) in a risk characterization using a weight of evidence approach and professional judgment to support conclusions. The risk characterizations of COUs without risk estimates are a best estimate of what EPA expects given the weight of scientific evidence without overstating the science.

The unreasonable risk determination must be informed by science, and in making a finding of "presents unreasonable risk," EPA considers risk-related factors beyond exceedance of benchmarks. Risk-related factors include the type and severity of health effects under consideration, the reversibility of the health effects being evaluated, exposure-related considerations (*e.g.,* duration, magnitude, frequency of exposure), or population exposed—particularly populations with greater exposure or greater susceptibility (PESS), and the confidence in the information used to inform the hazard and exposure values. EPA also considers, where relevant, the Agency's analyses on aggregate exposures and cumulative risk. For COUs evaluated quantitatively, as described in the risk characterization, EPA based the risk determination on the risk estimate that best represented the COU. Additionally, in the risk evaluation, the Agency describes the strength of the scientific evidence supporting the human health and environmental assessments as robust, moderate, slight, or indeterminate.

Robust confidence suggests thorough understanding of the scientific evidence and uncertainties, and the supporting weight of scientific evidence outweighs the uncertainties to the point where it is unlikely that the uncertainties could have a significant effect on the risk estimates. Moderate confidence suggests some understanding of the scientific evidence and uncertainties, and the supporting scientific evidence weighed against the uncertainties is reasonably adequate to characterize risk. Slight confidence is assigned when the weight of scientific evidence may not be adequate to characterize the risk, and when the Agency is making the best scientific assessment possible in the absence of complete information. This draft risk evaluation discusses important assumptions and key sources of uncertainty in the risk characterization, and these are described in more detail in the respective weight of scientific evidence conclusions sections for fate and transport (Section 2.2), environmental release (Sections 3.2.2 and 3.2.3), environmental concentrations (Section 3.3.1), environmental exposures and hazards (Section 5.3.4), and human health exposures and hazards (Sections 4.1.1.5, 4.1.2.4, and 4.1.3.3). It also includes overall confidence and remaining uncertainties sections for human health (Sections 4.3.2.1, 4.3.3.1, and 4.3.4.1) and environmental (Section 5.3.4) risk characterizations. In general, EPA makes an unreasonable risk determination based on risk estimates that have an overall confidence rating of moderate or robust because those confidence ratings indicate the scientific evidence is adequate to characterize risk estimates despite uncertainties or is such that it is unlikely the uncertainties could have a significant effect on the risk estimates.

6.1 Human Health

Calculated non-cancer risk estimates (MOEs[6]) can provide a risk profile of DBP by presenting a range of estimates for different health effects for different COUs. When characterizing the risk to human health from occupational exposures during risk evaluation under TSCA, EPA conducts baseline assessments of risk and makes its determination of unreasonable risk in a manner that takes in consideration reasonably available information (*e.g.*, test order information, site visits) regarding the use of respiratory protection or other PPE.[7] This allows EPA to make unreasonable risk determinations based on the available information regarding workers. In addition, the risk estimates are based on exposure scenarios with monitoring data that reflect existing requirements, such as those established by OSHA (*i.e.,* permissible exposure limit [PEL]) or through industry or sector best practices. In this draft risk evaluation, some of the risk estimates calculated do not reflect use of PPE; however, Table 4-17 provides more information on PPE, including risk estimates calculated with PPE, that could be used to reduce the exposures, so that the risk estimates are above the benchmark MOE. Because EPA does not currently have information regarding use of PPE under the COUs, the preliminary risk determination is based on the risk estimates that do not reflect use of PPE.

[6] EPA derives non-cancer MOEs by dividing the non-cancer POD (HEC [mg/m^3] or HED [mg/kg-day]) by the exposure estimate (mg/m^3 or mg/kg-day). Section 4.3.1 has additional information on the risk assessment approach for human health.
[7] It should be noted that, in some cases, baseline conditions may reflect certain mitigation measures, such as engineering controls, in instances where exposure estimates are based on monitoring data at facilities that have engineering controls in place.

To characterize risk from non-cancer endpoints, the estimated MOEs are compared to their respective benchmark MOE. The benchmark MOE accounts for the total uncertainty in a POD. The benchmark MOE is the total of several individual uncertainty factors relevant to a given POD with values usually of 1, 3, or 10. For DBP, two uncertainty factors were used to derive a benchmark MOE: (1) UF_A of 3 for the uncertainty in extrapolating animal data to humans (*i.e.*, interspecies variability), and (2) UF_H of 10 for the variation in sensitivity among the members of the human population (*i.e.*, intrahuman/ intraspecies variability). Therefore, the benchmark MOE for DBP is 30; is based on effects on the developing male reproductive system; and was used to characterize risk from exposure to DBP for acute, intermediate, and chronic exposure scenarios. A lower benchmark MOE (*e.g.*, 30) indicates greater certainty in the data (because the total UF for the relevant POD is low). A higher benchmark MOE (*e.g.*, 100) would indicate more extrapolation uncertainty for specific hazard endpoints and scenarios. Additional information regarding the non-cancer hazard identification and the benchmark MOE is provided in Section 4.2.2 of this draft risk evaluation. An MOE that is less than the benchmark MOE is a starting point for informing a determination of unreasonable risk of injury to human health, based on non-cancer effects. It is important to emphasize that these calculated risk estimates alone are not "bright-line" indicators of unreasonable risk.

6.1.1 Populations and Exposures EPA Assessed for Human Health

EPA has evaluated risk to workers (16+ years old), including ONUs and females of reproductive age directly working with DBP; consumers and bystanders (adults and children), as well as the general population (including fenceline communities) using reasonably available monitoring and modeling data for inhalation, dermal, and ingestion exposures, as applicable. The Agency has evaluated risk from inhalation, incidental ingestion of inhaled dust, and dermal exposure of DBP to workers, including ONUs. EPA has also evaluated risk from inhalation, dermal, and ingestion exposures for consumers. For the general population, EPA has evaluated risk from (1) ingestion exposures via drinking water, incidental surface water ingestion during swimming, fish ingestion (including subsistence and Tribal fishers), and soil ingestion by children; (2) dermal exposure to surface water during swimming; (3) acute and chronic inhalation exposure; and (4) exposures measured through urinary biomonitoring (*i.e.*, NHANES). EPA concluded it is not necessary to separately model risks to infants consuming the human milk of exposed individuals because the POD used in the assessment is based on male reproductive effects resulting from maternal exposures in multi-generational studies. EPA therefore has confidence that the risk estimates calculated based on maternal exposures are protective of a nursing infant's greater susceptibility during this unique lifestage whether due to sensitivity or greater exposure per body weight. Descriptions of the data used for human health exposure are in Section 4.1. Uncertainties for overall exposures are presented in the respective occupational, consumer, and general population exposure sections of this draft risk evaluation and are considered in the preliminary unreasonable risk determination.

6.1.2 Summary of Human Health Effects

EPA has preliminary determined that DBP presents unreasonable risk to human health because of non-cancer phthalate syndrome-related effects on the developing male reproductive system (*i.e.*, decreased fetal testicular testosterone) in the following populations:

- workers from acute, intermediate, and chronic dermal and inhalation exposures; and
- consumers from dermal exposures.

With respect to health endpoints upon which EPA has based this unreasonable risk determination, the Agency has robust confidence in the developmental toxicity POD. The POD is based on phthalate syndrome-related effects on the developing male reproductive system (*i.e.*, decreased fetal testicular testosterone) and was derived used BMD modeling. Risk estimates based on the POD are relevant for females of reproductive age and males at any lifestage. Decreased fetal testicular testosterone is the most sensitive endpoint for DBP. Additionally, there is epidemiological evidence that DBP exposure can adversely affect the developing male reproductive system consistent with phthalate syndrome in males of any age, and that DBP exposure at higher concentrations can cause other health effects in females as well (see the *Draft Non-cancer Human Health Hazard Assessment for Dibutyl Phthalate (DBP)* (U.S. EPA, 2024f)). Therefore, EPA considers the proposed decreased fetal testicular testosterone POD to be relevant across sex, lifestage, and durations. The confidence in the POD and descriptions of the data used to determine the human health effects from DBP are explained in Section 4.2.2. Additional information about EPA's confidence in the human health hazard of DBP is provided in Section 4.2.2.

With respect to carcinogenicity, overall, EPA considers there to be some limited evidence to support the conclusion that chronic oral exposure to DBP causes pancreatic tumors in rats. Under the *Guidelines for Carcinogen Risk Assessment* (U.S. EPA, 2005), the Agency reviewed the weight of scientific evidence for the carcinogenicity of DBP and has preliminarily determined that there is *Suggestive Evidence of Carcinogenic Potential* of DBP in rodents. According to the *Guidelines for Carcinogen Risk Assessment,* when there is *Suggestive Evidence,* "the Agency generally would not attempt a dose-response assessment, as the nature of the data generally would not support one." Consistently, EPA is not conducting a dose-response assessment for DBP or evaluating DBP for carcinogenic risk to humans.

The human health risk estimates for consumers and bystanders, and the general population are presented and characterized in Section 4.3. Human health risk estimates for workers including ONUs are presented in Table 4-18 and characterized in Section 4.3. Again, the benchmarks are not bright-lines, and EPA has discretion to consider other risk-related factors when concluding whether a COU significantly contributes to the unreasonable risk of the chemical substance.

6.1.3 Basis for Unreasonable Risk to Human Health

In developing the exposure and hazard assessments for DBP, EPA has analyzed reasonably available information to ascertain whether some human populations may have greater exposure and/or susceptibility than the general population to the hazard posed by DBP. For the DBP draft risk evaluation, EPA has accounted for the following PESS: females of reproductive age; pregnant women; infants; children and adolescents; people who frequently use consumer products and/or articles containing high concentrations of DBP; people exposed to DBP in the workplace; people in proximity to releasing facilities, including fenceline communities; and Tribes and subsistence fishers whose diets include large amounts of fish. Section 4.3.5 summarizes how PESS were incorporated into the risk evaluation through consideration of potentially increased exposures and/or potentially increased biological susceptibility and summarizes additional sources of uncertainty related to consideration of PESS.

Because EPA was able to calculate risk estimates for PESS groups in this assessment (*e.g.*, female workers of reproductive age, infants and children), the Agency did not always use risk estimates based on high-end exposure levels as the basis of the unreasonable risk determination for DBP. Additionally, EPA considered whether high-end risk estimates represented sentinel exposure levels accurately. As explained in the human health risk characterization (Section 4.3), for most occupational COUs, central-tendency risk estimates were used to preliminarily determine unreasonable risk. The assumptions of an 8-hour exposure duration for DBP may overestimate dermal exposure; however, even a 25-minute exposure of a femal worker of reproductive age or 20-minute exposure to workers under the Manufacturing OES could result in risk estimates below the benchmark MOE. Similarly, for consumer COUs, high-intensity risk estimates were used to preliminarily determine unreasonable risk—except for the consumer use of synthetic leather articles, automotive articles, and novelty articles. The UF_H of 10 for human variability that EPA has applied to MOEs accounts for increased susceptibility of populations. The non-cancer POD for DBP selected by the Agency for use in risk characterization is based on the most sensitive developmental effect (*i.e.,* reduced fetal testicular testosterone production) observed and is expected to be protective of susceptible subpopulations. More information on how EPA characterized sentinel and aggregate risks is provided in Section 4.1.5, and more information on how the Agency characterized PESS risks is provided in Section 4.3.5.

Additionally, EPA did not consider aggregate exposure scenarios across COUs because the Agency did not find any evidence to support such an aggregate analysis, such as statistics of populations using certain products represented across COUs or workers performing tasks across COUs. However, EPA considered combined exposure across all routes of exposure for each individual occupational and consumer COU to calculate aggregate risks (Sections 4.3.2 and 4.3.3). The Agency aggregated exposures across routes for workers, including ONUs, as well as consumers for COUs with quantitative risk estimates. EPA has identified at least one consumer COU where aggregating exposures across all exposure routes indicated risk where there was no risk indicated when considering a single route. EPA did not consider aggregate exposure for the general population. As described in Section 4.1.3, the Agency employed a risk screening approach for the general population exposure assessment. More information on how EPA characterized sentinel and aggregate risks is provided in Section 4.1.5.

In addition to the analysis done for DBP alone (referred to as "individual analysis"), EPA applied both the methods and principles of CRA (*Draft Proposed Approach for Cumulative Risk Assessment (CRA) of High-Priority Phthalates and a Manufacturer-Requested Phthalate under the Toxic Substances Control Act* (U.S. EPA, 2023c) as well as the *Revised Draft Technical Support Document for the Cumulative Risk Analysis of Di(2-ethylhexyl) Phthalate (DEHP), Dibutyl Phthalate (DBP), Butyl Benzyl Phthalate (BBP), Diisobutyl Phthalate (DIBP), Dicyclohexyl Phthalate (DCHP), and Diisononyl Phthalate (DINP) Under the Toxic Substances Control Act (TSCA)* (U.S. EPA, 2025x)) to derive non-cancer risk estimates for occupational and consumer exposures. EPA's draft CRA includes cumulative exposure to other toxicologically similar phthalates being evaluated under TSCA (*i.e.,* DEHP, DCHP, BBP, DIBP, and DINP) and uses an "Relative Potency Factor (RPF) analysis" to characterize risk. DBP was used as the index chemical for the meta-analysis and BMD modeling approach to model decreased fetal testicular testosterone. Because DBP is the index chemical and the RPF is 1, scaling by relative potency has no effect on the DBP exposure estimates used to derive DBP cumulative risk estimates. More information on how EPA characterized the risk from the cumulative exposure to the phthalates is provided in Section 4.4.1.

The revised draft CRA TSD also includes the addition of a non-attributable cumulative exposure to DEHP, DBP, BBP, DIBP, and DINP as estimated from NHANES urinary biomonitoring data using reverse dosimetry. The NHANES exposure is non-attributable—meaning it cannot be attributed to specific COUs or other sources that may result in high-dose exposure scenarios (*e.g.,* occupational exposures to workers)—but likely includes exposures attributable to both COUs assessed under TSCA and other, non-TSCA sources (*e.g.,* diet, food packaging, cosmetics).

6.1.4 Workers

Based on the occupational risk estimates and related risk factors, EPA is preliminarily determining that DBP presents unreasonable risk due to

- non-cancer risks from acute, intermediate, and chronic dermal and inhalation exposure to workers, including ONUs, that contribute to the preliminary determination of unreasonable risk due to certain COUs.

More information on occupational risk estimates is in Section 4.3.2, including the effect of PPE on the occupational risk estimates (Section 4.3.2.4. and Table 4-17). The occupational risk estimates are not impacted by the results from the cumulative risk assessment, even with the addition of non-attributable cumulative exposure NHANES urinary biomonitoring data. EPA's confidence in the cumulative MOEs for workers is moderate to robust (Section 4.4.4.1).

EPA is preliminarily determining that 20 COUs may significantly contribute to unreasonable risk of injury to human health for workers, including ONUs.

High-end inhalation risk estimates were used to preliminarily determine unreasonable risk due to eight COUs. High-end inhalation risk estimates were used for one occupational COU (Commercial use – inspection penetrant kits) for the acute exposure duration because the high-end inhalation risk estimates are expected to be most reflective of workers exposed to potentially elevated exposures (*e.g.*, low ventilation, high concentration, high use rate) for an acute duration; however, central tendency risk estimates were used for intermediate and chronic inhalation exposure durations, as well as dermal exposure risk estimates, (see in Section 4.3.2, "Use of penetrants and inspection fluids"). For seven COUs—(1) Manufacturing – domestic manufacturing; (2) Manufacturing – importing; (3) Processing – processing as a reactant – intermediate in plastic manufacturing; (4) Processing – incorporation into formulation, mixture, or reaction product – solvents (which become part of product formulation or mixture) in chemical product and preparation manufacturing; soap, cleaning compound, and toilet preparation manufacturing; adhesive manufacturing; and printing ink manufacturing; (5) Processing – incorporation into formulation, mixture, or reaction product – pre-catalyst manufacturing; (6) Processing – repackaging; and (7) Industrial use – non-incorporative activities – solvent, including in maleic anhydride manufacturing technology)—due to limited inhalation data points, both the central and high-end exposure estimates are expected to be reflective of worker inhalation exposures. Also, since the dermal exposures are upper-bound estimates, the central tendency values of exposure estimates are expected to be more reflective of worker dermal exposures (see Section 4.3.2). For all other COUs, EPA is using the central tendency risk estimates to preliminarily determine unreasonable risk due to inhalation, dermal, and aggregate exposure due to the uncertainties involved in the inhalation exposure estimates and the uncertainties present in the representativeness of the skin permeability data in the dermal exposure estimate, which varies with each OES mapped to occupational COUs, as described in Section 4.3.2. Overall, EPA has moderate to robust confidence in the risk estimates calculated for worker and ONU inhalation and dermal exposure scenarios.

For cases where occupational dermal exposure to liquid DBP was assessed, EPA used a flux-limited dermal absorption value derived from a study conducted by Doan et al. (2010) to estimate high-end and central tendency dermal exposures. For occupational dermal exposure to solid DBP, EPA used a flux-limited dermal absorption model to estimate high-end and central tendency dermal exposures for workers in each OES. Both methods are described in the *Draft Environmental Release and Occupational Exposure Assessment for Dibutyl Phthalate (DBP)* (U.S. EPA, 2025q) (see also Section 4.1.1.1). Dermal exposure for ONUs was assessed for COUs where contact with DBP-containing mist or dust on surfaces was expected. For the occupational dermal exposure assessment, EPA assumed a standard 8-hour workday and the chemical is contacted at least once per day. Because DBP has low volatility and relatively low absorption, it is possible that the chemical remains on the surface of the skin after dermal contact until the skin is washed. So, in absence of exposure duration data, EPA has assumed that absorption of DBP from occupational dermal contact with materials containing DBP may extend up to 8 hours per day (U.S. EPA, 1991). However, if a worker uses proper PPE or washes their hands after contact with DBP or DBP-containing materials, dermal exposure may be eliminated. Therefore, the assumption of an 8-hour exposure duration for DBP may lead to overestimation of dermal exposure.

For average adult workers, the surface area of contact was assumed equal to the area of one hand (*i.e.*, 535 cm^2), or two hands (*i.e.*, 1,070 cm^2), for central tendency exposures, or high-end exposures, respectively (U.S. EPA, 2011a). Despite moderate confidence in the estimated values themselves, EPA has robust confidence that the dermal liquid exposure estimates are upper bound of potential exposure scenarios. Additionally, there are uncertainties associated to the flux-limited approach which likely results in overestimations due to the assumption about excess DBP in contact with skin for the entire work duration. EPA has considered the weight of scientific evidence for dermal risk estimates to be sufficient for determining whether a COU significantly contributes to unreasonable risk. More information on the Agency's confidence in these risk estimates and the uncertainties associated with them can be found in Section 4.1.1.5.

For three COUs (Industrial use – construction, paint, electrical, and metal products – paints and coatings; Commercial use – construction, paint, electrical, and metal products – paints and coatings; and Commercial use – packaging, paper, plastic, hobby products – ink, toner and colorant products), EPA is preliminary determining that these COUs significantly contribute to the unreasonable risk of injury to human health due to acute, intermediate, and chronic dermal exposure (MOEs from 1.7–3.3 for each population assessed). The MOEs were below the benchmark for acute, intermediate, and chronic inhalation exposure; however, the intermediate and chronic duration risk estimates are at or only slightly below the benchmark (25+ for each population assessed). Taking into consideration the dermal exposure as well as the aggregate exposure assessment and risk estimates, the Agency believes that there is enough evidence to support EPA's preliminary determination that these COUs also significantly contribute to unreasonable risk of injury to human health due to intermediate and chronic inhalation exposure, as well as acute inhalation exposure. However, EPA preliminarily finds that dermal exposure is the driver of unreasonable risk presented by DBP.

EPA has assessed one (the following) occupational COU without deriving risk estimates:

- Distribution in commerce: EPA expects DBP to be transported in sealed containers from import sites to downstream processing and use sites, or for final disposal. EPA also expects under standard operating procedures, along with the expectation that DBP would be transported in a closed system, that there is negligible potential for releases except during an incident. Therefore, no occupational exposures are reasonably expected to occur and exposures and releases that could occur during distribution in commerce would not result in unreasonable risk.

EPA's overall risk characterization confidence for workers is summarized in Section 4.3.2.1.

6.1.5 Consumers

Based on the consumer risk estimates and related risk factors, EPA is preliminarily determining that DBP presents unreasonable risk due to non-cancer risk from

- acute dermal exposure for consumers.

EPA is preliminarily determining that four COUs may significantly contribute to unreasonable risk of injury to human health for consumers.

EPA reviewed the parameters for the exposure scenarios analyzed under each COU and preliminarily determined risk based on the most representative intensity assessed. For eight COUs, the high-intensity risk estimates were used in making a preliminary unreasonable risk determination—even after considering the conservative assumptions used in the dermal assessment. However, for the following five COUs, different intensity risk estimates were considered for the preliminary unreasonable risk determination:

- High-intensity dermal and medium-intensity aggregate and ingestion risk estimates were used for Consumer use – other uses – novelty articles;
- Low-intensity dermal for infants and toddlers and medium-intensity risk estimates for all other exposure routes and lifestages were used for Consumer use – furnishing, cleaning, treatment/care products – fabric, textile, and leather products;
- Low-intensity dermal for infants and toddlers and medium-intensity risk estimates for all other exposure routes and lifestages were used for Consumer use – other uses – automotive articles;
- Medium-intensity inhalation risk estimates were used for infants and toddlers for Consumer use – construction, paint, electrical, and metal products – paints and coatings; and
- Medium-intensity risk estimates were used for Consumer use – packaging, paper, plastic, toys, hobby products – toys, playground, sporting equipment.

See Section 4.3.3 and the *Draft Consumer and Indoor Dust Exposure Assessment for Dibutyl phthalate (DBP)* (U.S. EPA, 2025c) for additional information.

For dermal exposure, the CEM Model assumes infinite DBP migration from product to skin without considering saturation which results in overestimations of dose and subsequent risk, see Section 2.3 in U.S. EPA (2025c) for a detailed explanation. Because of this, CEM was not used to model consumer dermal exposures, and instead dermal exposures were estimated using a flux-limited dermal absorption approach for liquid and solid products (U.S. EPA, 2025d). For each exposure route, EPA used the 10th percentile, average, and 95th percentile value of an input parameter (*e.g.*, weight fraction, surface area) where possible to characterize low-, medium-, and high-intensities for a given COU. If only a range was reported, EPA used the minimum and maximum of the range as the low and high values, respectively. The average of the reported low and high values from the reported range was used for the medium exposure scenario. Section 4.1.2.1 includes a description of the uncertainties and methods used to evaluate dermal exposure for consumers. See *Draft Consumer and Indoor Dust Exposure Assessment for Dibutyl Phthalate (DBP)* (U.S. EPA, 2025c) for details about the consumer modeling approaches, sources of data, model parameterization, and assumptions. The largest chronic dose estimated was for dermal and inhalation exposure to metal coatings for young teens to adults, followed by dermal exposure to adhesives, footwear, and waxes. It is noteworthy that the dermal screening analysis with the flux-limited approach has larger uncertainties than inhalation dose results; see Section 4.1.2.4 for a detailed discussion of uncertainties within approaches, inputs, and overall estimate confidence (Section 4.1.2.2).

One COU, Consumer use – construction, paint, electrical, and metal products – paints and coatings, was assessed using three different exposure scenarios: (1) metal coatings, (2) indoor sealing and refinishing sprays, and (3) outdoor sealing and refinishing spray. Metal coatings refer to consumer or DIY paint-type products that can be sprayed in a home setting. The metal coatings exposure scenario was assessed for bystanders for children under 10 years of age who could be exposed from consumers using those products at home. Per the *Draft Consumer and Indoor Dust Exposure Assessment for Dibutyl phthalate (DBP)* (U.S. EPA, 2025c), metal coating products are expected to be used in comparatively smaller scale projects and were thus modeled at use durations of 120, 60, and 30 minutes. For metal coating products, daily use was not considered likely, but the product could reasonably be used weekly for hobby projects or a variety of small projects. Therefore, this product was modeled at a use frequency of 52 times per year. The overall confidence in this COU inhalation exposure estimate is robust because the CEM default parameters represent actual use patterns and location of use. The resulting chronic inhalation MOEs for bystanders from the high-intensity scenario were below the benchmark of 30 for infants and toddlers (children <2 years old; MOEs of 26 and 28, respectively). However, based on the conservative assumptions used in the assessment, the frequency of use likely overestimates potential exposure, and the medium-intensity is a more representative scenario of exposure for this COU. Medium-intensity exposure risk estimates for the metal coatings scenario were 130 and 140 for infants and toddlers, respectively. Therefore, EPA is preliminarily determining that this COU does not contribute to unreasonable risk for infants and toddlers for bystander inhalation exposure. EPA is also preliminarily determining that this COU significantly contributes to unreasonable risk for acute dermal and aggregate exposure for young teens, teenagers and adults using these products based on the metal coatings exposure scenario; see Table 6-2 for additional information.

For the COU Consumer use – packaging, paper, plastic, toys, hobby products – toys, playground, sporting equipment, EPA used four exposure scenarios: (1) children's toys (new); (2) children's toys (legacy); (3) small articles with semi routine contact – miscellaneous items including a football, balance ball, and pet toy; and (4) tire crumb. The individual chemical analysis indicated risk only to infants who use legacy toys and there was no risk indicated for infants who use newer toys (*i.e.*, toys containing <0.1% DBP) (MOE of 23 for high-intensity, acute aggregate exposure for legacy toys based on individual chemical analysis, and MOE of 21 for high-intensity, acute aggregate exposure for legacy toys based on cumulative assessment with non-attributable NHANES data). For new toys, after factoring in the non-attributable NHANES data, the MOE is 29 for aggregate exposure for infants (children <1 year). This additional risk indicated by the draft cumulative analysis supports EPA's risk conclusion about the overall COU because the individual chemical analysis also indicated acute aggregate risk for infants based on the high-intensity exposure scenario for the use of legacy toys (*i.e.*, toys containing >0.1% DBP).

The legacy toys assessment provides a range of reasonable values that reflect possible exposures. The high-intensity risk estimates likely represent an upper boundary for exposure and may, in some cases, overestimate the highest possible dose expected. One such case is inhalation-ingestion of DBP in dust and particulates. CEM assumes that 100 percent of the chemical that is on the dust or particulate matter will be absorbed when the dust or particulate matter is inhaled or ingested. This is highly unlikely to be the case as bioavailability is generally reduced in inhaled particles as compared to gas phase or aerosol chemicals. The bioavailable fraction of DBP in dust and particulate matter would be difficult to quantify due to the absence of quantitative data in literature. However, EPA recognizes that the assumption of 100 percent absorption through inhalation of DBP in dust/particulate matter and ingestion of DBP in dust/particulate matter likely overestimate exposure by these routes.

The aggregation across routes for a high-intensity exposure scenario for infants resulted in an MOE value of 23. The inhalation and ingestion of surface dust are the main contributors to the overall aggregate MOE value. The inhalation scenarios are explained above. The surface dust ingestion scenario model estimates the DBP concentration in settled dust on a toy's surface, assuming primarily that DBP partitions directly from the toy to settled dust. The model assumes exposure to occur through dust intake via incidental ingestion assuming a daily stay-at-home dust ingestion rate per lifestage. The model, assuming instantaneous equilibrium is achieved for partitioning, represents an upper-bound scenario. Overestimation of DBP concentration in the dust compartment happens when incidental ingestion after inhalation and hand-to-mouth are both included in every ingestion estimate. The model estimates that DBP enters the air phase and while suspended it can partition to dust particles generated by material wear and surfaces, which makes incidental ingestion after inhalation possible. Subsequently, the suspended particulate settles, which makes hand-to-mouth ingestion possible. The overestimation magnitude and effect cannot be quantified with any accuracy or certainty based on current literature. The aggregated MOE overall confidence originates from compounding and intensifying the uncertainties from each aggregated exposure route. The overestimation for all three high-intensity exposure routes suggest that the high-intensity use aggregate scenario may not reflect or capture realistic exposures. Given this information, the Agency is basing this preliminary risk determination on the medium-intensity use of toys, as it is representative of the middle of the range of exposures; therefore, EPA is preliminary determining that, for DBP, the COU Consumer use – packaging, paper, plastic, toys, hobby products – toys, playground, sporting equipment does not significantly contribute to unreasonable risk. More information on the cumulative risk considerations is provided in Section 4.4.

The DBP consumer exposure overall confidence to use the results for risk characterization ranges from moderate to robust, depending on COU scenario (Section 4.1.2.4). EPA's overall confidence in the acute, intermediate, and chronic consumer inhalation, ingestion, and dermal exposure risk estimates ranges from moderate to robust. The Agency has moderate to robust confidence in the risk estimates calculated for consumers inhalation, ingestion, and dermal exposure scenarios (Section 4.3.3.1), and has robust confidence that dermal exposure scenarios represent a conservative, upper-bound on exposure. EPA's confidence in the cumulative consumer MOEs is moderate to robust (Section 4.4.5.1).

6.1.6 General Population

Based on the risk estimates, EPA did not identify risk to the general population from the following exposure routes and pathways for DBP:

- exposure via the land pathway (*i.e.*, application of biosolids and landfills);
- incidental ingestion and dermal contact from swimming;
- acute and chronic ingestion of drinking water;
- acute and chronic ingestion exposure from fish ingestion;
- acute and chronic inhalation exposure to ambient air in proximity to releasing facilities, including fenceline communities; and
- soil ingestion exposure from air deposition to soil.

As stated in Section 4.3.4, EPA evaluated surface water, drinking water, fish ingestion, and ambient air pathways quantitatively using a screening level approach for DBP releases associated with COUs (see the *Draft Environmental Media and General Population Screening for Dibutyl Phthalate (DBP)* (U.S. EPA, 2025p) and Section 4.1.3 for additional details about the assessment and assessment process). Land pathways (*i.e.*, landfills and application of biosolids) were assessed qualitatively, and were inclusive of down-the-drain releases of consumer products and landfill disposal of consumer articles (see Section 3.1.4 for details on the qualitative assessment of consumer disposal of DBP-containing products and articles). For pathways assessed quantitatively, high-end estimates of DBP concentration in the various environmental media were used for screening level purposes. EPA used an MOE approach using high-end exposure estimates to determine whether an exposure pathway had potential non-cancer risks. High-end exposure estimates were defined as those associated with the industrial and commercial releases from a COU and OES that resulted in the highest environmental media concentrations. Therefore, if there is no risk for an individual identified as having the potential for the highest exposure associated with a COU for a given pathway of exposure, then that pathway was determined not to be a pathway of concern and not pursued further. Based on the screening level approach described in Section 4.1.3, and the qualitative assessment of landfill and biosolids pathways described in Section 3.1.4, EPA did not identify risk to the general population from exposure to DBP through biosolids, landfills, surface water, drinking water, fish ingestion, and ambient air.

EPA has robust confidence that the risk estimates calculated for the general population were conservative and appropriate for a screening level analysis. The Agency also has robust confidence that modeled releases used are appropriately conservative for a screening level analysis. Therefore, the Agency has robust confidence that no exposure scenarios will lead to greater doses than presented in this evaluation. Despite slight and moderate confidence in the estimated values themselves, confidence in exposure estimates capturing high-end exposure scenarios was robust given that many of the modeled values exceeded those of monitored values and exceeded total daily intake values calculated from NHANES biomonitoring data, adding to confidence that exposure estimates captured high-end exposure scenarios (Section 4.1.3.3).

6.2 Environment

Based on the environmental risk assessment, EPA is preliminarily determining that DBP presents unreasonable risk of injury to the environment from the Disposal COU due to chronic exposure for aquatic vertebrates using a screening approach with refinements. For environmental pathways which were quantitatively assessed, EPA compared the highest release estimates to environmental media for a given pathway with the hazard values for aquatic and terrestrial plants. If the exposure for the COU with the highest amount of environmental release (*i.e.*, the COU with the highest environmental exposures, the most conservative exposure estimates) did not exceed the hazard threshold for aquatic or terrestrial plants, it was determined that exposures due to releases from other COUs would not lead to environmental risk. If the analysis indicated risk, then the next-highest releasing exposure scenario was evaluated until all COUs were characterized. Discussion of the screening approach and the refinements made can be found in Section 5.3.

Using the screening approach with refinements, EPA was able to calculate RQs. Calculated RQs can provide a risk profile by presenting a range of estimates for different environmental hazard effects for different COUs. An RQ equal to 1 indicates that the exposures are the same as the concentration that causes effects. An RQ less than 1, when the exposure is less than the effect concentration, generally indicates that there is not a risk of injury to the environment that would support a determination of unreasonable risk for the chemical substance. An RQ greater than 1, when the exposure is greater than the effect concentration, generally indicates that there is risk of injury to the environment that would support a determination of unreasonable risk for the chemical substance. Additionally, if a chronic RQ is 1 or greater, the Agency evaluates whether the chronic RQ is 1 or greater for 30 days or more based on the exposure period of the hazard toxicity tests before making a determination of unreasonable risk.

Based on the quantitative screening approach with refinements, EPA is preliminarily determining that one COU, Disposal, significantly contributes to unreasonable risk to the environment.

EPA has qualitatively evaluated COUs without RQs and is preliminarily determining they do not contribute to unreasonable risk to the environment, including distribution in commerce. Risk to the environment from consumer down-the-drain releases and end-of-life disposal was assessed qualitatively for the 13 consumer COUs under the Disposal COU (see Section 3.1.4). Based on the qualitative assessment, EPA is preliminarily determining that consumer down-the-drain releases and end-of-life disposal do not contribute to unreasonable risk to the environment; however the Disposal COU, may, because of the results of the quantitative environmental risk assessment. Results indicated chronic risk for aquatic vertebrates due to high-end releases to surface water. More information about how COUs were assessed for risk to the environment are summarized in Table 5-2 and Table 5-6 of this draft risk evaluation.

6.2.1 Populations and Exposures EPA Assessed for the Environment

For aquatic organisms, EPA has evaluated exposures via surface water and trophic transfer. For benthic organisms, EPA has evaluated exposures via surface water and sediment. For aquatic plants and algae, the Agency evaluated exposures via surface water. For soil invertebrates and terrestrial plants, EPA evaluated exposures via air deposition to soil. For terrestrial organisms, the Agency has evaluated exposures via trophic transfer. Additionally, EPA evaluated terrestrial mammal exposures from biosolids and landfills.

For aquatic and terrestrial species, EPA expects the main environmental exposure pathways for DBP to be releases to surface water and subsequent deposition to sediment, and limited dispersal from fugitive and stack air release deposition to soil, respectively. Trophic transfer, biosolids, and landfills were all qualitatively assessed and did not indicate risk for the environment.

EPA's confidence in the aquatic exposure assessment ranges from slight (for COUs that were assessed using generic releases) to robust (for COUs with TRI/DMR releases). Additional information about the Agency's confidence in the aquatic, terrestrial, and trophic transfer exposure assessments is provided in Table 5-7 of this draft risk evaluation.

6.2.2 Summary of Environmental Effects

EPA is preliminarily determining that one COU, Disposal, may significantly contribute to unreasonable risk to the environment because of chronic effects for mortality, growth, reproduction, and development for aquatic vertebrates.

EPA has robust confidence that DBP has chronic effects on aquatic vertebrates in the environment. More information about the Agency's confidence in the aquatic, terrestrial, and trophic transfer hazard assessments is in Table 5-7 of this draft risk evaluation.

6.2.3 Basis for Unreasonable Risk to the Environment

Based on the risk evaluation for DBP—including the risk estimates, the environmental effects of DBP, the exposures, physical and chemical properties of DBP, and consideration of uncertainties—EPA has preliminarily identified unreasonable risk to the environment from DBP.

EPA quantitatively evaluated surface water, sediment and air deposition to soil exposure pathways (with the exception of eight COUs as explained below), and qualitatively evaluated trophic transfer, biosolids and landfills exposure pathways. Consistent with the Agency's determination of unreasonable risk to human health, the RQ is not treated as a bright-line and other risk-based factors may be considered (*e.g.*, confidence in the hazard and exposure characterization, duration, magnitude, uncertainty) for purposes of making an unreasonable risk determination.

Four COUs evaluated quantitatively resulted in RQs greater than 1. Three COUs have RQs of 1.04. Although EPA has robust confidence in the risk characterization, the Agency does not use the RQ of 1 as a bright-line and considering the assumptions in the modeling of water concentrations, EPA is preliminarily determining that these three COUs do not contribute to unreasonable risk to the environment for DBP (see Table 5-6). One COU, Disposal, has RQs of 9.23 and 1.18 for chronic exposure to aquatic vertebrates and invertebrates, respectively. The RQs are based on wastewater release from treatment plants and are inclusive of wastewater treatment removal of DBP. As stated in Section

5.3.4, for reported releases, the high-end modeled concentrations in the surface water are the same order of magnitude as the high-end monitored concentrations found in surface water. However, per the *Draft Environmental Media, General Population, and Environmental Exposure for Dibutyl Phthalate (DBP)*, the modeled surface water concentration value for the Disposal COU is higher than the highest reported monitored concentration value found in data obtained through the Water Quality Portal (WQP), which houses publicly available water quality data from the USGS, EPA, and state, federal, Tribal, and local agencies. (The highest monitored concentration was 8.2 µg/L, whereas the modeled concentration for the Disposal COU is 14.40 µg/L) (U.S. EPA, 2025p). Given the conservative nature of the environmental risk assessment and that the Agency does not use a bright-line approach for determining unreasonable risk, EPA is preliminarily determining that the Disposal COU does not significantly contribute to unreasonable risk of injury to the environment from chronic exposure for aquatic invertebrates. However, EPA is still preliminarily determining that the Disposal COU significantly contributes to unreasonable risk to the environment because of chronic exposures to aquatic vertebrates from wastewater discharge to surface water.

One COU evaluated with the Manufacturing OES (Manufacturing – domestic manufacturing) and three COUs evaluated with the Application of paints and coatings OES (Industrial use – construction, paint, electrical, and metal products – paints and coatings; Commercial use – construction, paint, electrical, and metal products – paints and coatings; and Commercial use – packaging, paper, plastic, hobby products – ink, toner and colorant products) indicated chronic risk for aquatic vertebrates due to surface water exposure. However, EPA has slight confidence in the risk characterization for these COUs because they are based on generic industrial release scenarios rather than reported release data and it is unclear whether individual estimates of media releases (to water, landfills, air, etc.) are an overestimate (Section 5.3.4). Therefore, EPA is preliminarily determining, that for DBP, these four COUs do not contribute to unreasonable risk to the environment.

For all environmental pathways, eight COUs do not appear to contribute to unreasonable risk to the environment for DBP based on a qualitative assessment of the Fabrication or use of final products or articles OES, indicating that environmental releases are expected to be minimal and dispersed. In addition, EPA evaluated activities resulting in exposures associated with distribution in commerce throughout the various life cycle stages and COUs (*e.g.*, manufacturing, processing, industrial use, commercial use, transportation) rather than a single distribution scenario. EPA expects that environmental releases from distribution in commerce will be similar or less than the exposure estimates from the COUs evaluated that did not exceed hazard to ecological receptors. EPA further expects all the DBP or DBP-containing products and/or articles to be transported in closed system or otherwise to be transported in a form (*e.g.,* articles containing DBP) such that there is negligible potential for releases except during an incident. Therefore, no separate assessment was performed for estimating releases and exposures from distribution in commerce (see Table 5-6).

EPA evaluated down-the-drain releases of DBP for consumer COUs qualitatively. Although EPA acknowledges that there may be DBP releases to the environment via the cleaning and disposal of adhesives, sealants, paints, coatings, cleaner, waxes, and polishes, the Agency did not quantitatively assess down-the-drain and disposal scenarios of consumer products due to limited information from monitoring data or modeling tools. However, the consideration of the physical and chemical properties of DBP allows the Agency to conduct a qualitative assessment. No studies were identified which reported the concentration of DBP in landfills or in the surrounding areas in the United States, but DBP was identified in sludge in wastewater plants in China, Canada, and the United States. DBP is expected to have a high affinity to particulate and organic media which would limit leaching to groundwater. Because of its high hydrophobicity and high affinity for soil sorption, it is unlikely that DBP will migrate from landfills via groundwater infiltration. Therefore, DBP from down-the-drain releases from consumer products or landfill disposal of consumer articles is not likely to pose risk to aquatic and terrestrial organisms (see Table 5-6).

EPA qualitatively assessed the potential for trophic transfer of DBP through food webs to wildlife. DBP is not expected to be persistent in the environment as it is expected to degrade rapidly under most environmental conditions (although there is delayed biodegradation in low-oxygen media); and DBP's bioavailability is expected to be limited (see Section 5.3.1). With respect to trophic transfer, concentrations of DBP in soil (biosolids, landfills, air deposition) and air is limited or is not expected to be bioavailable and were also assessed qualitatively.

There are uncertainties in the relevance of limited monitoring data for biosolids and landfill leachate to the COUs considered. However, based on high-quality physical and chemical property data, EPA determined that DBP will have low persistence potential and mobility in soils. Therefore, groundwater concentrations resulting from releases to the landfill or to agricultural lands via biosolids applications were not quantified but were discussed qualitatively. For ambient air/emissions to soil, where the highest stack emissions were combined with the highest fugitive emissions for screening, EPA did not aggregate other COUs or environmental exposure pathways. This consideration is further detailed in the *Draft Environmental Media, General Population, and Environmental Exposure Assessment for Dibutyl Phthalate (DBP)* (U.S. EPA, 2025p). Due to its physical and chemical properties, environmental fate, and exposure parameters, DBP is not expected to persist in surface water, groundwater, or air.

EPA's overall environmental risk characterization confidence levels range from moderate (for generic releases) to robust (for TRI/DMR releases and surrogates) for its qualitative and quantitative aquatic and terrestrial assessments for all pathways, with the exception of four COUs (Manufacturing – domestic manufacturing; Industrial use – construction, paint, electrical and metal products – paints and coatings; Commercial use – construction, paint, electrical and metal products – paints and coatings; and Commercial use – packaging, paper, plastic, hobby products – ink, toner and colorant products) that have moderate confidence for the surface water pathway. EPA's confidence in the environmental risk assessment is summarized in Table 5-7 of this draft risk evaluation.

6.3 Additional Information Regarding the Basis for the Risk Determination

Table 6-1 and Table 6-2 summarize the basis for this preliminary unreasonable risk determination of injury to human health presented in this DBP risk evaluation. In these tables, bold text indicates that an MOE is below the benchmark value. These tables identify the duration of exposure (*e.g.*, acute, intermediate, chronic duration) and the exposure route to the population or receptor. As explained in Section 6.2, for this preliminary unreasonable risk determination, EPA has considered the effects of DBP to human health, including PESS, as well as a range of risk estimates as appropriate, risk-related factors, and the confidence in the analysis. See Sections 4.3 and 5.3 for a summary of risk estimates.

Table 6-1. Supporting Basis for the Unreasonable Risk Determination for Human Health (Occupational COUs)

COU		OES	Worker Population	Exposure Level	Inhalation Risk Estimates (Benchmark MOE = 30)			Dermal Risk Estimates (Benchmark MOE = 30)			Aggregate Risk Estimates (Benchmark MOE = 30)		
Life Cycle Stage – Category	Subcategory				Acute	Inter.	Chronic	Acute	Inter.	Chronic	Acute	Inter.	Chronic
Manufacturing – Domestic manufacturing	Domestic manufacturing	Manufacturing	Average Adult Worker	CT	34	46	49	**1.7**	**2.3**	**2.4**	**1.6**	**2.2**	**2.3**
				HE	**17**	**23**	**25**	**0.8**	**1.1**	**1.2**	**0.8**	**1.1**	**1.2**
			Female of Reproductive Age	CT	30	41	44	**1.8**	**2.5**	**2.7**	**1.7**	**2.3**	**2.5**
				HE	**15**	**21**	**22**	**0.9**	**1.2**	**1.3**	**0.9**	**1.2**	**1.3**
			ONU	CT	34	46	49	N/A	N/A	N/A	34	46	49
Manufacturing – Importing	Importing	Import and repackaging	Average Adult Worker	CT	34	46	49	**1.7**	**2.3**	**2.4**	**1.6**	**2.2**	**2.3**
				HE	**17**	**23**	**25**	**0.8**	**1.1**	**1.2**	**0.8**	**1.1**	**1.2**
Processing – Repackaging	Laboratory chemicals in wholesale and retail trade; plasticizers in wholesale and retail trade; and plastics material and resin manufacturing		Female of Reproductive Age	CT	30	41	44	**1.8**	**2.5**	**2.7**	**1.7**	**2.3**	**2.5**
				HE	**15**	**21**	**22**	**0.9**	**1.2**	**1.3**	**0.9**	**1.2**	**1.3**
			ONU	CT	34	46	49	N/A	N/A	N/A	34	46	49
Processing – Processing as a reactant	Intermediate in plastic manufacturing	Incorporation into formulations, mixtures, or reaction product	Average Adult Worker	CT	34	46	49	**1.7**	**2.3**	**2.4**	**1.6**	**2.2**	**2.3**
Processing – Incorporation into formulation, mixture, or reaction product	Solvents (which become part of product formulation or mixture) in chemical product and preparation manufacturing; soap, cleaning compound, and toilet preparation manufacturing; adhesive manufacturing; and printing ink manufacturing			HE	**17**	**23**	**25**	**0.8**	**1.1**	**1.2**	**0.8**	**1.1**	**1.2**
	Plasticizer in paint and coating manufacturing; soap, cleaning compound, and toilet preparation manufacturing; textiles, apparel, and leather manufacturing; printing ink manufacturing; basic organic chemical manufacturing; and adhesive and sealant manufacturing												
	Pre-catalyst manufacturing		Female of Reproductive Age	CT	30	41	44	**1.8**	**2.5**	**2.7**	**1.7**	**2.3**	**2.5**
				HE	**15**	**21**	**22**	**0.9**	**1.2**	**1.3**	**0.9**	**1.2**	**1.3**
			ONU	CT	34	46	49	N/A	N/A	N/A	34	46	49

COU		OES	Worker Population	Exposure Level	Inhalation Risk Estimates (Benchmark MOE = 30)			Dermal Risk Estimates (Benchmark MOE = 30)			Aggregate Risk Estimates (Benchmark MOE = 30)		
Life Cycle Stage – Category	**Subcategory**				**Acute**	**Inter.**	**Chronic**	**Acute**	**Inter.**	**Chronic**	**Acute**	**Inter.**	**Chronic**
Processing – Processing: incorporation into formulation, mixture, or reaction product	Plasticizer in plastic material and resin manufacturing	PVC plastics compounding	Average Adult Worker	CT	49	67	71	**1.7**	**2.3**	**2.4**	**1.6**	**2.2**	**2.3**
				HE	**5.9**	**8.0**	**8.6**	**0.8**	**1.1**	**1.2**	**0.7**	**1.0**	**1.1**
			Female of Reproductive Age	CT	44	60	65	**1.8**	**2.4**	**2.6**	**1.7**	**2.4**	**2.5**
				HE	**5.3**	**7.2**	**7.8**	**0.9**	**1.2**	**1.3**	**0.8**	**1.0**	**1.1**
			ONU	CT	49	67	71	124	169	181	35	48	51
Processing – Processing: incorporation into articles	Plasticizer in adhesive and sealant manufacturing; building and construction materials manufacturing; furniture and related product manufacturing; ceramic powders; plastics product manufacturing	PVC plastics converting	Average Adult Worker	CT	49	67	71	124	169	181	35	48	51
				HE	**5.9**	**8.0**	**8.6**	62	85	90	**5.4**	**7.3**	**7.8**
			Female of Reproductive Age	CT	44	60	65	135	184	197	33	45	49
				HE	**5.3**	**7.2**	**7.8**	67	92	98	**4.9**	**6.7**	**7.2**
			ONU	CT	49	67	71	124	169	181	35	48	51
Processing – Processing: incorporation into formulation, mixture, or reaction product	Plasticizer in plastic material and resin manufacturing; rubber manufacturing	Non-PVC materials manufacturing	Average Adult Worker	CT	59	80	86	**1.7**	**2.3**	**2.4**	**1.6**	**2.2**	**2.3**
				HE	**9.9**	**14**	**15**	**0.8**	**1.1**	**1.2**	**0.8**	**1.0**	**1.1**
			Female of Reproductive Age	CT	53	73	78	**1.8**	**2.4**	**2.6**	**1.7**	**2.4**	**2.5**
Processing – Incorporation into articles	Plasticizer in adhesive and sealant manufacturing; building and construction materials manufacturing; furniture and related product manufacturing; ceramic powders; plastics product manufacturing; and rubber product manufacturing			HE	**9.0**	**12**	**13**	**0.9**	**1.2**	**1.3**	**0.8**	**1.1**	**1.2**
			ONU	CT	59	80	86	124	169	181	40	54	58

COU		OES	Worker Population	Exposure Level	Inhalation Risk Estimates (Benchmark MOE = 30)			Dermal Risk Estimates (Benchmark MOE = 30)			Aggregate Risk Estimates (Benchmark MOE = 30)		
Life Cycle Stage – Category	Subcategory				Acute	Inter.	Chronic	Acute	Inter.	Chronic	Acute	Inter.	Chronic
Commercial Use – Construction, paint, electrical, and metal products	Adhesives and sealants	Application of adhesives and sealants	Average Adult Worker	CT	336	458	529	**1.7**	**2.3**	**2.6**	**1.7**	**2.3**	**2.6**
				HE	168	229	245	**0.8**	**1.1**	**1.2**	**0.8**	**1.1**	**1.2**
			Female of Reproductive Age	CT	304	415	479	**1.8**	**2.5**	**2.9**	**1.8**	**2.5**	**2.8**
Industrial Use – Construction, paint, electrical, and metal products	Adhesives and sealants			HE	152	207	222	**0.9**	**1.2**	**1.3**	**0.9**	**1.2**	**1.3**
			ONU	CT	336	458	529	**1.7**	**2.3**	**2.6**	**1.7**	**2.3**	**2.6**
Commercial Use – Packaging, paper, plastic, toys, hobby products	Ink, toner, and colorant products	Application of paints and coatings	Average Adult Worker	CT	**20**	**28**	30	**1.7**	**2.3**	**2.4**	**1.5**	**2.1**	**2.3**
				HE	**3.2**	**4.4**	**4.7**	**0.8**	**1.1**	**1.2**	**0.7**	**0.9**	**1.0**
			Female of Reproductive Age	CT	**18**	**25**	**27**	**1.8**	**2.5**	**2.7**	**1.7**	**2.3**	**2.4**
				HE	**2.9**	**4.0**	**4.2**	**0.9**	**1.2**	**1.3**	**0.7**	**0.9**	**1.0**
Commercial Use – Commercial use – Construction, paint, electrical, and metal products	Paints and coatings		ONU	CT	**20**	**28**	30	**2.2**	**3.1**	**3.3**	**2.0**	**2.8**	**2.9**
Industrial Use – Non-incorporative activities	Solvent, including in maleic anhydride manufacturing technology	Industrial process solvent use	Average Adult Worker	CT	34	46	49	**1.7**	**2.3**	**2.4**	**1.6**	**2.2**	**2.3**
				HE	**17**	**23**	**25**	**0.8**	**1.1**	**1.2**	**0.8**	**1.1**	**1.2**
			Female of Reproductive Age	CT	30	41	44	**1.8**	**2.5**	**2.7**	**1.7**	**2.3**	**2.5**
				HE	**15**	**21**	**22**	**0.9**	**1.2**	**1.3**	**0.9**	**1.2**	**1.3**
			ONU	CT	34	46	49	N/A	N/A	N/A	34	46	49
Commercial Use – Other uses	Laboratory chemicals	Use of laboratory chemicals (solid)	Average Adult Worker	CT	442	603	645	124	169	181	97	132	141
				HE	31	42	45	62	85	90	**21**	**28**	30
			Female of Reproductive Age	CT	400	546	584	135	184	197	101	138	147
				HE	**28**	38	41	67	92	98	**20**	**27**	**29**
			ONU	CT	442	603	645	124	169	181	97	132	141

COU		OES	Worker Population	Exposure Level	Inhalation Risk Estimates (Benchmark MOE = 30)			Dermal Risk Estimates (Benchmark MOE = 30)			Aggregate Risk Estimates (Benchmark MOE = 30)		
Life Cycle Stage – Category	Subcategory				Acute	Inter.	Chronic	Acute	Inter.	Chronic	Acute	Inter.	Chronic
Commercial Use – Other uses	Laboratory chemicals	Use of laboratory chemicals (liquid)	Average Adult Worker	CT	336	458	491	**2.2**	**3.1**	**3.3**	**2.2**	**3.0**	**3.3**
				HE	168	229	245	**0.8**	**1.1**	**1.2**	**0.8**	**1.1**	**1.2**
			Female of Reproductive Age	CT	304	415	444	**2.4**	**3.3**	**3.6**	**2.4**	**3.3**	**3.5**
				HE	152	207	222	**0.9**	**1.2**	**1.3**	**0.9**	**1.2**	**1.3**
			ONU	CT	336	458	491	N/A	N/A	N/A	336	458	491
Commercial Use – Other uses	Lubricants and lubricant additives	Use of lubricants and functional fluids	Average Adult Worker	CT	336	5,040	61,320	**3.0**	45	546	**3.0**	44	541
				HE	168	1,260	15,330	**1.0**	**7.5**	91	**1.0**	**7.4**	90
			Female of Reproductive Age	CT	304	4,563	55,514	**3.3**	49	594	**3.2**	48	588
Industrial Use – Other uses	Lubricants and lubricant additives			HE	152	1,141	13,878	**1.1**	**8.1**	99	**1.1**	**8.1**	98
Commercial Use – Automotive, fuel, agriculture, outdoor use products	Automotive care products		ONU	CT	336	5,040	61,320	N/A	N/A	N/A	336	5,040	61,320
Commercial Use – Other uses	Inspection penetrant kit	Use of penetrants and inspection fluids	Average Adult Worker	CT	**11**	**15**	**16**	**1.7**	**2.3**	**2.5**	**1.5**	**2.0**	**2.1**
				HE	**3.0**	**4.1**	**4.4**	**0.8**	**1.1**	**1.2**	**0.7**	**0.9**	**1.0**
			Female of Reproductive Age	CT	**10**	**14**	**15**	**1.8**	**2.5**	**2.7**	**1.5**	**2.1**	**2.3**
				HE	**2.7**	**3.7**	**4.0**	**0.9**	**1.2**	**1.3**	**0.7**	**0.9**	**1.0**
			ONU	CT	329	449	487	**1.7**	**2.3**	**2.5**	**1.7**	**2.3**	**2.5**

COU		OES	Worker Population	Exposure Level	Inhalation Risk Estimates (Benchmark MOE = 30)			Dermal Risk Estimates (Benchmark MOE = 30)			Aggregate Risk Estimates (Benchmark MOE = 30)		
Life Cycle Stage – Category	Subcategory				Acute	Inter.	Chronic	Acute	Inter.	Chronic	Acute	Inter.	Chronic
Commercial Use – Furnishing, cleaning, treatment care products	Floor coverings; construction and building materials covering large surface areas including stone, plaster, cement, glass and ceramic articles; fabrics, textiles, and apparel	Fabrication or use of final product or articles	Average Adult Worker	CT	168	229	245	124	169	181	71	97	104
	Furniture and furnishings			HE	**20**	**27**	**29**	62	85	90	**15**	**21**	**22**
			Female of Reproductive Age	CT	152	207	222	135	184	197	71	97	104
				HE	**18**	**25**	**26**	67	92	98	**14**	**19**	**21**
Commercial Use – Other uses	Automotive articles		ONU	CT	168	229	245	124	169	181	71	97	104
	Chemiluminescent light sticks												
	Propellants												
Commercial Use – Packaging, paper, plastic, toys, hobby products	Packaging (excluding food packaging), including rubber articles; plastic articles (hard); plastic articles (soft); other articles with routine direct contact during normal use, including rubber articles; plastic articles (hard)												
	Toys, playground, and sporting equipment												
Processing – Recycling	Recycling	Recycling	Average Adult Worker	CT	156	212	227	124	169	181	69	94	101
				HE	**11**	**15**	**16**	62	85	90	**9.1**	**12**	**13**
			Female of Reproductive Age	CT	141	192	206	135	184	197	69	94	101
				HE	**9.7**	**13**	**14**	67	92	98	**8.4**	**12**	**12**
			ONU	CT	156	212	227	124	169	181	69	94	101

COU		OES	Worker Population	Exposure Level	Inhalation Risk Estimates (Benchmark MOE = 30)			Dermal Risk Estimates (Benchmark MOE = 30)			Aggregate Risk Estimates (Benchmark MOE = 30)		
Life Cycle Stage – Category	Subcategory				Acute	Inter.	Chronic	Acute	Inter.	Chronic	Acute	Inter.	Chronic
Disposal – Disposal	Disposal	Waste handling, treatment, and disposal	Average Adult Worker	CT	156	212	227	124	169	181	69	94	101
				HE	**11**	**15**	**16**	62	85	90	**9.1**	**12**	**13**
			Female of Reproductive Age	CT	141	192	206	135	184	197	69	94	101
				HE	**9.7**	**13**	**14**	67	92	98	**8.4**	**12**	**12**
			ONU	CT	156	212	227	124	169	181	69	94	101

[a] The Draft Risk Calculator for Occupational Exposures for Dibutyl Phthalate (DBP) (U.S. EPA, 2025t) contains MOE values with PPE for all the OES for all populations (average adult workers, female of reproductive age, and ONUs) and all durations (acute, intermediate, and chronic).
Bold text in a gray shaded cell indicates an MOE below the benchmark value of 30.

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Table 6-2. Supporting Basis for the Unreasonable Risk Determination for Human Health (Consumer COUs)

Life Cycle Stage: COU: Subcategory	Product or Article	Duration	Exposure Route	Exposure Scenario (H, M, L) [a]	Lifestage (years) MOE (Benchmark MOE = 30)						
					Infant (<1 Year)	Toddler (1–2 Years)	Pre-schooler (3–5 years)	Middle Childhood (6–10 years)	Young Teen (11–15 years)	Teenagers (16–20 years)	Adults (21+ years)
Consumer Uses: Automotive, fuel, agriculture, outdoor use products: Automotive care products	Uses matched with automotive adhesives										
Consumer Uses: Construction, paint, electrical, and metal products: Adhesives and sealants	Automotive adhesives	Acute	Dermal	H	–	–	–	–	**7**	**8**	**7**
				M	–	–	–	–	**28**	31	**29**
				L	–	–	–	–	140	150	140
			Ingestion	–	–	–	–	–	–	–	–
			Inhalation	H	160 [b]	170 [b]	210 [b]	300 [b]	370	440	540
			Aggregate	H	–	–	–	–	**7**	**8**	**7**
				M	–	–	–	–	**28**	31	**29**
				L	–	–	–	–	140	150	140
		Intermed.	Dermal	H	–	–	–	–	210	230	220
			Ingestion	–	–	–	–	–	–	–	–
			Inhalation	H	4,800 [b]	5,100 [b]	6,200 [b]	9,000 [b]	1.1E04	1.3E04	1.6E04
			Aggregate	H	–	–	–	–	210	230	210
		Chronic	–	–	–	–	–	–	–	–	–
	Construction adhesives	Acute	Dermal	H	–	–	–	–	**7**	**8**	**7**
				M	–	–	–	–	**28**	31	**29**
				L	–	–	–	–	140	150	140
			Ingestion	–	–	–	–	–	–	–	–
			Inhalation	–	–	–	–	–	–	–	–
		Intermed.	Dermal	H	–	–	–	–	210	230	220
			Ingestion	–	–	–	–	–	–	–	–
			Inhalation	–	–	–	–	–	–	–	–
		Chronic	–	–	–	–	–	–	–	–	–
	Adhesives for small repairs	Acute	Dermal	H	–	–	–	–	70	77	72
			Ingestion	–	–	–	–	–	–	–	–
			Inhalation	–	–	–	–	–	–	–	–
		Intermed.	–	–	–	–	–	–	–	–	–
		Chronic	Dermal	H	–	–	–	–	490	540	510
			Ingestion	–	–	–	–	–	–	–	–
			Inhalation	–	–	–	–	–	–	–	–

Life Cycle Stage: COU: Subcategory	Product or Article	Duration	Exposure Route	Exposure Scenario (H, M, L) [a]	Lifestage (years) MOE (Benchmark MOE = 30)						
					Infant (<1 Year)	Toddler (1–2 Years)	Pre-schooler (3–5 years)	Middle Childhood (6–10 years)	Young Teen (11–15 years)	Teenagers (16–20 years)	Adults (21+ years)
Consumer Uses: Construction, paint, electrical, and metal products: Paints and coatings	Metal coatings	Acute	Dermal	H	–	–	–	–	**7**	**8**	**7**
				M	–	–	–	–	**28**	31	**29**
				L	–	–	–	–	140	150	140
			Ingestion	–	–	–	–	–	–	–	–
			Inhalation	H	72 [b]	76 [b]	94 [b]	130 [b]	130	160	190
			Aggregate	H	–	–	–	–	**7**	**7**	**7**
				M	–	–	–	–	**24**	**26**	**26**
				L	–	–	–	–	89	100	100
		Intermed.	–	–	–	–	–	–	–	–	–
		Chronic	Dermal	H	–	–	–	–	49	54	51
			Ingestion	–	–	–	–	–	–	–	–
			Inhalation	H	**26 [b]**	**28 [b]**	34 [b]	49 [b]	51	62	75
				M	130 [b]	140 [b]	170 [b]	250 [b]	290	340	420
			Aggregate	H	–	–	–	–	**25**	**29**	30
				M	–	–	–	–	120	130	140
	Indoor flooring sealing and refinishing products	Acute	Dermal	H	–	–	–	–	**16**	**17**	**16**
				M	–	–	–	–	**23**	**26**	**24**
				L	–	–	–	–	47	51	48
			Ingestion	–	–	–	–	–	–	–	–
			Inhalation	H	100 [b]	110 [b]	140 [b]	190 [b]	260	300	380
			Aggregate	H	–	–	–	–	**15**	**16**	**15**
				M	–	–	–	–	**22**	**24**	**23**
				L	–	–	–	–	45	49	46
		Intermed.	Dermal	H	–	–	–	–	470	510	480
			Ingestion	–	–	–	–	–	–	–	–
			Inhalation	H	3,100 [b]	3,300 [b]	4,100 [b]	5,800 [b]	7,800	9,100	1.1E04
			Aggregate	H	–	–	–	–	440	490	460
		Chronic	–	–	–	–	–	–	–	–	–
	Sealing and refinishing sprays (outdoor use)	Acute	Dermal	H	–	–	–	–	**9**	**10**	**9**
				M	–	–	–	–	**18**	**19**	**18**
				L	–	–	–	–	35	39	36
			Ingestion	–	–	–	–	–	–	–	–

Life Cycle Stage: COU: Subcategory	Product or Article	Duration	Exposure Route	Exposure Scenario (H, M, L) [a]	Lifestage (years) MOE (Benchmark MOE = 30)						
					Infant (<1 Year)	Toddler (1–2 Years)	Pre-schooler (3–5 years)	Middle Childhood (6–10 years)	Young Teen (11–15 years)	Teenagers (16–20 years)	Adults (21+ years)
Consumer Uses: Construction, paint, electrical, and metal products: Paints and coatings	Sealing and refinishing sprays (outdoor use)	Acute	Inhalation	H	92 [b]	98 [b]	120 [b]	150 [b]	49	66	73
			Aggregate	H	–	–	–	–	**8**	**8**	**8**
				M	–	–	–	–	**15**	**16**	**16**
				L	–	–	–	–	35	38	36
		Intermed.	Dermal	H	–	–	–	–	260	290	270
			Ingestion	–	–	–	–	–	–	–	–
			Inhalation	H	2,800 [b]	2,900 [b]	3,600 [b]	4,500 [b]	1,500	2,000	2,200
			Aggregate	H	–	–	–	–	220	250	240
		Chronic	–	–	–	–	–	–	–	–	–
Consumer Uses: Furnishing, cleaning, treatment care products: Fabric, textile, and leather products	Synthetic leather clothing	Acute	Dermal	H	–	–	–	–	–	–[d]	–[d]
				M	–	–	–	–	–	76	72
			Ingestion	–	–	–	–	–	–	–	–
			Inhalation	–	–	–	–	–	–	–	–
		Intermed.	–	–	–	–	–	–	–	–	–
		Chronic	Dermal	H	–	–	–	–	–	–[d]	–[d]
				M	–	–	–	–	–	540	510
			Ingestion	–	–	–	–	–	–	–	–
			Inhalation	–	–	–	–	–	–	–	–
Consumer Uses: Furnishing, cleaning, treatment care products: Fabric, textile, and leather products	Synthetic leather furniture	Acute	Dermal	H	–[d]	–[d]	–[d]	–[d]	–[d]	–[d]	–[d]
				M	–[d]	–[d]	41	54	69	76	72
				L	–[d]	140	160	200	250	280	260
			Ingestion [c]	H	83	140	220	2.3E06	4.1E06	5.2E06	12E06
				M	280	380	670	2.3E07	4.1E07	5.2E07	1.2E08
				L	1.1E05	7.6E04	1.4E05	3.4E07	6.1E07	7.7E07	1.7E08
			Inhalation [c]	H	5.7E04	6.0E04	7.4E04	1.1E05	1.5E05	1.8E05	2.2E05
				M	5.8E05	6.1E05	7.5E05	1.1E06	1.5E06	1.8E06	2.2E06
				L	8.8E05	9.3E05	1.1E06	1.6E06	2.3E06	2.7E06	3.4E06
			Aggregate	H	83	140	220	1E05	1.5E05	1.7E05	2.1E05
				M	280	380	39	54	69	76	72
				L	9.7E04	140	160	200	250	280	260
		Intermed.	–	–	–	–	–	–	–	–	–
		Chronic	Dermal	H	–[d]	–[d]	–[d]	–[d]	–[d]	–[d]	–[d]
				M	–[d]	–[d]	41	54	69	76	72

Life Cycle Stage: COU: Subcategory	Product or Article	Duration	Exposure Route	Exposure Scenario (H, M, L) [a]	Lifestage (years) MOE (Benchmark MOE = 30)						
					Infant (<1 Year)	Toddler (1–2 Years)	Pre-schooler (3–5 years)	Middle Childhood (6–10 years)	Young Teen (11–15 years)	Teenagers (16–20 years)	Adults (21+ years)
Consumer Uses: Furnishing, cleaning, treatment care products: Fabric, textile, and leather products	Synthetic leather furniture	Chronic	Dermal	L	–[d]	140	160	200	250	280	260
			Ingestion [c]	H	83	140	220	2.5E06	4.5E06	5.7E06	1.3E07
				M	280	380	670	2.5E07	4.5E07	5.7E07	1.3E08
				L	1.1E05	7.6004	1.4E05	3.7E07	6.7E07	8.4E07	1.9E08
			Inhalation [c]	H	5.9E04	6.3E04	7.7E04	1.1E05	1.6E05	1.8E05	2.3E05
				M	6.0E05	6.4E05	7.9E05	1.1E06	1.6E06	1.9E06	2.3E06
				L	9.2E05	9.7E05	1.2E06	1.7E06	2.4E06	2.8E06	3.5E06
			Aggregate	H	83	140	220	1.1E05	1.5E05	1.8E05	2.2E05
				M	280	380	39	54	69	76	72
				L	120	140	160	200	250	280	260
Consumer uses: Furnishing, cleaning, treatment care products: Floor coverings; construction and building materials covering large surface areas including stone, plaster, cement, glass and ceramic articles; fabrics, textiles, and apparel	Vinyl flooring	Acute	Dermal	H	240	280	320	400	510	550	520
			Ingestion [c]	H	2.4E04	1.9E04	1.7E04	4.8E04	8.6E04	1.1E05	2.4E05
			Inhalation [c]	H	800	850	1,000	1,500	2,100	2,500	3,100
			Aggregate	H	180	210	240	310	410	450	440
		Intermed.	–	–	–	–	–	–	–	–	–
		Chronic	Dermal	H	240	280	320	400	510	550	520
			Ingestion [c]	H	7.9E04	6.4E04	5.7E04	1.6E05	2.9E05	3.6E05	8.1E05
			Inhalation [c]	H	3,800	4,000	4,900	7,100	1.0E04	1.2E04	1.5E04
			Aggregate	H	220	260	300	380	480	530	500
	Wallpaper (in–place)	Acute	Dermal	H	120	140	160	200	250	280	–
			Ingestion [c]	H	1.0E05	8.3E04	7.3E04	2.1E05	3.7E05	4.7E05	1.0E06
			Inhalation [c]	H	3,500	3,700	4,500	6,500	9.2E03	1.1E04	1.3E04
			Aggregate	H	120	130	160	190	250	270	1.3E04
		Chronic	Dermal	H	120	140	160	200	250	280	9.5E04
			Ingestion [c]	H	3.4E05	2.8E05	2.5E05	7.0E05	1.3E06	1.6E06	3.5E06
			Inhalation [c]	H	1.6E04	1.7E04	2.1E04	3.1E04	4.3E04	5.1E04	6.3E04
			Aggregate	H	120	140	160	200	250	280	3.8E04
	Wallpaper (installation)	Acute	Dermal	H	–	–	–	–	130	140	130
			Ingestion	–	–	–	–	–	–	–	–
			Inhalation	–	–	–	–	–	–	–	–

Life Cycle Stage: COU: Subcategory	Product or Article	Duration	Exposure Route	Exposure Scenario (H, M, L) [a]	Lifestage (years) MOE (Benchmark MOE = 30) Infant (<1 Year)	Toddler (1–2 Years)	Pre-schooler (3–5 years)	Middle Childhood (6–10 years)	Young Teen (11–15 years)	Teenagers (16–20 years)	Adults (21+ years)
Consumer uses: Furnishing, cleaning, treatment care products: Cleaning and furnishing care products	Spray cleaner	Acute	Dermal	H	–	–	–	–	**28**	31	**29**
				M	–	–	–	–	110	120	120
			Ingestion	–	–	–	–	–	–	–	–
			Inhalation	H	6.7E04	7.1E04 [b]	8.7E04 [b]	1.3E05 [b]	3.7E04	4.8E04	5.5E04
				M	1.4E05 [b]	1.5E05 [b]	1.8E05 [b]	2.7E05 [b]	7.7E04	9.6E04	1.1E05
			Aggregate	H	6.7E04	7.1E04	8.7E04	1.3E05	**28**	31	**29**
				M	1.4E05	1.5E05	1.8E05	2.7E05	110	120	120
		Chronic	Dermal	H	–	–	–	–	200	220	200
			Ingestion	–	–	–	–	–	–	–	–
			Inhalation	H	1.2E05 [b]	1.2E05 [b]	1.5E05 [b]	2.2E05 [b]	1.3E05	1.7E05	2.0E05
			Aggregate	H	1.2E05	1.2E05	1.5E05	2.2E05	200	220	200
	Waxes and polishes	Acute	Dermal	H	–	–	–	–	**14**	**15**	**14**
				M	–	–	–	–	56	62	58
			Ingestion	–	–	–	–	–	–	–	–
			Inhalation	H	1.0E05 [b]	1.1E05 [b]	1.3E05 [b]	1.9E05 [b]	2.6E05	3.0E05	3.7E05
			Aggregate	H	1.0E05	1.1E05	1.3E05	1.9E05	**14**	**15**	**14**
				M	1.6E05	1.7E05	2.0E05	2.9E05	56	62	58
		Chronic	Dermal	H	–	–	–	–	99	110	100
			Ingestion	–	–	–	–	–	–	–	–
			Inhalation	H	8,500 [b]	9,100 [b]	1.1E04 [b]	1.6E04 [b]	2.0E04	2.4E04	2.9E04
			Aggregate	H	8,500	9,100	1.1E04	1.6E04	98	110	100
Consumer uses: Packaging, paper, plastic, toys, hobby products: Ink, toner, and colorant products	No consumer products identified. Foreseeable uses were matched with adhesives for small repairs because similar use patterns are expected.										

Life Cycle Stage: COU: Subcategory	Product or Article	Duration	Exposure Route	Exposure Scenario (H, M, L) [a]	Lifestage (years) MOE (Benchmark MOE = 30)						
					Infant (<1 Year)	Toddler (1–2 Years)	Pre-schooler (3–5 years)	Middle Childhood (6–10 years)	Young Teen (11–15 years)	Teenagers (16–20 years)	Adults (21+ years)
Consumer uses: Packaging, paper, plastic, toys, hobby products; Packaging (excluding food packaging), including rubber articles; plastic articles (hard); plastic articles (soft); other articles with routine direct contact during normal use, including rubber articles; plastic articles (hard)	Footwear components	Acute	Dermal	H	60	70	81	100	130	140	130
			Ingestion	–	–	–	–	–	–	–	–
			Inhalation	–	–	–	–	–	–	–	–
		Chronic	Dermal	H	60	70	81	100	130	140	130
			Ingestion	–	–	–	–	–	–	–	–
			Inhalation	–	–	–	–	–	–	–	–
	Shower curtains	Acute	Dermal	H	340	400	460	570	720	780	730
			Ingestion [c]	H	1.1E06	9.0E05	8.0E05	2.3E06	4.1E06	5.1E06	1.1E07
			Inhalation [c]	H	1.4E04	1.5E04	1.8E04	2.6E04	3.7E04	4.3E04	5.3E04
			Aggregate	H	330	380	450	550	700	770	720
		Chronic	Dermal	H	340	400	460	570	720	780	730
			Ingestion [c]	H	3.7E06	3.0E06	2.6E06	7.5E06	1.3E07	1.7E07	3.8E07
			Inhalation [c]	H	6.6E04	7.0E04	8.6E04	1.2E05	1.7E05	2.0E05	2.5E05
			Aggregate	H	340	390	450	560	710	780	730
	Small articles with semi routine contact; miscellaneous items including a pen, pencil case, hobby cutting board, costume jewelry, tape, garden hose, disposable gloves, and plastic bags/pouches	Acute	Dermal	H	120	140	160	200	250	280	260
			Ingestion	–	–	–	–	–	–	–	–
			Inhalation	–	–	–	–	–	–	–	–
		Chronic	Dermal	H	120	140	160	200	250	280	260
			Ingestion	–	–	–	–	–	–	–	–
			Inhalation	–	–	–	–	–	–	–	–

Life Cycle Stage: COU: Subcategory	Product or Article	Duration	Exposure Route	Exposure Scenario (H, M, L) [a]	Lifestage (years) MOE (Benchmark MOE = 30)						
					Infant (<1 Year)	Toddler (1–2 Years)	Pre-schooler (3–5 years)	Middle Childhood (6–10 years)	Young Teen (11–15 years)	Teenagers (16–20 years)	Adults (21+ years)
Consumer uses: Packaging, paper, plastic, toys, hobby products: Toys, playground, and sporting equipment	Children's toys (New)	Acute	Dermal	H	110	130	150	190	240	260	–
			Ingestion [c]	H	52	200	380	8.5E04	1.5E05	1.9E05	4.3E05
			Inhalation [c]	H	690	740	900	1,300	1,800	2,200	2,700
			Aggregate	H	34	71	97	160	210	230	2,700
		Chronic	Dermal	H	110	130	150	190	240	260	–
			Ingestion [c]	H	52	200	390	2.8E05	5.1E05	6.4E05	1.4E06
			Inhalation [c]	H	3,300	3,500	4,300	6,200	8,800	1.0E04	1.3E04
			Aggregate	H	35	77	110	180	230	250	1.3E04
	Children's toys (Legacy)	Acute	Dermal	H	110	130	150	190	240	260	–
			Ingestion [c]	H	51	190	340	8,500	1.5E04	1.9E04	4.3E04
			Inhalation [c]	H	69	74	90	130	180	220	270
			Aggregate	H	23	38	49	76	100	120	270
			Aggregate	M	64	91	120	180	230	250	1,400
		Chronic	Dermal	H	110	130	150	190	240	260	–
			Ingestion [c]	H	52	190	370	2.8E04	5.1E04	6.4E04	1.4E05
			Inhalation [c]	H	330	350	430	620	880	1,000	1,300
			Aggregate	H	32	64	86	140	190	210	1,300
	Tire crumb	Acute	Dermal	H	–	–	1.1E06	1.2E06	1.6E06	1.8E06	1.7E06
			Ingestion	H	–	–	3.4E08	7.7E08	1.4E09	3.5E09	3.9E09
			Inhalation	H	–	–	2.5E08	3.7E08	1.9E08	3.6E08	3.9E08
			Aggregate	H	–	–	1.1E06	1.2E06	1.5E06	1.8E06	1.7E06
		Chronic	Dermal	H	–	–	5.4E06	5.7E06	4.1E06	4.7E06	8.0E06
			Ingestion	H	–	–	1.6E09	3.6E09	3.6E09	9.1E09	1.8E10
			Inhalation	H	–	–	1.2E09	1.7E09	5.0E08	9.5E08	1.8E09
			Aggregate	H	–	–	5.3E06	5.7E06	4.1E06	4.6E06	8.0E06
	Small articles with semi routine contact; miscellaneous items including a football, balance ball, and pet toys	Acute	Dermal	H	120	140	160	200	250	280	260
			Ingestion	–	–	–	–	–	–	–	–
			Inhalation	–	–	–	–	–	–	–	–
		Chronic	Dermal	H	120	140	160	200	250	280	260
			Ingestion	–	–	–	–	–	–	–	–
			Inhalation	–	–	–	–	–	–	–	–

Life Cycle Stage: COU: Subcategory	Product or Article	Duration	Exposure Route	Exposure Scenario (H, M, L) [a]	Lifestage (years) MOE (Benchmark MOE = 30)						
					Infant (<1 Year)	Toddler (1–2 Years)	Pre-schooler (3–5 years)	Middle Childhood (6–10 years)	Young Teen (11–15 years)	Teenagers (16–20 years)	Adults (21+ years)
Consumer uses: Other: Chemiluminescent light sticks	Small articles with semi routine contact; glow sticks	Acute	Dermal	H	120	140	160	200	250	280	260
			Ingestion	–	–	–	–	–	–	–	–
			Inhalation	–	–	–	–	–	–	–	–
		Chronic	Dermal	H	120	140	160	200	250	280	260
			Ingestion	–	–	–	–	–	–	–	–
			Inhalation	–	–	–	–	–	–	–	–
Consumer uses: Other uses: Automotive articles	Car mats	Acute	Dermal	H	–	–	–	–	1,800	2,000	1,800
			Ingestion [c]	H	3.8E06	3.1E06	2.8E06	7.7E06	1.3E07	1.7E07	3.4E07
			Inhalation [c]	H	6.1E04	6.5E04	7.9E04	1.1E05	1.6E05	1.9E05	2.4E05
			Aggregate	H	6.0E04	6.3E04	7.7E04	1.1E05	1,800	1,900	1,800
		Chronic	Dermal	H	–	–	–	–	1.3E04	1.4E04	1.3E04
			Ingestion [c]	H	1.3E07	1.1E07	9.5E06	2.6E07	4.5E07	5.7E07	1.2E08
			Inhalation [c]	H	3.0E05	3.1E05	3.9E05	5.6E05	7.9E05	9.2E05	1.1E06
			Aggregate	H	2.9E05	3.1E05	3.7E05	5.4E05	1.2E04	1.4E04	1.3E04
	Synthetic leather seats (see synthetic leather furniture)	Acute	Dermal	H	–[d]	–[d]	–[d]	–[d]	–[d]	–[d]	–[d]
				M	–[d]	–[d]	41	54	69	76	72
				L	–[d]	140	160	200	250	280	260
			Ingestion [c]	H	83	140	220	2.3E06	4.1E06	5.2E06	1.2E07
				M	280	380	670	2.3E07	4.1E07	5.2E07	1.2E08
				L	1.1E05	7.6E04	1.4E05	3.4E07	6.1E07	7.7E07	1.7E08
			Inhalation [c]	H	5.7E04	6.0E04	7.4E04	1.1E05	1.5E05	1.8E05	2.2E05
				M	5.8E05	6.1E05	7.5E05	1.1E06	1.5E06	1.8E06	2.2E06
				L	8.8E05	9.3E05	1.1E06	1.6E06	2.3E06	2.7E06	3.4E06
			Aggregate	H	83	140	220	1.0E05	1.5E05	1.7E05	2.1E05
				M	280	380	39	54	69	76	72
				L	9.7E04	140	160	200	250	280	260
		Chronic	Dermal	H	–[d]	–[d]	–[d]	–[d]	–[d]	–[d]	–[d]
				M	–[d]	–[d]	41	54	69	76	72
				L	–[d]	140	160	200	250	280	260
			Ingestion [c]	H	83	140	220	2.5E06	4.5E06	5.7E06	1.3E07
				M	280	380	670	2.5E07	4.5E07	5.7E07	1.3E08
				L	1.1E05	7.6E04	1.4E05	3.7E07	6.7E07	8.4E07	1.9E08

Life Cycle Stage: COU: Subcategory	Product or Article	Duration	Exposure Route	Exposure Scenario (H, M, L) [a]	Lifestage (years) MOE (Benchmark MOE = 30)						
					Infant (<1 Year)	Toddler (1–2 Years)	Pre-schooler (3–5 years)	Middle Childhood (6–10 years)	Young Teen (11–15 years)	Teenagers (16–20 years)	Adults (21+ years)
Consumer uses: Other uses: Automotive articles	Synthetic leather seats (see synthetic leather furniture)	Chronic	Inhalation [c]	H	5.9E04	6.3E04	7.7E04	1.1E05	1.6E05	1.8E05	2.3E05
				M	6.0E05	6.4E05	7.9E05	1.1E06	1.6E06	1.9E06	2.3E06
				L	9.2E05	9.7E05	1.2E06	1.7E06	2.4E06	2.8E06	3.5E06
			Aggregate	H	83	140	220	1.1E05	1.5E05	1.8E05	2.2E05
				M	280	380	39	54	69	76	72
				L	120	140	160	200	250	280	260
Consumer uses: Other uses: Novelty articles	Adult toys	Acute	Dermal	H	–	–	–	–	–	780	730
				M	–	–	–	–	–	1,100	1,000
			Ingestion	H	–	–	–	–	–	–[d]	–[d]
				M	–	–	–	–	–	190	210
			Inhalation	–	–	–	–	–	–	–	–
			Aggregate	H	–	–	–	–	–	–[d]	–[d]
				M	–	–	–	–	–	160	170
		Chronic	Dermal	H	–	–	–	–	–	780	730
				M	–	–	–	–	–	1,100	1,000
			Ingestion	H	–	–	–	–	–	–[d]	–[d]
				M	–	–	–	–	–	190	210
			Inhalation	–	–	–	–	–	–	–	–
			Aggregate	H	–	–	–	–	–	–[d]	–[d]
				M	–	–	–	–	–	160	170
Consumer uses: Other uses: Lubricants and lubricant additives	No consumer products identified. Foreseeable uses were matched with adhesives for small repairs because similar use patterns are expected.										

[a] Exposure scenario intensities include high (H), medium (M), and low (L).
[b] MOE for bystander scenario
[c] Exposure routes evaluated for indoor environments.
[d] Scenario was deemed to be unlikely due to high uncertainties.
Bold text in a gray shaded cell indicates an MOE below the benchmark value of 30.

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APPENDICES

Appendix A KEY ABBREVIATIONS AND ACRONYMS

ADD	Average daily dose
ADC	Average daily concentration
AERMOD	American Meteorological Society/EPA Regulatory Model
BBP	Butyl benzyl phthalate
BLS	Bureau of Labor Statistics
CAP	Criteria Air Pollutant
CASRN	Chemical Abstracts Service Registry Number
CBI	Confidential business information
CDC	Centers for Disease Control and Prevention (U.S.)
CDR	Chemical Data Reporting
CEHD	Chemical Exposure Health Data
CEM	Consumer Exposure Model
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
COC	Concentration of concern
CPSC	Consumer Product Safety Commission
CWA	Clean Water Act
DBP	Dibutyl phthalate
DCHP	Dicyclohexyl phthalate
DEHP	Diethylhexyl phthalate
DIBP	Diisobutyl phthalate
DIDP	Diisodecyl phthalate
DINP	Dicyclohexyl phthalate
DIY	Do-it-yourself
DMR	Discharge Monitoring Report
ECJRC	European Commission’s Joint Research Centre
EPA	Environmental Protection Agency (or “the 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
GS	Generic scenario
K_{OC}	Soil organic carbon: water partitioning coefficient
K_{OW}	Octanol: water partition coefficient
HAP	Hazardous Air Pollutant
HEC	Human equivalent concentration
HED	Human equivalent dose
HV	Hazard value
IADD	Intermediate average daily dose
IIOAC	Integrated Indoor/Outdoor Air Calculator (Model)
IR	Ingestion rate
LCD	Life cycle diagram
LOD	Limit of detection

LOAEL	Lowest-observed-adverse-effect level
LOEC	Lowest-observed-effect concentration
Log K_{OC}	Logarithmic organic carbon: water partition coefficient
Log K_{OW}	Logarithmic octanol: water partition coefficient
MBP	Monobutyl phthalate
MOE	Margin of exposure
NAICS	North American Industry Classification System
NEI	National Emissions Inventory
NHANES	National Health and Nutrition Examination Survey
NHDPlus	National Hydrography Dataset Plus
NICNAS	National Industrial Chemicals Notification and Assessment Scheme
NOAEL	No-observed-adverse-effect level
NOEC	No-observed-effect-concentration
NPDES	National Pollutant Discharge Elimination System
NTP	National Toxicology Program
OCSPP	Office of Chemical Safety and Pollution Prevention
OECD	Organisation for Economic Co-operation and Development
OEL	Occupational exposure limit
OES	Occupational exposure scenario
OEV	Occupational exposure value
ONU	Occupational non-user
OPPT	Office of Pollution Prevention and Toxics
OSHA	Occupational Safety and Health Administration (U.S.)
P50	The 50th percentile or median flow rate of a distribution of hydrologic flows
P75	The 75th percentile flow rate of a distribution of hydrologic flows
P90	The 90th percentile flow rate of a distribution of hydrologic flows
PBZ	Personal breathing zone
PECO	Population, exposure, comparator, and outcome
PEL	Permissible exposure limit (OSHA)
PESS	Potentially exposed or susceptible subpopulations
PND	Postnatal day
PNOR	Particulates not otherwise regulated
POD	Point of departure
POTW	Publicly owned treatment works
PPARα	Peroxisome proliferator activated receptor alpha
PV	Production volume
PVC	Polyvinyl chloride
REL	Recommended Exposure Limit
RPF	Relative potency factor
SACC	Science Advisory Committee on Chemicals
SDS	Safety data sheet
SOC	Standard Occupational Classification
SpERC	Specific Emission Release Category
SSD	Species sensitivity distribution
SUSB	Statistics of U.S. Businesses (U.S. Census)
TOC	Total organic carbon
TRI	Toxic Release Inventory
TRV	Toxicity reference value
TSCA	Toxic Substances Control Act

TSD	Technical support document
TWA	Time-weighted average
UF	Uncertainty factor
U.S.	United States
VVWM-PSC	Variable Volume Water Model with Point Source Calculator Tool
WWTP	Wastewater treatment plant
7Q10	The lowest 7-day average flow that occurs (on average) once every 10 years
30Q5	The lowest 30-day average flow that occurs (on average) once every 5 years

Appendix B REGULATORY AND ASSESSMENT HISTORY

B.1 Federal Laws and Regulations

Table_Apx B-1. Federal Laws and Regulations

Statutes/Regulations	Description of Authority/Regulation	Description of Regulation
EPA statutes/regulations		
Toxic Substances Control Act (TSCA) – section 6(b)	EPA is directed to identify high-priority chemical substances for risk evaluation; and conduct risk evaluations on at least 20 high priority substances no later than three and one-half years after the date of enactment of the Frank R. Lautenberg Chemical Safety for the 21st Century Act.	Dibutyl phthalate is one of the 20 chemicals EPA designated as a High-Priority Substance for risk evaluation under TSCA (84 FR 71924, December 30, 2019). Designation of dibutyl phthalate as high-priority substance constitutes the initiation of the risk evaluation on the chemical.
Toxic Substances Control Act (TSCA) – section 8(a)	The TSCA section 8(a) CDR Rule requires manufacturers (including importers) to give EPA basic exposure-related information on the types, quantities and uses of chemical substances produced domestically and imported into the United States.	Dibutyl phthalate manufacturing (including importing), processing and use information is reported under the CDR rule (85 FR 20122, April 9, 2020).
Toxic Substances Control Act (TSCA) – section 8(b)	EPA must compile, keep current and publish a list (the TSCA Inventory) of each chemical substance manufactured (including imported) or processed in the United States.	Dibutyl phthalate was on the initial TSCA Inventory and therefore was not subject to EPA's new chemicals review process under TSCA Section 5 (60 FR 16309, March 29, 1995).
Toxic Substances Control Act (TSCA) – section 8(e)	Manufacturers (including importers), processors, and distributors must immediately notify EPA if they obtain information that supports the conclusion that a chemical substance or mixture presents a substantial risk of injury to health or the environment.	Seven substantial risk reports received for dibutyl phthalate (1996 -2010) (U.S. EPA, 2018). Accessed April 8, 2019).
Toxic Substances Control Act (TSCA) – section 4	Provides EPA with authority to issue rules and orders requiring manufacturers (including importers) and processors to test chemical substances and mixtures.	In 1989, EPA entered an Enforceable Consent Agreement under TSCA Section 4 with six companies to perform certain chemical fate and environmental effects on certain Alkyl Phthalates (54 FR 618, January 9, 1989). Twelve chemical data submissions from test rules received for dibutyl phthalate: 1 acute aquatic plant toxicity, 8 acute aquatic toxicity, 2 chronic aquatic toxicity, and 1 vapor pressure. (U.S. EPA, 2018). Listings undated. Accessed April 8, 2019.

Statutes/Regulations	Description of Authority/Regulation	Description of Regulation
Emergency Planning and Community Right-To-Know Act (EPCRA) – section 313	Requires annual reporting from facilities in specific industry sectors that employ 10 or more full-time equivalent employees and that manufacture, process or otherwise use a TRI-listed chemical in quantities above threshold levels. A facility that meets reporting requirements must submit a reporting form for each chemical for which it triggered reporting, providing data across a variety of categories, including activities and uses of the chemical, releases and other waste management (*e.g.*, quantities recycled, treated, combusted) and pollution prevention activities (under section 6607 of the Pollution Prevention Act). These data include on- and off-site data as well as multimedia data (*i.e.*, air, land and water).	Dibutyl phthalate is a listed substance subject to reporting requirements under 40 CFR 372.65 effective as of January 01, 1987.
Clean Air Act (CAA) – section 112(b)	Defines the original list of 189 Hazardous Air Pollutants (HAPs). Under 112(c) of the CAA, EPA must identify and list source categories that emit HAP and then set emission standards for those listed source categories under CAA section 112(d). CAA section 112(b)(3)(A) specifies that any person may petition the Administrator to modify the list of HAP by adding or deleting a substance. Since 1990, EPA has removed two pollutants from the original list leaving 187 at present.	Dibutyl phthalate is listed as a HAP (42 U.S.C. 7412).
Clean Air Act (CAA) – section 112(d)	Directs EPA to establish, by rule, NESHAPs for each category or subcategory of listed major sources and area sources of HAPs (listed pursuant to section 112(c)). For major sources, the standards must require the maximum degree of emission reduction that EPA determines is achievable by each particular source category. This is generally referred to as maximum achievable control technology (MACT). For area sources, the standards must require generally achievable control technology (GACT) though may require MACT.	EPA has established NESHAPs for a number of source categories that emit dibutyl phthalate to air (see https://www.epa.gov/stationary-sources-air-pollution/national-emission-standards-hazardous-air-pollutants-neshap-9)

Statutes/Regulations	Description of Authority/Regulation	Description of Regulation
Clean Water Act (CWA) – section 304(a)(1)	Requires EPA to develop and publish ambient water quality criteria (AWQC) reflecting the latest scientific knowledge on the effects on human health that may be expected from the presence of pollutants in any body of water.	In 2015, EPA published updated AWQC for dibutyl phthalate, including a recommendation of 20 µg/L for "Human Health for the consumption of Water + Organism" and 30 µg/L for "Human Health for the consumption of Organism Only" for states and authorized tribes to consider when adopting criteria into their water quality standards. (Docket ID: EPA-HQ-OW-2014-0135-0242)
Clean Water Act (CWA) – sections 301, 304, 306, 307, and 402	Clean Water Act section 307(a) establishes a list of toxic pollutants or combination of pollutants under the CWA. The statute specifies a list of families of toxic pollutants also listed in the Code of Federal Regulations at 40 CFR Part 401.15. The "priority pollutants" specified by those families are listed in 40 CFR Part 423 Appendix A. These are pollutants for which best available technology effluent limitations must be established on either a national basis through rules (sections 301(b), 304(b), 307(b), 306) or on a case-by-case best professional judgement basis in NPDES permits, see section 402(a)(1)(B). EPA identifies the best available technology that is economically achievable for that industry after considering statutorily prescribed factors and sets regulatory requirements based on the performance of that technology.	Dibutyl phthalate is designated as a toxic pollutant under section 307(a)(1) of the CWA and as such is subject to effluent limitations. (40 CFR 401.15). Under CWA section 304, dibutyl phthalate is included in the list of total toxic organics (TTO) (40 CFR 413.02(i)).
Clean Water Act (CWA) – sections 311(b) (2)(A) and 501(a) of the Federal Water Pollution Control Act.	Requires EPA to develop, promulgate, and revise as may be appropriate, regulations designating as hazardous substances, other than oil, which, when discharged present an imminent and substantial danger to the public health or welfare, including, but not limited to, fish, shellfish, wildlife, shorelines, and beaches.	Dibutyl phthalate is a designated hazardous substance in accordance with Section 311(b)(2)(A) of the Federal Water Pollution Control Act.
Resource Conservation and Recovery Act (RCRA) – section 3001	Directs EPA to develop and promulgate criteria for identifying the characteristics of hazardous waste, and for listing hazardous waste, taking into account toxicity, persistence, and degradability in nature, potential for accumulation in tissue and other	Dibutyl phthalate is included on the list of hazardous wastes pursuant to RCRA 3001. RCRA Hazardous Waste Code: U069 (40 CFR 261.33).

Statutes/Regulations	Description of Authority/Regulation	Description of Regulation
	related factors such as flammability, corrosiveness, and other hazardous characteristics.	
Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) – sections 102(a) and 103	Authorizes EPA to promulgate regulations designating as hazardous substances those substances which, when released into the environment, may present substantial danger to the public health or welfare or the environment. EPA must also promulgate regulations establishing the quantity of any hazardous substance the release of which must be reported under section 103. Section 103 requires persons in charge of vessels or facilities to report to the National Response Center if they have knowledge of a release of a hazardous substance above the reportable quantity threshold.	Dibutyl phthalate is a hazardous substance under CERCLA. Releases of dibutyl phthalate in excess of 10 lb must be reported (40 CFR 302.4).
Superfund Amendments and Reauthorization Act (SARA) –	Requires the Agency to revise the hazardous ranking system and update the National Priorities List of hazardous waste sites, increases state and citizen involvement in the superfund program and provides new enforcement authorities and settlement tools.	Dibutyl phthalate is listed on SARA, an amendment to CERCLA and the CERCLA Priority List of Hazardous Substances. This list includes substances most commonly found at facilities on the CERCLA National Priorities List (NPL) that have been deemed to pose the greatest threat to public health.
Other federal statutes/regulations		
Federal Food, Drug, and Cosmetic Act (FFDCA)	Provides the FDA with authority to oversee the safety of food, drugs and cosmetics.	Dibutyl phthalate is listed as an optional substance to be used in: adhesives to be used as components of articles intended for use in packaging, transporting, or holding food (21 CFR 175.105); the base sheet and coating of cellophane, alone or in combination with other phthalates where total phthalates do not exceed 5 percent (21 CFR 177.1200). The FDA has reviewed phthalates in cosmetic products but does **not** restrict their use.
Consumer Product Safety Improvement Act of 2008 (CPSIA)	Under section 108 of the Consumer Product Safety Improvement Act of 2008, CPSC prohibits the manufacture for sale, offer for sale, distribution in	The use of dibutyl phthalate at concentrations greater than 0.1 percent is banned in toys and child care articles (16 CFR part 1307).

Statutes/Regulations	Description of Authority/Regulation	Description of Regulation
	commerce or importation of eight phthalates in toys and childcare articles at concentrations greater than 0.1 percent: di-ethylhexyl phthalate, dibutyl phthalate, butyl benzyl phthalate, di-isononyl phthalate, di-isobutyl phthalate, di-n-pentyl phthalate, di-n-hexyl phthalate and dicyclohexyl phthalate.	
Federal Hazardous Materials Transportation Act (HMTA)	Section 5103 of the Act directs the Secretary of Transportation to: • Designate material (including an explosive, radioactive material, infectious substance, flammable or combustible liquid, solid or gas, toxic, oxidizing or corrosive material, and compressed gas) as hazardous when the Secretary determines that transporting the material in commerce may pose an unreasonable risk to health and safety or property. • Issue regulations for the safe transportation, including security, of hazardous material in intrastate, interstate and foreign commerce.	Dibutyl phthalate is listed as a hazardous material with regard to transportation and is subject to regulations prescribing requirements applicable to the shipment and transportation of listed hazardous materials (70 FR 34381, June 14 2005). (49 CFR part 172.101 Appendix A)
Occupational Safety and Health Administration (OSHA) Permissible Exposure Limit (PEL)	Requires employers to provide their workers with a place of employment free from recognized hazards to safety and health, such as exposure to toxic chemicals, excessive noise levels, mechanical dangers, heat or cold stress or unsanitary conditions (29 U.S.C. § 651 et seq.). Under the Act, OSHA can issue occupational safety and health standards including such provisions as Permissible Exposure Limits (PELs), exposure monitoring, engineering and administrative control measures, and respiratory protection.	Dibutyl phthalate is listed in OSHA Table Z-1. OSHA issued occupational safety and health standards for dibutyl phthalate that included a PEL of 5 mg/m^3 as an 8-hour TWA.

B.2 State Laws and Regulations

Table_Apx B-2. State Laws and Regulations

State Actions	Description of Action
State Air Regulations	Allowable Ambient Levels: New Hampshire (Env-A 1400: Regulated Toxic Air Pollutants); Rhode Island (Air Pollution Regulation No. 22)
State Drinking Water Standards and Guidelines	Florida (Fla. Admin. Code R. Chap. 62-550); Michigan (Mich. Admin. Code r.299.44 and r.299.49, 2017); Minnesota (Minn R. Chap. 4720).
State PELs	California (PEL of 5 ppm and no STEL) (Cal Code Regs. Title 8, § 5155); Hawaii (PEL-TWA of 5 mg/m^3 and PEL-STEL of 10 mg/m^3) (Hawaii Administrative Rules Section 12-60-50)
State Right-to-Know Acts	Massachusetts (105 Code Mass. Regs. § 670.000 Appendix A); New Jersey (8:59 N.J. Admin. Code § 9.1); Pennsylvania (P.L. 734, No. 159 and 34 Pa. Code § 323)
Chemicals of High Concern to Children	Several states have adopted reporting laws for chemicals in children's products containing dibutyl phthalate, including: Maine (38 MRSA Chapter 16-D); Oregon (Toxic-Free Kids Act, Senate Bill 478, 2015); Vermont (18 V.S.A § 1776); and Washington State (Wash. Admin. Code 173-334-130
Volatile Organic Compound (VOC) Regulations for Consumer Products	California regulations may set VOC limits for consumer products and/or ban the sale of certain consumer products as an ingredient and/or impurity. California (Title 17, California Code of Regulations, Division 3, Chapter 1, Subchapter 8.5, Articles 1, 2, 3 and 4). Under the Aerosol Coating Products Regulation, a Maximum Incremental Reactivity value has been established for dibutyl phthalate (Subchapter 8.6, Article 1, § 94700).
Other	California listed dibutyl phthalate on Proposition 65 in 2005 due to developmental toxicity, female and male reproductive toxicity (Cal Code Regs. Title 27, § 27001). Dibutyl phthalate is listed as a Candidate Chemical under California's Safer Consumer Products Program (Health and Safety Code § 25252 and 25253). California issued a Health Hazard Alert for dibutyl phthalate (Hazard Evaluation System and Information Service, 2016). Dibutyl phthalate is on the Massachusetts Toxic Use Reduction Act (TURA) list of 2019 (300 CMR 41.00).

B.3 International Laws and Regulations

Table_Apx B-3. International Laws and Regulations

Country/ Organization	Requirements and Restrictions
Canada	Dibutyl phthalate is on the Domestic Substances List (Government of Canada. Managing substances in the environment. Substances search Database accessed April 10, 2019). Other regulations include: • Canada's National Pollutant Release Inventory (NPRI). Canada Gazette Part II, Vol. 128, No. 9, May 04 1994, SOR/94-311 • Dibutyl phthalate did not meet the criteria under subsection 73(1) of the Canadian Environmental Protection Act, 1999 (CEPA).
European Union	Dibutyl phthalate is registered for use in the EU. (European Chemicals Agency (ECHA) database. Accessed April 10, 2019.) In 2008, dibutyl phthalate was listed on the Candidate list as a Substance of Very High Concern (SVHC) under regulation (EC) No 1907/2006 - REACH (Registration, Evaluation, Authorization and Restriction of Chemicals due to its reproductive toxicity (category 1B). In 2012, dibutyl phthalate was added to Annex XIV of REACH (Authorisation List) with a sunset date of December 21, 2015. After the sunset date, only persons with approved authorization applications may continue to use the chemical (European Chemicals Agency (ECHA) database. The exempted category of use is: uses in the immediate packaging of medicinal products covered under Regulation (EC) No 726/2004, Directive 2001/82/EC, and/or Directive 2001/83/EC. Accessed April 10, 2019. Applications for authorizations to use, including in propellants, electronics manufacture and closed manufacturing processes: Under Annex XVII to REACH, dibutyl phthalate: 1. shall not be used as substances or in mixtures, individually or in any combination of the phthalates listed in column 1 of this entry, in a concentration equal to or greater than 0,1 % by weight of the plasticized material, in toys and childcare articles 2. shall not be placed on the market in toys or childcare articles, individually or in any combination of the first three phthalates listed in column 1 of this entry, in a concentration equal to or greater than 0,1 % by weight of the plasticized material. In addition, di-isobutyl phthalate shall not be placed on the market after 7 July 2020 in toys or childcare articles, individually or in any combination with the first three phthalates listed in column 1 of this entry, in a concentration equal to or greater than 0,1 % by weight of the plasticized material. 3. Shall not be placed on the market after 7 July 2020 in articles, individually or in any combination of the phthalates listed in column 1 of this entry, in a concentration equal to or greater than 0,1 % by weight of the plasticized material in the article.

Country/ Organization	Requirements and Restrictions
	4. Paragraph 3 shall not apply to: (a) articles exclusively for industrial or agricultural use, or for use exclusively in the open air, provided that no plasticized material comes into contact with human mucous membranes or into prolonged contact with human skin; (b) aircraft, placed on the market before 7 January 2024, or articles, whenever placed on the market, for use exclusively in the maintenance or repair of those aircraft, where those articles are essential for the safety and airworthiness of the aircraft; (c) motor vehicles within the scope of Directive 2007/46/EC, placed on the market before 7 January 2024, or articles, whenever placed on the market, for use exclusively in the maintenance or repair of those vehicles, where the vehicles cannot function as intended without those articles; (d) articles placed on the market before 7 July 2020; (e) measuring devices for laboratory use, or parts thereof; (f) materials and articles intended to come into contact with food within the scope of Regulation (EC) No 1935/2004 or Commission Regulation (EU) No 10/20111; (g) medical devices within the scope of Directives 90/385/EEC, 93/42/EEC or 98/79/EC, or parts thereof; (h) electrical and electronic equipment within the scope of Directive 2011/65/EU; (i) the immediate packaging of medicinal products within the scope of Regulation (EC) No 726/2004, Directive 2001/82/EC or Directive 2001/83/EC; (j) toys and childcare articles covered by paragraphs 1 or 2. 5. For the purposes of paragraphs 1, 2, 3 and 4(a), (a) ‘plasticized material’ means any of the following homogeneous materials: - polyvinyl chloride (PVC), polyvinylidene chloride (PVDC), polyvinyl acetate (PVA), polyurethanes, - any other polymer (including, inter alia, polymer foams and rubber material) except silicone rubber and natural latex coatings, - surface coatings, non-slip coatings, finishes, decals, printed designs, - adhesives, sealants, paints and inks. European Commission Directive (EU) 2015/863 of 31 March 2015 amended Annex II to Directive 2011/65/EU, to restrict dibutyl phthalate at 0.1% or greater so that: - The restriction of dibutyl phthalate shall apply to medical devices, including *in vitro* medical devices, and monitoring and control instruments, including industrial monitoring and control instruments, from 22 July 2021. - The restriction of dibutyl phthalate shall not apply to cables or spare parts for the repair, the reuse, the updating of functionalities or upgrading of capacity of EEE placed on the market before 22 July 2019, and of

Country/ Organization	Requirements and Restrictions
	medical devices, including *in vitro* medical devices, and monitoring and control instruments, including industrial monitoring and control instruments, placed on the market before 22 July 2021. - The restriction of dibutyl phthalate shall not apply to toys which are already subject to the restriction of di-ethylhexyl phthalate, butyl benzyl phthalate and dibutyl phthalate through entry 51 of Annex XVII to Regulation (EC) No 1907/2006. Dibutyl phthalate is subject to the Restriction of Hazardous Substances Directive (RoHS), EU/2015/863, which restricts the use of hazardous substances at more than 0.1% by weight at the 'homogeneous material' level in electrical and electronic equipment, beginning July 22, 2019. (European Commission RoHS).
Australia	Dibutyl phthalate was assessed under Human Health and Environment (Phthalate esters) Tier II of the Inventory Multi-Tiered Assessment and Prioritisation (IMAP). Dibutyl phthalate has been listed and assessed as a Priority Existing Chemical (PEC/36, November 2013). NICNAS found no reports of the phthalate being manufactured as a raw material in Australia. Dibutyl phthalate is imported into Australia mainly as a component of finished products or mixtures and also as a raw material for local formulation and processing. There are currently no restrictions on the manufacture, import or use of dibutyl phthalate in Australia. Dibutyl phthalate is listed in the Safe Work Australia List of Designated Hazardous Substances contained in the Hazardous Substances Information System (HSIS) as a Reproductive Toxicant Category 2 (requiring it to be labelled with the risk phrase [R61]—May cause harm to the unborn child); and Reproductive Toxicant Category 3 (requiring the risk phrase [R62]—Possible risk of impaired fertility). Data accessed April 10, 2019:
Japan	Dibutyl phthalate is regulated in Japan under the following legislation: • Act on the Evaluation of Chemical Substances and Regulation of Their Manufacture, etc. (Chemical Substances Control Law; CSCL) • Act on Confirmation, etc. of Release Amounts of Specific Chemical Substances in the Environment and Promotion of Improvements to the Management Thereof • Industrial Safety and Health Act (ISHA) • Air Pollution Control Law As referenced in the National Institute for National Institute for Technology and Evaluation [NITE] Chemical Risk Information Platform [CHRIP]. Accessed April 10, 2019

Country/ Organization	Requirements and Restrictions
World Health Organization (WHO)	Established a tolerable daily intake of 66 µg dibutyl phthalate/kg body weight based on a LOAEL of 66 mg/kg body weight per day for developmental and reproductive toxicity in rats from a continuous breeding study, incorporating an uncertainty factor of 1,000. (WHO Environmental Health Criteria 189, 1997)
Australia, Austria, Belgium, Canada, Denmark, France, Germany, Ireland, Japan, Latvia, New Zealand, Norway, People's Republic of China, Poland, Romania, Singapore, South Africa, South Korea, Spain, Sweden, Switzerland, United Kingdom	Occupational exposure limits for dibutyl phthalate (GESTIS International limit values for chemical agents (Occupational exposure limits, OELs) database. Accessed February 14, 2025).

B.4 Assessment History

Table_Apx B-4. Assessment History of DBP

Authoring Organization	Publication(s)/Hyperlink(s) and Year
EPA publications	
National Center for Environmental Assessment	Integrated Risk Information System (IRIS), chemical assessment summary, dibutyl phthalate; CASRN 84-74-2 (U.S. EPA, 1987)
Other U.S.-based organizations	
National Academies of Sciences, Engineering, and Medicine	Application of systematic review methods in an overall strategy for evaluating low-dose toxicity from endocrine active chemicals (NASEM, 2017)
U.S. Department of Health and Human Services, Public Health Service, Agency for Toxic Substances and Disease Registry (ATSDR)	Toxicological Profile for Di-n-Butyl Phthalate (ATSDR, 2001)
U.S. Consumer Product Safety Commission (U.S. CPSC)	Chronic Hazard Panel on Phthalates and Phthalate Alternatives Final Report (with Appendices) (CPSC, 2014) Toxicity Review of DBP (CPSC, 2010)
National Toxicology Program (NTP), Center for the Evaluation of Risks to Human Reproduction (CERHR), National Institute of Health (NIH)	NTP-CERHR Monograph on the Potential Human Reproductive and Developmental Effects of Di-n-Butyl Phthalate (DBP) (NTP, 2003)

Office of Environmental Health Hazard Assessment (OEHHA), California Environmental Protection Agency	Proposition 65 Maximum Allowable Dose Level (MADL) for Reproductive Toxicity for Di-(n-butyl)phthalate (DBP) (OEHHA, 2007)
International	
European Union, European Chemicals Agency (ECHA), European Chemicals Bureau (ECB)	European Union risk assessment report: Dibutyl phthalate. Vol. 29, 1st priority list (ECJRC, 2003) European Union Risk Assessment Report: Dibutyl phthalate with addendum to the environmental section (ECJRC, 2004) Evaluation of new scientific evidence concerning the restrictions contained in Annex XVII to Regulation (EC) No 1907/2006 (REACH): Review of new available information for dibutyl phthalate (DBP) CAS No 84-74-2 Einecs No 201-557-4 (ECHA, 2010) Opinion on an Annex XV dossier proposing restrictions on four phthalates (DEHP, BBP, DBP, DIBP) (ECHA, 2017b) Annex to the Background document to the Opinion on the Annex XV dossier proposing restrictions on four phthalates (DEHP, BBP, DBP, DIBP) (ECHA, 2017a)
European Food Safety Authority (EFSA)	Opinion of the Scientific Panel on food additives, flavourings, processing aids and materials in contact with food (AFC) related to di-Butylphthalate (DBP) for use in food contact materials (EFSA, 2005) Update of the Risk Assessment of Di-butylphthalate (DBP), Butyl-benzyl-phthalate (BBP), Bis(2-ethylhexyl)phthalate (DEHP), Di-isononylphthalate (DINP) and Di-isodecylphthalate (DIDP) for Use in Food Contact Materials (EFSA, 2019)
Government of Canada, Environment Canada, Health Canada	Canadian Environmental Protection Act: Priority Substances List Assessment Report: Dibutyl Phthalate (EC/HC, 1994) Screening Assessment: Phthalate Substance Grouping (Health Canada, 2020) State of the Science Report - Part 1: Phthalates Substance Grouping: Medium-Chain Phthalate Esters. Chemical Abstracts Service Registry Numbers 84-61-7; 84-64-0; 84-69-5; 523-31-9; 5334-09-8; 16883-83-3; 27215-22-1; 27987-25-3; 68515-40-2; 71888-89-6 (EC/HC, 2015)
National Industrial Chemicals Notification and Assessment Scheme (NICNAS), Australian Government	Priority Existing Chemical Assessment Report: Dibutyl phthalate (NICNAS, 2013) Existing Chemical Hazard Assessment Report: Dibutyl Phthalate (NICNAS, 2008)

Appendix C LIST OF TECHNICAL SUPPORT DOCUMENTS

Appendix C incudes a list and citations for all supplemental documents included in the Draft Risk Evaluation for DBP.

Associated **Systematic Review Protocol and Data Quality Evaluation and Data Extraction** Documents – Provide additional detail and information on systematic review methodologies used as well as the data quality evaluations and extractions criteria and results.

Draft Systematic Review Protocol for Dibutyl Phthalate (DBP) (U.S. EPA, 2025w) – In lieu of an update to the *Draft Systematic Review Protocol Supporting TSCA Risk Evaluations for Chemical Substances*, also referred to as the "2021 Draft Systematic Review Protocol" (U.S. EPA, 2021a), this systematic review protocol for the Draft Risk Evaluation for DBP describes some clarifications and different approaches that were implemented than those described in the 2021 Draft Systematic Review Protocol in response to (1) SACC comments, (2) public comments, or (3) to reflect chemical-specific risk evaluation needs. This supplemental file may also be referred to as the "DBP Systematic Review Protocol."

Draft Data Quality Evaluation and Data Extraction Information for Physical and Chemical Properties for Dibutyl Phthalate (DBP) (U.S. EPA, 2025k) – Provides a compilation of tables for the data extraction and data quality evaluation information for DBP. Each table shows the data point, set, or information element that was extracted and evaluated from a data source that has information relevant for the evaluation of physical and chemical properties.

Draft Data Quality Evaluation and Data Extraction Information for Environmental Fate and Transport for Dibutyl Phthalate (DBP) (U.S. EPA, 2025i) – Provides a compilation of tables for the data extraction and data quality evaluation information for DBP. Each table shows the data point, set, or information element that was extracted and evaluated from a data source that has information relevant for the evaluation for environmental fate and transport.

Draft Data Quality Evaluation and Data Extraction Information for Environmental Release and Occupational Exposure for Dibutyl Phthalate (DBP) (U.S. EPA, 2025j) – Provides a compilation of tables for the data extraction and data quality evaluation information for DBP. Each table shows the data point, set, or information element that was extracted and evaluated from a data source that has information relevant for the evaluation of environmental release and occupational exposure.

Draft Data Quality Evaluation and Data Extraction Information for Dermal Absorption for Dibutyl Phthalate (DBP) (U.S. EPA, 2025h) – Provides a compilation of tables for the data extraction and data quality evaluation information for DBP. Each table shows the data point, set, or information element that was extracted and evaluated from a data source that has information relevant for the evaluation for dermal absorption.

Draft Data Quality Evaluation Information for General Population, Consumer, and Environmental Exposure for Dibutyl Phthalate (DBP) (U.S. EPA, 2025m) – Provides a compilation of tables for the data quality evaluation information for DBP. Each table shows the data point, set, or information element that was evaluated from a data source that has information relevant for the evaluation of general population, consumer, and environmental exposure.

Draft Data Extraction Information for General Population, Consumer, and Environmental Exposure for Dibutyl Phthalate (DBP) (U.S. EPA, 2025g) – Provides a compilation of tables for the data extraction for DBP. Each table shows the data point, set, or information element that was extracted from a data source that has information relevant for the evaluation of general population, consumer, and environmental exposure.

Draft Data Quality Evaluation Information for Human Health Hazard Epidemiology for Dibutyl Phthalate (DBP) (U.S. EPA, 2025o) – Provides a compilation of tables for the data quality evaluation information for DBP. Each table shows the data point, set, or information element that was evaluated from a data source that has information relevant for the evaluation of epidemiological information.

Draft Data Quality Evaluation Information for Human Health Hazard Animal Toxicology for Dibutyl Phthalate (DBP) (U.S. EPA, 2025n) – Provides a compilation of tables for the data quality evaluation information for DBP. Each table shows the data point, set, or information element that was evaluated from a data source that has information relevant for the evaluation of human health hazard animal toxicity information.

Draft Data Quality Evaluation Information for Environmental Hazard for Dibutyl Phthalate (DBP) (U.S. EPA, 2025l) – Provides a compilation of tables for the data quality evaluation information for DBP. Each table shows the data point, set, or information element that was evaluated from a data source that has information relevant for the evaluation of environmental hazard toxicity information.

Draft Data Extraction Information for Environmental Hazard and Human Health Hazard Animal Toxicology and Epidemiology for Dibutyl Phthalate (DBP) (U.S. EPA, 2025f) – Provides a compilation of tables for the data extraction for DBP. Each table shows the data point, set, or information element that was extracted from a data source that has information relevant for the evaluation of environmental hazard and human health hazard animal toxicology and epidemiology information.

Associated **Technical Support Documents** (TSDs) – Provide additional details and information on exposure, hazard, and risk assessments.

Draft Fate & Physical Chemistry Assessment for Dibutyl Phthalate (DBP) (U.S. EPA, 2024j).

Draft Environmental Release and Occupational Exposure Assessment for Dibutyl Phthalate (DBP) (U.S. EPA, 2025q).

Draft Consumer and Indoor Exposure Assessment for Dibutyl Phthalate (DBP) (U.S. EPA, 2025c).

Draft Environmental Media, General Population, and Environmental Exposure for Dibutyl Phthalate (DBP) (U.S. EPA, 2025p).

Draft Environmental Hazard Assessment for Dibutyl Phthalate (DBP) (U.S. EPA, 2024m).

Draft Non-cancer Human Health Hazard Assessment for Dibutyl Phthalate (DBP) (U.S. EPA, 2024f).

Draft Cancer Human Health Hazard Assessment for Di(2-ethylhexyl) Phthalate (DEHP), Dibutyl Phthalate (DBP), Butyl Benzyl Phthalate (BBP), Diisobutyl Phthalate (DIBP), and Dicyclohexyl Phthalate (DCHP) (U.S. EPA, 2025b).

Draft Consumer Exposure Analysis for Dibutyl Phthalate (DBP) (U.S. EPA, 2025d).

Draft Consumer Risk Calculator for Dibutyl Phthalate (DBP) (U.S. EPA, 2025e).

Draft Risk Calculator for Occupational Exposures for Dibutyl Phthalate (DBP) (U.S. EPA, 2025t).

Draft Fish Ingestion Risk Calculator for Dibutyl Phthalate (DBP) (U.S. EPA, 2025r)

Draft Surface Water Human Exposure Risk Calculator for Dibutyl Phthalate (DBP) (U.S. EPA, 2025v)

Draft Occupational and Consumer Cumulative Risk Calculator for Dibutyl Phthalate (DBP) (U.S. EPA, 2025s)

Draft Ambient Air IIOAC Exposure Results And Risk Calculations for Dibutyl Phthalate (DBP) (U.S. EPA, 2025a)

Draft Meta-Analysis and Benchmark Dose Modeling of Fetal Testicular Testosterone for Di(2-ethylhexyl) Phthalate (DEHP), Dibutyl Phthalate (DBP), Butyl Benzyl Phthalate (BBP), Diisobutyl Phthalate (DIBP), and Dicyclohexyl Phthalate (DCHP) (U.S. EPA, 2024d).

Revised Draft Technical Support Document for the Cumulative Risk Analysis of Di(2-ethylhexyl) Phthalate (DEHP), Dibutyl Phthalate (DBP), Butyl Benzyl Phthalate (BBP), Diisobutyl Phthalate (DIBP), Dicyclohexyl Phthalate (DCHP), and Diisononyl Phthalate (DINP) Under the Toxic Substances Control Act (TSCA) (U.S. EPA, 2025x).

Draft Summary of Human Health Hazard Animal Toxicology Studies for Dibutyl Phthalate (DBP) - Literature Published from 2014 to 2019 (U.S. EPA, 2025u).

Appendix D UPDATES TO THE DBP CONDITIONS OF USE TABLE

After the publication of the final scope document (U.S. EPA, 2020c), EPA received updated submissions from the 2020 CDR cycle (U.S. EPA, 2020a). In addition to new submissions received under the 2020 CDR cycle, the use and processing codes changed for the 2020 CDR cycle. Therefore, EPA amended the description of certain DBP COUs based on those new submissions and new use and processing codes. Also, the Agency received information from stakeholders about uses of DBP. For cases where COUs were consolidated under a category, if the category was not present in the scope, the nomenclature was taken directly from the 2020 CDR cycle codes and categories. Table_Apx D-1 summarizes the changes to the COUs based on the new codes in the 2020 CDR and any other additional information reasonably available to EPA since the publication of the final scope document.

Table_Apx D-1. Changes to Categories and Subcategories of Conditions of Use Based on CDR and Stakeholder Engagement

Life Cycle Stage and Category in the Final Scope Document	Subcategory in the Final Scope Document	Occurred Change	Revised COU in the 2025 Draft Risk Evaluation
Manufacturing – Import	Import	Changed category and subcategory by adding "ing"	Importing
Processing – Processing as a reactant	Intermediates in all other basic organic chemical manufacturing	Removed based on stakeholder feedback (U.S. EPA, 2024b)	N/A
Processing – Processing as a reactant	Plasticizers in wholesale and retail trade	Consolidated subcategory into processing; incorporation into article, plasticizer to avoid duplication based on 2020 CDR reporting codes.	N/A
N/A	N/A	Added "intermediate in plastic manufacturing" subcategory due to stakeholder feedback (W.R. Grace, 2024).	Processing – processing as a reactant – intermediate in plastic manufacturing
Processing – Processing – Incorporating into formulation, mixture or reaction product	Solvents (which become part of product formulation or mixture) in all other chemical product and preparation manufacturing	Changed category by removing "ing" and replacing with "incorporation," removed "processing –"to avoid redundancy Consolidated "soap, cleaning compound, and toilet preparation manufacturing"; and "ink, toner, and colorant manufacturing" sectors under this COU. Consolidated functional fluids (closed systems) in printing and related support activities with the 2020 CDR reports of DBP as a solvent in printing ink manufacturing under one COU. The name was changed to "ink, toner, and colorant	Processing – incorporation into formulation, mixture, or reaction product – solvents (which become part of product formulation or mixture) in chemical product and preparation manufacturing; soap, cleaning compound, and toilet preparation manufacturing; adhesive manufacturing; and ink, toner, and colorant manufacturing

Life Cycle Stage and Category in the Final Scope Document	Subcategory in the Final Scope Document	Occurred Change	Revised COU in the 2025 Draft Risk Evaluation
		manufacturing" sector to be consistent with other phthalates. Added "adhesive manufacturing" and "chemical product and preparation manufacturing" sectors based on a 2020 CDR report.	
Processing – Processing – Incorporating into formulation, mixture or reaction product	Intermediate in asphalt paving, roofing, and coating materials manufacturing	Changed category by removing "ing" and replacing with "incorporation," removed "processing –"to avoid redundancy. Consolidated subcategory into processing – incorporation into article, plasticizer to avoid duplication based on to the 2020 CDR codes and stakeholder feedback (U.S. EPA, 2024b)	Processing – incorporation into formulation, mixture, or reaction product – plasticizer in adhesive and sealant manufacturing; building and construction materials manufacturing; furniture and related product manufacturing; ceramic powders; plastics product manufacturing; and rubber product manufacturing
Processing – Processing – Incorporating into formulation, mixture or reaction product	N/A	Changed category by removing "ing" and replacing with incorporation, removed "processing –"to avoid redundancy. New COU based on stakeholder feedback (W.R. Grace, 2024).	Processing – incorporation into formulation, mixture, or reaction product – pre-catalyst manufacturing
Processing – Processing – Incorporating into formulation, mixture or reaction product	Plasticizer in paint and coating manufacturing	Changed category by removing "ing" and replacing with "incorporation," removed "processing –"to avoid redundancy. Consolidated with other plasticizer COUs under the "Processing – incorporation into formulation, mixture or reaction product – plasticizer in…" COU.	Processing – incorporation into formulation, mixture, or reaction product – plasticizer in paint and coating manufacturing; plastic material and resin manufacturing; rubber manufacturing; soap, cleaning compound, and toilet preparation manufacturing; textiles, apparel, and leather manufacturing; printing ink manufacturing; basic chemical manufacturing; and adhesive and sealant manufacturing
Processing – Processing – Incorporating into formulation, mixture or reaction product	Adhesives and sealant chemicals in construction	Changed category by removing "ing" and replacing with "incorporation," removed "processing –"to avoid redundancy. Consolidated with other plasticizer COUs under the "Processing – incorporation into formulation, mixture or reaction	Processing – incorporation into formulation, mixture, or reaction product – plasticizer in paint and coating manufacturing; plastic material and resin manufacturing; rubber manufacturing; soap, cleaning compound, and toilet preparation manufacturing; textiles, apparel, and leather manufacturing; printing ink

Life Cycle Stage and Category in the Final Scope Document	Subcategory in the Final Scope Document	Occurred Change	Revised COU in the 2025 Draft Risk Evaluation
		product – plasticizer in…" COU, with a name change to "adhesive and sealant manufacturing" sector.	manufacturing; basic chemical manufacturing; and adhesive and sealant manufacturing
Processing – Processing – Incorporating into formulation, mixture or reaction product	Intermediates in petrochemical manufacturing	Changed category by removing "ing" and replacing with "incorporation," removed "processing –"to avoid redundancy. Removed COU based on feedback from stakeholder that it is not a correct use for DBP (U.S. EPA, 2024b)	N/A
Processing – Processing – Incorporating into formulation, mixture or reaction product	Plasticizers in plastic material and resin manufacturing	Changed category by removing "ing" and replacing with "incorporation," removed "processing –"to avoid redundancy. Consolidated with other plasticizer COUs under the "Processing – incorporation into formulation, mixture or reaction product – plasticizer in…" COU.	Processing – incorporation into formulation, mixture, or reaction product – plasticizer in paint and coating manufacturing; plastic material and resin manufacturing; rubber manufacturing; soap, cleaning compound, and toilet preparation manufacturing; textiles, apparel, and leather manufacturing; printing ink manufacturing; basic chemical manufacturing; and adhesive and sealant manufacturing
Processing – processing – incorporating into formulation, mixture or reaction product	Plasticizers in plastic product manufacturing	Changed category by removing "ing" and replacing with "incorporation," removed "processing –"to avoid redundancy. Consolidated with other plasticizer COUs under the "Processing – incorporation into formulation, mixture or reaction product – plasticizer in…" COU, specifically as "plastic material and resin manufacturing."	Processing – incorporation into formulation, mixture, or reaction product – plasticizer in paint and coating manufacturing; plastic material and resin manufacturing; rubber manufacturing; soap, cleaning compound, and toilet preparation manufacturing; textiles, apparel, and leather manufacturing; printing ink manufacturing; basic chemical manufacturing; and adhesive and sealant manufacturing
Processing – processing – incorporating into formulation, mixture or reaction product	Functional fluids (closed systems) in printing and related support activities; solvent in printing ink manufacturing	Changed category by removing "ing" and replacing with "incorporation," removed "processing –"to avoid redundancy. Consolidated under solvent in ink, toner, and colorant manufacturing sector under the "Processing – incorporation into	Processing – incorporation into formulation, mixture, or reaction product – solvents (which become part of product formulation or mixture) in chemical product and preparation manufacturing; soap, cleaning compound, and toilet preparation manufacturing; adhesive manufacturing; and ink, toner, and colorant manufacturing

Life Cycle Stage and Category in the Final Scope Document	Subcategory in the Final Scope Document	Occurred Change	Revised COU in the 2025 Draft Risk Evaluation
		formulation, mixture, or reaction product; solvents…" COU.	
Processing – processing – incorporating into formulation, mixture or reaction product	Intermediate in rubber product manufacturing	Changed category by removing "ing" and replacing with "incorporation," removed "processing –"to avoid redundancy. Consolidated with other plasticizer COUs under the "Processing – incorporation into formulation, mixture or reaction product – plasticizer in…" COU, with a name change to "rubber manufacturing" sector.	Processing – incorporation into formulation, mixture, or reaction product – plasticizer in paint and coating manufacturing; plastic material and resin manufacturing; rubber manufacturing; soap, cleaning compound, and toilet preparation manufacturing; textiles, apparel, and leather manufacturing; printing ink manufacturing; basic chemical manufacturing; and adhesive and sealant manufacturing
Processing – processing – incorporating into formulation, mixture or reaction product	Plasticizers in soap, cleaning compound, and toilet preparation manufacturing	Changed category by removing "ing" and replacing with "incorporation," removed "processing –"to avoid redundancy. Consolidated with other plasticizer COUs under the "Processing – incorporation into formulation, mixture or reaction product – plasticizer in…" COU.	Processing – incorporation into formulation, mixture, or reaction product – plasticizer in paint and coating manufacturing; plastic material and resin manufacturing; rubber manufacturing; soap, cleaning compound, and toilet preparation manufacturing; textiles, apparel, and leather manufacturing; printing ink manufacturing; basic chemical manufacturing; and adhesive and sealant manufacturing
Processing – processing – incorporating into formulation, mixture or reaction product	Solvents in soap, cleaning compound, and toilet preparation manufacturing	Changed category by removing "ing" and replacing with "incorporation," removed "processing –"to avoid redundancy. Consolidated under the "Processing – incorporation into formulation, mixture, or reaction product; solvents…" COU as "soap, cleaning compound, and toilet preparation manufacturing" sector.	Processing – incorporation into formulation, mixture, or reaction product – solvents (which become part of product formulation or mixture) in chemical product and preparation manufacturing; soap, cleaning compound, and toilet preparation manufacturing; adhesive manufacturing; and ink, toner, and colorant manufacturing
Processing – incorporating into formulation, mixture or reaction product	Plasticizers in textiles, apparel, and leather manufacturing	Changed category by removing "ing" and replacing with "incorporation," removed "processing –"to avoid redundancy. Consolidated with other plasticizer COUs under the "Processing – incorporation into	Processing – incorporation into formulation, mixture, or reaction product – plasticizer in paint and coating manufacturing; plastic material and resin manufacturing; rubber manufacturing; soap, cleaning compound, and toilet preparation manufacturing; textiles, apparel, and leather manufacturing; printing ink

Life Cycle Stage and Category in the Final Scope Document	Subcategory in the Final Scope Document	Occurred Change	Revised COU in the 2025 Draft Risk Evaluation
		formulation, mixture or reaction product – plasticizer in…" COU.	manufacturing; basic chemical manufacturing; and adhesive and sealant manufacturing
Processing – processing – incorporating into articles	Plasticizers in adhesive manufacturing	Changed category by removing "ing" and replacing with "incorporation," removed "processing –"to avoid redundancy. Consolidated "plastics product manufacturing" and "rubber product manufacturing" sectors under this COU. Added "building and construction materials manufacturing" and "furniture and related product manufacturing" sectors based on 2020 CDR cycle submissions. Added "and sealant" to better describe the adhesive manufacturing sector based on 2020 CDR codes. Added "ceramic powders" due to public comment (NASA, 2020).	Processing – incorporation into article – plasticizer in adhesive and sealant manufacturing; building and construction materials manufacturing; furniture and related product manufacturing; ceramic powders; plastics product manufacturing; and rubber product manufacturing
Processing – processing – incorporating into articles	Plasticizers in rubber product manufacturing	Changed category by removing "ing" and replacing with "incorporation," removed "processing –"to avoid redundancy. Consolidated with other plasticizer COUs under the "Processing – incorporation into articles – plasticizer in…" COU.	Processing – incorporation into article – plasticizer in adhesive and sealant manufacturing; building and construction materials manufacturing; furniture and related product manufacturing; ceramic powders; plastics product manufacturing; and rubber product manufacturing
Processing; processing – incorporating into articles	Plasticizers in plastics product manufacturing	Changed category by removing "ing" and replacing with "incorporation," removed "processing –"to avoid redundancy. Consolidated with other plasticizer COUs under the "Processing – incorporation into articles; plasticizer in…" COU.	Processing – incorporation into article – plasticizer in adhesive and sealant manufacturing; building and construction materials manufacturing; furniture and related product manufacturing; ceramic powders; plastics product manufacturing; and rubber product manufacturing
Processing – repackaging	Laboratory chemicals in wholesale and retail trade	Consolidated with "plasticizers in wholesale and retail trade" repackaging COU.	Processing – repackaging – laboratory chemicals in wholesale and retail trade; plasticizers in

Life Cycle Stage and Category in the Final Scope Document	Subcategory in the Final Scope Document	Occurred Change	Revised COU in the 2025 Draft Risk Evaluation
		Added plastics material and resin manufacturing based on 2020 CDR data.	wholesale and retail trade; and plastics material and resin manufacturing
Industrial Uses; non-incorporative use	Solvent in Huntsman's maleic anhydride manufacturing technology	Changed "uses" in life cycle stage to "use." Consolidated with the "solvent" subcategory under this category to avoid redundancy. Changed subcategory to be more general to incorporate a 2020 CDR report of "absorbent in miscellaneous manufacturing."	Industrial use – non-incorporative activities – solvent, including in maleic anhydride manufacturing technology
Industrial Uses; Non-incorporative use	Solvent	Consolidated with the subcategory for "solvent in Huntsman's maleic anhydride manufacturing technology"	Industrial use – non-incorporative activities – solvent, including in maleic anhydride manufacturing technology
N/A	N/A	Changed "uses" in life cycle stage to "use." Added "Industrial use – construction, paint, electrical, and metal products – adhesives and sealants" based on public comment (NASA, 2020; MEMA, 2019).	Industrial use – construction, paint, electrical, and metal products – adhesives and sealants
N/A	N/A	Changed "uses" in life cycle stage to "use." Added "Industrial use – construction, paint, electrical, and metal products – paints and coatings" based on public comment (NASA, 2020; MEMA, 2019).	Industrial use – construction, paint, electrical, and metal products – paints and coatings
N/A	N/A	Changed "uses" in life cycle stage to "use." Added "Industrial Use – other uses – automotive articles" based on public comment (MEMA, 2019).	Industrial use – other uses – automotive articles
N/A	N/A	Changed "uses" in life cycle stage to "use." Added "Industrial Use – other uses – lubricants" based on public comment (MEMA, 2019).	Industrial use – other uses – lubricants and lubricant additives

Life Cycle Stage and Category in the Final Scope Document	Subcategory in the Final Scope Document	Occurred Change	Revised COU in the 2025 Draft Risk Evaluation
Commercial Uses – Explosive materials	Explosive materials	Changes "uses" in life cycle stage to "use." Updated life cycle stage to "industrial use" based on public comment (AIA, 2019) and reasonable available information (Liang et al., 2021); The name was changed to "other uses" and the subcategory to "propellants" to more accurately reflect the use of DBP in explosive materials regulated under TSCA.	Industrial use – other uses – propellants
N/A	N/A	Changed "uses" in life cycle stage to "use." Added "Commercial Use – automotive, fuel, agriculture, outdoor use products – automotive care products" to be consistent with 2020 CDR codes.	Commercial use – automotive, fuel, agriculture, outdoor use products – automotive care products
Commercial Uses – Adhesives and sealants	Adhesives and sealants	Changed "uses" in life cycle stage to "use." Changed the name of the category to "construction, paint, electrical, and metal products" to be consistent with 2020 CDR codes.	Commercial use – construction, paint, electrical, and metal products – adhesives and sealants
Commercial Uses – Paints and coatings	Paints and coatings	Changed "uses" in life cycle stage to "use." Changed the name of the category to "construction, paint, electrical, and metal products" to be consistent with 2020 CDR codes.	Commercial use – construction, paint, electrical, and metal products – paints and coatings
Commercial Uses – Cleaning and furnishing care products	Cleaning and furnishing care products	Changed "uses" in life cycle stage to "use." Changed the name of the category to "furnishing, cleaning, treatment care products" to be consistent with 2020 CDR codes.	Commercial use – furnishing, cleaning, treatment care products – cleaning and furnishing care products
Commercial Uses – Cleaning and furnishing care products	Floor coverings	Changed "uses" in life cycle stage to "use."	Commercial use – furnishing, cleaning, treatment care products – construction and building materials covering large surface areas including stone, plaster,

Life Cycle Stage and Category in the Final Scope Document	Subcategory in the Final Scope Document	Occurred Change	Revised COU in the 2025 Draft Risk Evaluation
		Changed the name of the category to "furnishing, cleaning, treatment care products" to be consistent with 2020 CDR codes. Changed the name of the subcategory to "construction and building materials covering large surface areas including stone, plaster, cement, glass and ceramic articles – fabrics, textiles, and apparel" to be consistent with 2020 CDR codes.	cement, glass and ceramic articles; fabrics, textiles, and apparel
Commercial Uses – Cleaning and furnishing care products	Furniture and furnishings not covered elsewhere	Changed "uses" in life cycle stage to "use." Changed the name of the category to "furnishing, cleaning, treatment care products" to be consistent with 2020 CDR codes. The new name does not include "not covered elsewhere."	Commercial use – furnishing, cleaning, treatment care products – furniture and furnishings
Commercial Uses – Ink, toner, and colorant products	Ink, toner, and colorant products	Changed "uses" in life cycle stage to "use." Changed the name of the category to "packaging, paper, plastic, toys, hobby products" to be consistent with 2020 CDR codes.	Commercial use – packaging, paper, plastic, toys, hobby products – ink, toner, and colorant products
Commercial Uses – rubber and plastic products not covered elsewhere	Rubber and plastic products not covered elsewhere	Changed "uses" in life cycle stage to "use." Changed the name of the category to "packaging, paper, plastic, toys, hobby products" to be consistent with 2020 CDR codes. Changed the name of the subcategory to "packaging (excluding food packaging), including rubber articles; plastic articles (hard); plastic articles (soft) – other articles with routine direct contact during normal use, including rubber articles; plastic articles (hard)" to be consistent with 2020 CDR codes.	Commercial use – packaging, paper, plastic, toys, hobby products – packaging (excluding food packaging), including rubber articles; plastic articles (hard); plastic articles (soft); other articles with routine direct contact during normal use, including rubber articles; plastic articles (hard)

Life Cycle Stage and Category in the Final Scope Document	**Subcategory in the Final Scope Document**	**Occurred Change**	**Revised COU in the 2025 Draft Risk Evaluation**
N/A	N/A	Added "Toys, playground, and sporting equipment" subcategory to the "Packaging, paper, plastic, toys, hobby products" category based on additional information (U.S. EPA, 2019a, f).	Commercial use – packaging, paper, plastic, toys, hobby products – toys, playground, and sporting equipment
Commercial Uses – Personal care products	Personal care products	Removed COU since no personal care products containing DBP were identified.	N/A
Commercial Uses – miscellaneous uses	Laboratory chemicals chemiluminescent light sticks inspection penetrant kit lubricants	Changed "uses" in life cycle stage to "use." Changed "miscellaneous" in the name of the category to "other" to be consistent with other phthalate risk evaluations. Split COU into different COUs with different subcategories for clarity.	Commercial use – other uses – laboratory chemicals Commercial use – other uses – chemiluminescent light sticks Commercial use – other uses – inspection penetrant kit Commercial use – other uses – lubricants and lubricant additives
N/A	N/A	Added "Automotive care products" subcategory and "Automotive, fuel, agriculture, outdoor use products" category based on 2020 CDR cycle submissions.	Consumer use – automotive, fuel, agriculture, outdoor use products – automotive care products
Consumer Uses – Adhesives and sealants	Adhesives and sealants	Changed "uses" in life cycle stage to "use." Changed name of category to "construction, paint, electrical, and metal products" to be consistent with 2020 CDR codes.	Commercial use – construction, paint, electrical, and metal products – adhesives and sealants
Consumer Uses – Paints and coatings	Paints and coatings	Changed "uses" in life cycle stage to "use." Changed name of category to "construction, paint, electrical, and metal products" to be consistent with 2020 CDR codes.	Consumer use – construction, paint, electrical, and metal products – paints and coatings
Consumer Uses – Cleaning and furnishing care products	Fabric, textile, and leather products not covered elsewhere	Changed "uses" in life cycle stage to "use." Change name of category to "furnishing, cleaning, treatment care products" to be consistent with 2020 CDR codes. The new name does not include "not covered elsewhere."	Consumer use – furnishing, cleaning, treatment care products – fabric, textile, and leather products

Life Cycle Stage and Category in the Final Scope Document	Subcategory in the Final Scope Document	Occurred Change	Revised COU in the 2025 Draft Risk Evaluation
Consumer Uses – Floor coverings	Floor coverings	Changed "uses" in life cycle stage to "use." Changed name of category and subcategory to be consistent with 2020 CDR cycle codes.	Commercial use – furnishing, cleaning, treatment care products – floor coverings; construction and building materials covering large surface areas including stone, plaster, cement, glass and ceramic articles; fabrics, textiles, and apparel
Consumer Uses – Cleaning and furnishing care products	Cleaning and furnishing care products	Changed "uses" in life cycle stage to "use." Changed name of category to "furnishing, cleaning, treatment care products" to be consistent with 2020 CDR codes.	Consumer use – furnishing, cleaning, treatment care products – cleaning and furnishing care products
Consumer Uses – Arts, crafts, and hobby materials	Arts, crafts, and hobby materials	Removed category and subcategory because it was not reported in CDR data in 2016, or 2020, and no relevant products could be identified.	N/A
Consumer Uses – Plastic and rubber products not found elsewhere	Plastic and rubber products not found elsewhere	Changed "uses" in life cycle stage to "use." Changed name of category to "packaging, paper, plastic, toys, hobby products" to be consistent with other phthalate risk evaluations. Changed name of subcategory to "packaging (excluding food packaging), including rubber articles; plastic articles (hard); plastic articles (soft); other articles with routine direct contact during normal use, including rubber articles; plastic articles (hard)" to be consistent with 2020 CDR codes.	Consumer use – packaging, paper, plastic, toys, hobby products – packaging (excluding food packaging), including rubber articles; plastic articles (hard); plastic articles (soft); other articles with routine direct contact during normal use, including rubber articles; plastic articles (hard)
N/A	N/A	Changed "uses" in life cycle stage to "use." Change name of category to "packaging, paper, plastic, toys, hobby products" to be consistent with 2020 CDR codes.	Consumer use – packaging, paper, plastic, toys, hobby products – toys, playgrounds, and sporting equipment
Consumer Uses – Miscellaneous Uses	Chemiluminescent light sticks	Changed "uses" in life cycle stage to "use."	Consumer use – other uses – chemiluminescent light sticks

Life Cycle Stage and Category in the Final Scope Document	Subcategory in the Final Scope Document	Occurred Change	Revised COU in the 2025 Draft Risk Evaluation
		Change name of category to "other uses" to be consistent with other phthalate risk evaluations.	
N/A	N/A	Added "automotive articles" based on stakeholder information received since publication of the final scope document (MEMA, 2019).	Consumer use – other uses – automotive articles
N/A	N/A	Added "lubricants and lubricant additives" based on stakeholder information received since publication of the final scope document (MEMA, 2019).	Consumer use – Other uses – lubricants and lubricant additives
N/A	N/A	Added subcategory "novelty articles" based on additional information (Stabile, 2013).	Consumer use – other uses – novelty articles

In addition, EPA is including further detail about edits to the following COUs, which are presented in Table_Apx D-1:

- In the 2016 CDR cycle, one company reported the use of DBP in processing – processing as a reactant – intermediates in all other basic organic chemical manufacturing (U.S. EPA, 2019b). Upon outreach with the stakeholder, they clarified that the report of DBP as an intermediate in all other basic organic chemical manufacturing was not a representative use for DBP (U.S. EPA, 2024b).

- In the 2020 CDR cycle, one company reported the use of DBP in processing – processing as a reactant – plasticizers in wholesale and retail trade (U.S. EPA, 2020a). EPA has determined not to include this activity as a separate COU and considers it captured under "processing, incorporation into articles" and "processing, incorporation into formulation, mixture, or reaction product." DBP is not used as a reactant in a chemical reaction, rather DBP is used as plasticizer. The use as a plasticizer is better described as "processing – incorporation into formulation, mixture or reaction product" and/or as "processing – incorporation into articles. Therefore, EPA changed the functional use to plasticizer and consolidated this 2020 CDR submission under "*processing – incorporation into formulation, mixture, or reaction product– plasticizer*."

- *"Processing – processing as a reactant – Intermediate in plastic manufacturing"* and "*Processing – incorporation into formulation, mixture, or reaction product – Pre-catalyst manufacturing"* were added after a stakeholder informed the Agency that DBP is used in polyolefin production as part of a catalyst and in reactions to make polyolefins (W.R. Grace, 2024).

- "*Commercial Use – toys, playground, and sporting equipment*" was added to the draft risk evaluation based on the use of recycled rubber tire crumb to build synthetic turf playing fields and playground contains DBP.

- "*Consumer use – novelty articles*" was added to the draft risk evaluation based on Agency research into the use of various phthalate in adult sex toys (*i.e.*, novelty products).

Appendix E CONDITIONS OF USE DESCRIPTIONS

The following descriptions are intended to include examples of uses so as not to exclude other activities that may also be included in the COUs of the chemical substance. To better describe the COU, EPA considered CDR submissions from the last two CDR cycles for DBP (CASRN 84-74-2) and the COU descriptions reflect what EPA identified as the best fit for that submission. Examples of articles, products, or activities are included in the following descriptions to help describe the COU but are not exhaustive. EPA uses the terms "articles" and "products" or product mixtures in the following descriptions and is generally referring to articles and products as defined by 40 CFR Part 751. There may be instances where the terms are used interchangeably by a company or commenters, or by EPA in reference to a code from the CDR reports which are referenced; for example, "plastic products manufacturing," or "fabric, textile, and leather products." EPA will clarify as needed when these references are included throughout the COU descriptions below.

E.1 Manufacturing – Domestic Manufacturing

Domestic manufacturing means to manufacture or produce DBP within the Unites States. For purposes of the DBP risk evaluation, this includes the extraction of DBP from a previously existing chemical substance or complex combination of chemical substances and loading and repackaging (but not transport) associated with the manufacturing or production of DBP.

DBP is typically manufactured through the catalytic esterification of the phthalic anhydride with n-butyl alcohol in the presence of an acid as a catalyst. A typical manufacturing operation takes place in closed systems either via batch or more automated continuous operations and will involve the purification of dibutyl phthalate product streams via either vacuum distillation or by passing over activated charcoal as a means of recovering unreacted alcohols (U.S. EPA, 2020c). This condition of use includes the typical manufacturing process and any other similar manufacturing of DBP.

Examples of CDR Submissions

In the 2016 CDR cycle, one company reported domestic manufacture of DBP, and in 2020, two companies reported domestic manufacture of DBP (U.S. EPA, 2020b, 2019b).

E.2 Manufacturing – Importing

Import refers to the import of DBP into the customs territory of the United States. This condition of use includes loading/unloading and repackaging (but not transport) associated with the import of DBP. In general, chemicals may be imported into the United States in bulk via water, air, land, and intermodal shipments. These shipments take the form of oceangoing chemical tankers, railcars, tank trucks, and intermodal tank containers (U.S. EPA, 2020c). Imported DBP is shipped in liquid form with concentrations ranging from 1 to 100 percent DBP (U.S. EPA, 2019b).

Examples of CDR Submissions

In the 2016 CDR cycle, 11 companies reported importation of DBP as a liquid (U.S. EPA, 2019b). EPA has identified two sites that imported DBP directly to their sites for on-site processing or use and nine sites that imported DBP directly to other sites for processing or use (U.S. EPA, 2020c).

In the 2020 CDR cycle, seven companies reported importation of DBP as a liquid (U.S. EPA, 2020b). Five companies reported that the imported chemical substance is never physically at the reporting site (*e.g.*, the chemical substance from a foreign country is directly imported to another location such as a warehouse, a processing or use site, or a customer's site). One company reported the importation for the purposes of repackaging in various industries.

E.3 Processing – Processing as a Reactant – Intermediate in Plastic Manufacturing

This COU refers to the use of a chemical as a reactant; that is, the use of DBP in a chemical reaction, which occurs when a chemical substance is added to a product or product mixture after its manufacture for distribution in commerce. In this case, DBP is used in a catalyst formulation for processing as a reactant in the generation of polyolefins (*i.e.*, polypropylene and polyethylene). EPA's understanding is that very small amounts of DBP are used as a catalyst for the associated chemical reactions (*i.e.*, 1 g used for 40,000 g of polypropylene). As the reaction progresses, the catalyst degrades and a small amount of DBP (1−3 parts per million) remains encapsulated in the final product (W.R. Grace, 2024).

This use was not reported to EPA in the 2016 or 2020 CDR cycles.

E.4 Processing – Incorporation into Formulation, Mixture, or Reaction Product – Solvents (Which Become Part of Product Formulation or Mixture) in Chemical and Preparation Manufacturing; in Soap, Cleaning Compound, and Toilet Preparation Manufacturing; Adhesive Manufacturing; and in Printing Ink Manufacturing

This COU refers to the preparation of a product; that is, the incorporation of DBP into formulation, mixture, or a reaction product which occurs when a chemical substance is added to a product or product mixture after its manufacture, for distribution in commerce, in this case as a solvent in various industrial sectors.

DBP can be used as a solvent in various sectors, including soap, cleaning compound, toilet preparation manufacturing, all other chemical product and preparation manufacturing, adhesive manufacturing, and printing ink manufacturing. In the soap, cleaning compound, and toilet preparation manufacturing sector, DBP can be used as a cleaner or degreaser (U.S. EPA, 2019b).

Examples of CDR Submissions

In the 2016 CDR cycle, one company reported the use of DBP as a solvent for cleaning or degreasing in soap, cleaning compound, and toilet preparation manufacturing. Additionally, one company reported the use of DBP in functional fluids for printing ink manufacturing, and two companies reported the use of DBP in the chemical product and preparation manufacturing sector (U.S. EPA, 2019b).

In the 2020 CDR cycle, one company reported the use of DBP as a solvent in adhesive manufacturing; this company also reported the use of DBP as a solvent in printing ink manufacturing. Additionally, one company reported the use of DBP in all other chemical product and preparation manufacturing (U.S. EPA, 2020a).

E.5 Processing – Incorporation into Formulation, Mixture, or Reaction Product – Pre-Catalyst Manufacturing

This COU refers to the preparation of a product; that is, the incorporation of DBP into formulation, mixture, or a reaction product which occurs when a chemical substance is added to a product (or product mixture) after its manufacture, for distribution in commerce.

DBP is used in pre-catalyst manufacturing prior to its use as a catalyst component for polyolefin manufacturing. As part of this process, DBP is included in the solids in the pre-catalyst at about 10 percent as a solid that is suspended in a solvent or an oil (W.R. Grace, 2024).

Examples of CDR Submissions

This use was not reported to EPA in the 2016 or 2020 CDR cycles.

E.6 Processing – Incorporation into Formulation, Mixture, or Reaction Product – Plasticizer in Paint and Coating Manufacturing; Plastic Material and Resin Manufacturing; Rubber Manufacturing; Soap, Cleaning Compound, and Toilet Preparation Manufacturing; Textiles, Apparel, and Leather Manufacturing; in Printing Ink Manufacturing; Basic Organic Chemical Manufacturing; and Adhesive and Sealant Manufacturing

This COU refers to the preparation of a product; that is, the incorporation of DBP into formulation, mixture, or a reaction product which occurs when a chemical substance is added to a product (or product mixture), after its manufacture, for distribution in commerce—in this case, processing of DBP as a plasticizer into several different products for use in multiple sectors.

In manufacturing of plastic material and resin through non-PVC and PVC compounding, DBP is blended into polymers. Compounding involves the mixing of the polymer with the plasticizer and other chemical such as, fillers and heat stabilizers. The plasticizer needs to be absorbed into the particle to impart flexibility to the polymer. For PVC compounding, compounding occurs through mixing of ingredients to produce a powder (dry blending) or a liquid (Plastisol blending). The most common process for dry blending involves heating the ingredients in a high-intensity mixer and transfer to a cold mixer. The Plastisol blending is done at ambient temperature using specific mixers that allow for the breakdown of the PVC agglomerates and the absorption of the plasticizer into the resin particle.

Examples of CDR Submissions

In the 2016 CDR cycle, use of DBP as a plasticizer was reported for the following sectors: three companies in paint and coating manufacturing; one company in plastics product manufacturing; one company in textiles, apparel, and leather manufacturing; one company in soap, cleaning compound, and toilet preparation manufacturing; one company in petrochemical manufacturing; one company in all other basic organic chemical manufacturing; and one company in plastics material and resin manufacturing (U.S. EPA, 2019b).

In the 2020 CDR cycle, one company reported the use of DBP as a plasticizer in plastics material and resin manufacturing; one company reported the use of DBP as a plasticizer in textiles, apparel, and leather manufacturing; and one company reported the use of DBP as a plasticizer in plastics product manufacturing (U.S. EPA, 2020a).

E.7 Processing – Incorporation into Article – Plasticizer in Adhesive and Sealant Manufacturing; Building and Construction Materials Manufacturing; Furniture and Related Product Manufacturing; Ceramic Powders; Plastics Product Manufacturing; and Rubber Product Manufacturing

This COU refers to the preparation of an article; that is, the incorporation of DBP into articles, meaning DBP becomes a component of the article, after its manufacture, for distribution in commerce. In this case, DBP is present in a raw material such as rubber or plastic that contains a mixture of plasticizers and other additives, and this COU refers to the manufacturing of PVC and non-PVC articles, including rubber, plastic, and miscellaneous articles using those raw materials. PVC articles are manufactured after the formation of a raw material that can contain a mixture of plasticizer and other additives. The raw material is converted by processes such as calendaring, extrusion, injection molding, and plastisol spread coating (ACC, 2020). This COU encompasses the step that occurs immediately after PVC compounding, where the compounded resin is sent to an extruder that shapes and sizes the plastic into an article or pellet to be used in downstream processing at PVC or non-PVC conversion sites (U.S. EPA, 2021e). DBP also is an additive in inks, which are then incorporated into textiles and articles (U.S. EPA, 2020c). This COU also includes the incorporation of the rubber or plastic and other articles into finished articles, such as electrical and electronic articles, machinery, mechanical appliances, fabric, textiles and leather articles, or furniture and furnishings. This COU also includes activities identified by the U.S. Department of Defense.

Plastisol technology or film calendaring technology is used in the production of plastic and rubber products such as textiles, apparel, and leather; vinyl tape; flexible tubes; profiles; and hoses (ACC, 2023).

In toy manufacturing, toys could contain up to 0.1 percent of DBP (U.S. EPA, 2019a). (The CPSC has a regulatory limit of no more than 0.1 percent for DBP concentration in toys.) Additionally, it is possible that DBP could be incorporated into playground equipment manufacturing due to its use as a plasticizer in PVC and non-PVC articles that may be components of playground equipment.

EPA expects that the use of DBP in textiles, apparel, and leather manufacturing is associated with PVC applications for durable vinyl articles, such as raincoats, boots, and gloves.

DBP is also reported to be used as a plasticizer in tapecasting for ceramic powders (NASA, 2020).

Examples of CDR Submissions

In the 2016 CDR cycle, use of DBP as a plasticizer was reported for the following sectors: one company in adhesive manufacturing; one company in rubber product manufacturing; and two companies in plastics product manufacturing. Additionally, one company reported use of DBP as an intermediate in asphalt paving, roofing, and coating materials manufacturing. EPA’s understanding is that DBP, if used as an intermediate for article manufacturing, likely is used as a plasticizer, which is why this CDR report was included under this COU (U.S. EPA, 2019b).

In the 2020 CDR cycle, use of DBP as a plasticizer was reported for the following sectors: one company in plastics material and resin manufacturing; one company in furniture and related product manufacturing and in construction; and one company in adhesives manufacturing and in plastics product manufacturing (U.S. EPA, 2020a).

E.8 Processing – Repackaging – Laboratory Chemicals in Wholesale and Retail Trade; Plasticizers in Wholesale and Retail Trade; and Plastics Material and Resin Manufacturing

Repackaging refers to the preparation of DBP for distribution in commerce in a different form, state, or quantity than originally received or stored by various industrial sectors, including wholesale and retail trade, laboratory chemicals manufacturing, and plastic material and resin manufacturing. This includes the transferring of a chemical substance from a bulk container into smaller containers. This COU would not apply to the relabeling or redistribution of a chemical substance without removing the chemical substance from the original container it was supplied in.

Examples of CDR Submissions

In the 2016 CDR cycle, two companies reported repackaging DBP as a plasticizer in wholesale and retail trade and one company reported repackaging DBP as a laboratory chemical (U.S. EPA, 2019b).

In the 2020 CDR cycle, two companies reported repackaging DBP as a plasticizer in wholesale and retail trade and plastic material and resin manufacturing (U.S. EPA, 2020a).

E.9 Processing – Recycling

This COU refers to the process of treating generated waste streams (*i.e.*, which would otherwise be disposed of as waste), containing DBP, that are collected, either on-site or at a third-party site, for commercial purpose (U.S. EPA, 2019b). DBP is primarily recycled industrially in the form of DBP-containing PVC waste streams. New PVC can be manufactured from recycled and virgin materials (Lowe et al., 2021).

Examples of CDR Submissions

In the 2016 CDR cycle, two companies reported recycling DBP (U.S. EPA, 2019b).

This use does not have CDR data reported for the 2020 cycle.

E.10 Distribution in Commerce

For purposes of assessment in this risk evaluation, distribution in commerce consists of the transportation associated with the moving of DBP or DBP-containing products and/or articles between sites manufacturing, processing, or recycling DBP or DBP-containing products and/or articles, or to final use sites, or for final disposal of DBP or DBP-containing products and/or articles. More broadly under TSCA, “distribution in commerce” and “distribute in commerce” are defined under TSCA section 3(5).

E.11 Industrial Use – Non-Incorporative Activities – Solvent, Including in Maleic Anhydride Manufacturing Technology

This COU refers to the DBP as it is used as a solvent in various industrial sectors. Specifically, this includes using DBP in the process of maleic anhydride manufacturing.

EPA understands that DBP is used in the manufacturing of maleic anhydride; however, DBP is not incorporated into the maleic anhydride product (Huntsman, 2024).

Examples of CDR Submissions

One company reported the use of DBP in non-incorporative activities in the 2016 CDR cycle (U.S. EPA, 2019b).

The use was reported again in the 2020 CDR cycle for "non-incorporative activities" under miscellaneous manufacturing, as an absorbent (U.S. EPA, 2020a).

E.12 Industrial Use – Construction, Paint, Electrical, and Metal Products – Adhesives and Sealants

This COU refers to DBP as it is used in various industrial sectors as a component of adhesive or sealant mixtures, meaning the use of DBP after it has already been incorporated into an adhesive and/or sealant product or mixture, as opposed to when it is used upstream, (*e.g.*, when DBP is processed into the adhesive and sealant formulation).

DBP is used in adhesives and sealant in the manufacture of automobiles (MEMA, 2019). DBP may be found in adhesives, potting compounds, sealants, and putties used in the manufacture, operations and maintenance of aerospace products (AIA, 2019). Specific application of DBP-containing adhesives in aerospace includes adhesives critical to electrical/circuit boards, and as a processing aid for crosslinking in cement for acrylic processing (AIA, 2019). DBP is a component of adhesives and sealants used in the testing test articles and human-rated spaceflight hardware (NASA, 2020). This COU also includes activities identified by the U.S. Department of Defense.

This use was not reported to EPA in the 2016 or 2020 CDR cycles.

E.13 Industrial Use – Construction, Paint, Electrical, and Metal Products – Paints and Coatings

This COU refers to the use of DBP in various industrial sectors as a component of industrial paints and coatings. This includes the use of DBP after it has already been incorporated into a paint or coating product or mixture, as opposed to when it is used upstream (*e.g.*, when DBP is processed into the paint or coating formulation).

DBP is used in coatings in the manufacture of automobiles (MEMA, 2019). DBP may be found in conductive and interior coatings used in the manufacture, operations, and maintenance of aerospace products (AIA, 2019). This COU also includes activities identified by the U.S. Department of Defense.

This use was not reported to EPA in the 2016 or 2020 CDR cycles.

E.14 Industrial Use – Other Uses – Automotive Articles

This COU refers to the use of DBP in the automobile manufacturing sector as a component in various automotive articles. This is a use of DBP after it has already been incorporated into a plastic article, as opposed to when it is used upstream (*e.g.*, when DBP is processed into an article).

DBP was identified in numerous components in the exterior and interior of the vehicle, the powertrain, the chassis, and the electrical system. DBP was identified in 391 parts, including those used in replacement parts. Some examples of parts are the passenger side seat buckle, the engine assembly, the trim panel assembly on the body of the door, and the center floor full console on the passenger side (MEMA, 2019). Based on DBP being found downstream in tire crumb applications for playgrounds and turf (Armada et al., 2022; U.S. EPA, 2019f), users may be handling DBP in tires for automobiles in industrial settings.

This use was not reported to EPA in the 2016 or 2020 CDR cycles.

E.15 Industrial Use – Other Uses – Lubricants and Lubricant Additives

This COU refers to the industrial use of DBP incorporated within lubricant products. DBP is used in products for industrial applications including synthetic lubricants and anti-seize compounds in automobile and aerospace applications (NASA, 2020; U.S. EPA, 2020d; MEMA, 2019). For the industrial use of these products, EPA expects them to be poured or applied by workers in factories and other industrial settings. This COU also includes activities identified by the U.S. Department of Defense.

This use was not reported to EPA in the 2016 or 2020 CDR cycles.

E.16 Industrial Use – Other Uses – Propellants

This COU refers to the industrial use of DBP incorporated into propellants. This COU encompasses incorporating DBP into a propellant, loading of that propellant into a cartridge, and TSCA use of said cartridge, *e.g.*, installing into aircraft ejection seats and use of aircraft ejection seats. DBP is included in some aerospace applications as a component of the propellant in aircraft ejection seats (AIA, 2019). DBP is also used by ammunition processors, although this COU does not include the use of ammunition (U.S. EPA, 2020a). DBP is used as a deterring agent in propellants where it coats the propellant granules and slows the combustion process so that the propellant burns slowly at first and increases gradually as the combustion process progresses (Liang et al., 2021).

This COU does not include use of dibutyl phthalate in propellants in articles, or components of articles subject to Section 4181 of the Internal Revenue Code of 1954; for example, ammunition, since such use is outside the scope of the definition of "chemical substance" TSCA section 3(2)(B)(v), is not being considered as a "condition of use" and will not be evaluated during risk evaluation (U.S. EPA, 2020c). This COU also includes activities identified by the U.S. Department of Defense.

Examples of CDR Submissions

In the 2020 CDR cycle, one company reported the use of DBP at an ammunition plant (U.S. EPA, 2020a).

E.17 Commercial Use – Automotive, Fuel, Agriculture, Outdoor Use Products – Automotive Care Products

This COU refers to the commercial use of DBP in automotive care products. This COU includes the use of DBP-containing products for automotive upkeep in a commercial setting.

DBP is used in various automotive product applications. EPA notes that this reporting code in the 2020 CDR cycle is intended to describe exterior car washes and soaps, exterior car waxes, polishes, and coatings, touch up paint, and interior car care products (U.S. EPA, 2022a).

Examples of CDR Submissions

In the 2020 CDR cycle, one company reported the use of DBP as a plasticizer in interior car care products. Another company reported the use of DBP in exterior car waxes, polishes, and coatings (U.S. EPA, 2020a).

E.18 Commercial Use – Construction, Paint, Electrical, and Metal Products – Adhesives and Sealants

This COU refers to the commercial use of DBP in adhesives and sealants. This includes the use of DBP-containing adhesives and sealants in a commercial setting, such as a business or non-industrial job site, such as an office, property owned by a client for which commercial services are being provided, or an auto shop, as opposed to upstream use of DBP (*e.g.*, when DBP-containing products are used in the manufacturing of construction products) or use in an industrial setting. This COU also includes activities identified by the U.S. Department of Defense.

Workers in a commercial setting generally apply adhesives and sealants that already have DBP incorporated as a plasticizer. Adhesives and sealants (which could also be fillers and putties) are highly malleable materials used to repair, smooth over or fill minor cracks in holds and buildings. EPA expects that commercial applications of adhesives and sealants containing DBP would occur using non-pressurized methods based on products identified in the marketplace for DBP and other similar chemicals.

EPA identified several commercially available (denoted as being possibly industrial, commercial, or consumer viable) adhesive products which contain DBP at various concentrations. These adhesive and sealants can be applied using a caulk gun (U.S. EPA, 2020e).

DBP is an additive in polyester, vinyl ester, or epoxy resin for in-place repairs to pipes such as water mains. Workers repair pipes in place by first inserting a resin-impregnated liner in the damaged pipe, then forcing steam, hot water, or ultraviolet light across the liner to cure the resin (U.S. EPA, 2020c).

DBP is used in adhesives and sealants in the manufacture of automobiles (MEMA, 2019). EPA expects that these types of products could also be used commercially in automobile repair applications.

Examples of CDR Submissions

In the 2016 CDR cycle, four companies reported the use of DBP in adhesives and sealants (U.S. EPA, 2019b).

In the 2020 CDR cycle, one company reported the use of DBP in hot-melt adhesives and one company reported the use of DBP in fillers and putties (U.S. EPA, 2020a).

E.19 Commercial Use – Construction, Paint, Electrical, and Metal Products – Paints and Coatings

This COU refers to the commercial use of DBP already incorporated as a plasticizer in paints and coatings.

EPA expects that some of these products are likely to be used for industrial applications; however, this COU only encompasses the products purchased by commercial operations and applied by professional contractors in various commercial settings. EPA also expects that compared to the industrial applications, these products would be used in smaller scale in commercial settings for similar purposes (*e.g.*, corrosion and water protection on structural components, residential construction). This COU encompasses solvent and water-based paints.

Examples of CDR Submissions

In the 2016 CDR cycle, three companies reported the use of DBP in paints and coatings (U.S. EPA, 2019b).

In the 2020 CDR cycle, one company reported the use of DBP in water-based paint and in solvent-based paint (U.S. EPA, 2020a).

E.20 Commercial Use – Furnishing, Cleaning, Treatment Care Products – Cleaning and Furnishing Care Products

This COU refers to the commercial use of DBP in cleaning and furnishing care products. The commercial users of products under this category would be expected to apply cleaning and furnishing care products that contain DBP either manually or with automated equipment (U.S. EPA, 2020c). EPA expects that the type of products reported under this COU are likely to be both commercial and consumer in nature; however, this COU encompasses only the commercial uses of the products. This COU also includes activities identified by the U.S. Department of Defense.

DBP may be present in cleaning and furnishing care products, such as glass window cleaning formulations, carpet and floor cleaners, spot removers, and shoe care products (U.S. EPA, 2020c). DBP was also reported as present in polishes/waxes and in alternative tub/tile cleaner (Dodson et al., 2012).

Examples of CDR Submissions

In the 2016 CDR cycle, two companies reported the use of DBP in cleaning and furnishing care products (U.S. EPA, 2019b).

E.21 Commercial Use – Furnishing, Cleaning, Treatment/Care Products – Floor Coverings; Construction and Building Materials Covering Large Surface Areas Including Stone, Plaster, Cement, Glass, and Ceramic Articles; Fabrics, Textiles, and Apparel

This COU refers to the commercial installation of floor covering containing DBP covering large surface areas including stone, plaster, cement, glass and ceramic articles; and fabrics, textiles, and apparel. DBP is expected to be already incorporated into floor coverings, and this COU describes handling and installing tiles, carpeting, etc.

DBP may be a constituent of various building/construction materials because of its use as a general-purpose plasticizer in PVC applications. EPA expects that certain building/construction materials that would be covered by this COU in commercial use would include items such as vinyl and PVC-backed carpeting, and other construction/building materials covering large surface areas.

Examples of CDR Submissions

In the 2016 CDR cycle, one company reported the use of DBP in floor coverings (U.S. EPA, 2019b). In the 2020 CDR cycle, one company reported the use of DBP as a plasticizer in construction and building materials covering large surface areas including stone, plaster, cement, glass, and ceramic articles; fabrics, textiles, and apparel (U.S. EPA, 2020a).

E.22 Commercial Use – Furnishing, Cleaning, Treatment Care Products – Furniture and Furnishings

This COU refers to the commercial use of DBP already incorporated into furniture and furnishings. This COU includes use of DBP already incorporated into furniture upholstery or in plastic materials to make furniture (U.S. EPA, 2020c).

This use was not reported to EPA in the 2016 or 2020 CDR cycles.

E.23 Commercial Use – Packaging, Paper, Plastic, and Hobby Products – Ink, Toner, and Colorant Products

This COU is refers to the commercial use of DBP in inks, toner, and colorants, that can be used in packaging, paper, plastic, toys, hobby products and articles. This COU also includes activities identified by the U.S. Department of Defense.

DBP is used in printing ink and pigments (U.S. EPA, 2020e). EPA expects that the majority of ink, toner, and colorant products containing DBP would be commercial in nature; however, it is possible that these products are used by consumers for commercial purposes as many of the commercial products are available for consumer purchasers through various online vendors. This COU encompasses only the commercial uses of these products by workers and consumer DIYers. EPA would expect the commercial uses of these products by consumer DIYers to be similar to typical applications in commercial printing and drafting shops, albeit on a smaller scale.

Examples of CDR Submissions

In the 2016 CDR cycle, one company reported the use of DBP in ink, toner, and colorant products (U.S. EPA, 2019b).

E.24 Commercial Use – Packaging, Paper, Plastic, and Hobby Products – Packaging (Excluding Food Packaging), Including Rubber Articles; Plastic Articles (Hard); Plastic Articles (Soft); Other Articles with Routine Direct Contact During Normal Use, Including Rubber Articles; Plastic Articles (Hard)

This COU refers to the commercial use of DBP in various plastic and rubber packaging and in soft and hard plastic articles and rubber articles. EPA notes that the CDR use code for "packaging (excluding food packaging), including rubber articles; plastic articles (hard); plastic articles (soft)" includes examples such as phone covers, personal tablet covers, styrofoam packaging, and bubble wrap. In addition, the CDR processing and use code for "other articles with routine direct contact during normal use including rubber articles; plastic articles (hard)" in the 2020 CDR cycle includes examples such as gloves, boots, clothing, rubber handles, gear lever, steering wheels, handles, pencils, and handheld device casing. This COU also includes activities identified by the U.S. Department of Defense.

The articles provided as examples under this code are likely to be both commercial and consumer in nature. This COU refers to the commercial use of these articles. Soft packaging containing DBP would be used during packaging of articles in commercial settings. Hard articles containing DBP would be used in commercial settings.

Examples of CDR Submissions

In the 2016 CDR cycle, two companies reported the use of DBP in plastic and rubber products not covered elsewhere, which is listed as both "packaging (excluding food packaging), including rubber articles; plastic articles (hard); plastic articles (soft)" and as "other articles with routine direct contact during normal use, including rubber articles; plastic articles (hard)" in the 2020 CDR cycle (U.S. EPA, 2019b).

E.25 Commercial Use – Packaging, Paper, Plastic, and Hobby Products – Toys, Playground, and Sporting Equipment

This COU refers to the commercial use of DBP in toys, playground, and sporting equipment. The COU includes the commercial installation, use, and maintenance of toys, playgrounds, and sporting equipment that contain DBP (such as in daycare or school environments by workers such as teachers or providers). This use refers to workers molding or otherwise fabricating articles already containing DBP into other articles for commercial and consumer applications, as well as during installation of sporting or playground equipment.

DBP can be used as a plasticizer to provide flexibility to toys. The Consumer Product Safety Improvement Act (CPSIA) of 2008 placed a prohibition on DBP that limited manufacturers' use of DBP in children's toys to 0.1 percent (U.S. EPA, 2019a). Toys containing DBP that were manufactured and/or processed prior to the CPSIA restriction in 2008 may still be in use. DBP is reported to be found downstream in tire crumb applications for playgrounds and turf, and this COU includes the commercial use of playgrounds and turf that contains DBP (U.S. EPA, 2019f).

This use was not reported to EPA in the 2016 or 2020 CDR cycles.

E.26 Commercial Use – Other Uses – Automotive Articles

This COU refers to the commercial use of DBP in automotive articles, which already have DBP incorporated into them. This COU refers to the use of DBP-containing automotive articles in a commercial setting, such as an automotive parts business or a worker driving a vehicle, as opposed to upstream use of DBP (*e.g.*, when DBP-containing products are used in the manufacturing of the automobile) or use in an industrial setting. This COU also includes activities identified by the U.S. Department of Defense.

DBP was identified in numerous components in the exterior and interior of the vehicle, the powertrain, the chassis, and the electrical system. DBP was identified in 391 parts, including those used in replacement parts. Some examples of parts are the passenger side seat buckle, the engine assembly, the trim panel assembly on the body of the door, and the center floor full console on the passenger side (MEMA, 2019). DBP is reported to be found downstream in tire crumb applications for playgrounds and turf (Armada et al., 2022; U.S. EPA, 2019f).

This use was not reported to EPA in the 2016 or 2020 CDR cycles.

E.27 Commercial Use – Other Uses – Laboratory Chemicals

This COU refers to the use of DBP as a laboratory chemical.

DBP can be used as a laboratory chemical such as a chemical standard or reference material during analyses. Some laboratory chemical manufacturers identify use of DBP as a certified reference material and research chemical.

Commercial use of laboratory chemicals may involve handling DBP by hand-pouring or pipette and either adding to the appropriate labware in its pure form to be diluted later or added to dilute other chemicals already in the labware. EPA expects that laboratory DBP products are pure DBP in neat liquid form. The Agency notes that the same applications and methods used for quality control can be applied in industrial and commercial settings.

Examples of CDR Submissions

In the 2016 CDR cycle, one company reported the use of DBP in laboratory chemicals (U.S. EPA, 2019b).

E.28 Commercial Use – Other Uses – Chemiluminescent Light Sticks

This COU refers to the commercial use of DBP incorporated into chemiluminescent light sticks, sometimes referred to colloquially as glow sticks. DBP is present in chemiluminescent light sticks as part of some Department of Defense applications (U.S. EPA, 2020d). This COU also includes activities identified by the U.S. Department of Defense.

This use was not reported to EPA in the 2016 or 2020 CDR cycles.

E.29 Commercial Use – Other Uses – Inspection Penetrant Kit

This COU refers to the commercial use of DBP incorporated in inspection penetrant kits. Inspection fluids or penetrants are used to reveal surface defects on metal parts, including cracks, folds, or pitting. Penetrant testing can be used to detect imperfections and flaws that are not detectable by the eye. DBP is present in inspection penetrant kits as part of some government Agency applications (U.S. EPA, 2020d). This COU also includes activities identified by the U.S. Department of Defense.

This use was not reported to EPA in the 2016 or 2020 CDR cycles.

E.30 Commercial Use – Other Uses – Lubricants and Lubricant Additives

This COU refers to the commercial use of lubricants and lubricant additives that contain DBP for commercial applications such as synthetic lubricants and anti-seize compounds in automobile and aerospace applications (NASA, 2020; U.S. EPA, 2020d; MEMA, 2019; Texacone, 2016). Lubricants and lubricant additives may be poured or applied by workers in auto repair and other maintenance shops.

This use was not reported to EPA in the 2016 or 2020 CDR cycles.

E.31 Consumer Use – Automotive, Fuel, Agriculture, Outdoor Use Products – Automotive Care Products

This COU refers to the consumer use of DBP in automotive care products. This COU includes the use of DBP-containing products in a consumer DIY setting.

DBP is used in various automotive product applications. EPA notes that this reporting code in the 2020 CDR cycle is intended to describe exterior car washes and soaps, exterior car waxes, polishes, and coatings, touch up paint, and interior car care (U.S. EPA, 2022a).

The consumer use was not reported to EPA in the 2016 or 2020 CDR cycles, but EPA expects the commercial automotive care products reported in the CDR cycles are available to consumers for use in a DIY setting.

E.32 Consumer Use – Construction, Paint, Electrical, and Metal Products – Adhesives and Sealants

This COU refers to the consumer use of DBP in adhesives and sealants, including fillers and putties.

EPA notes in the final scope that DBP is used as an adhesive and sealant (U.S. EPA, 2021c). The Agency expects that the use of these types of products would occur in commercial applications; however, EPA notes that this product are likely to be sourced by DIY consumers through various online vendors. DBP-containing adhesives and sealants are used in automotive applications (MEMA, 2019).

The Agency does expect the primary use of the automotive adhesives and sealants to be industrial and commercial in nature but the possibility for consumer use is still possible. This COU includes consumer DIYers who may perform exterior or interior car maintenance involving adhesives and sealants. Any product containing DBP which is applied as an undercover coating, would most likely be applied by spraying the coating on the underside of the vehicle.

Examples of CDR Submissions

In the 2016 CDR cycle, two companies reported the use of DBP in adhesives and sealants (U.S. EPA, 2019b).

In the 2020 CDR cycle, one company reported the use of DBP in fillers and putties (U.S. EPA, 2020a).

E.33 Consumer Use – Construction, Paint, Electrical, and Metal Products – Paints and Coatings

This COU refers to the consumer use of DBP in paints and coatings. Consumers generally use paints and coatings containing DBP in an indoor environment and DIYers handle the paints and coatings that have DBP incorporated into the product. DBP is used in a variety of paint and coating products and is often used as a surfactant in paints and coatings.

Examples of CDR Submissions

In the 2020 CDR cycle, one company reported the use of DBP in water-based paint and in solvent-based paint (U.S. EPA, 2020a).

E.34 Consumer Use – Furnishing, Cleaning, Treatment Care Products – Fabric, Textile, and Leather Products

This COU refers to the consumer use of DBP already incorporated as a plasticizer in fabric, textile, and synthetic leather products and/or articles. This COU includes consumer wear and use of DBP-containing textiles. EPA expects this COU to include consumer use of DBP in in apparel, including in cases where DBP has been incorporated into the fabric as a plasticizer.

The Washington State Department of Ecology identified 1,326 reports of DBP use in children's products, primarily in footwear between 2012 and 2019 (WSDE, 2023; U.S. EPA, 2020c).

Examples of CDR Submissions

This use was not reported to EPA in the 2016 or 2020 CDR cycle.

E.35 Consumer Use – Furnishing, Cleaning, Treatment/Care Products – Floor Coverings; Construction and Building Materials Covering Large Surface Areas Including Stone, Plaster, Cement, Glass, and Ceramic Articles; Fabrics, Textiles, and Apparel

This COU refers to the consumer use of DBP in solid flooring and construction and building materials. Consumers generally use flooring containing DBP in an indoor environment and DIYers handle the construction materials (*e.g.*, tiles, carpeting) that have DBP incorporated into the articles, which may involve cutting and shaping the articles for installation.

Examples of CDR Submissions

In the 2016 CDR cycle, one company reported the use of DBP in floor coverings (U.S. EPA, 2019b).

In the 2020 CDR cycle, one company reported the use of DBP as a plasticizer in construction and building materials covering large surface areas including stone, plaster, cement, glass, and ceramic articles; fabrics, textiles, and apparel (U.S. EPA, 2020a).

E.36 Consumer Use – Furnishing, Cleaning, Treatment/Care Products – Cleaning and Furnishing Care Products

This COU refers to the consumer use of cleaning and furnishing care products containing DBP. The consumer users of products under this category would be expected to manually apply cleaning and furnishing care products that contain DBP (U.S. EPA, 2020c).

DBP may be present in cleaning and furnishing care products, such as glass window cleaning formulations, carpet and floor cleaners, spot removers, and shoe care products (U.S. EPA, 2020c). EPA expects that the type of products reported under this COU are likely to be both commercial and consumer in nature; however, this COU refers to the consumer use only.

This use was not reported in the 2016 or 2020 CDR cycles.

E.37 Consumer Use – Packaging, Paper, Plastic, Hobby Products – Ink, Toner, and Colorant Products

This COU refers to the consumer use of DBP in inks, toner, and colorants, that can be used in packaging, paper, plastic, toys, hobby products and articles.

DBP is used in ink, toner, and colorant products, including coloring agents, printing inks, digital inks, and inks and toners used in the electronics industry (U.S. EPA, 2020c). EPA expects that the majority of ink, toner, and colorant products containing DBP would be commercial in nature; however, it is possible that these products are used by DIY consumers as many of the commercial products are available for consumer purchasers through various online vendors. This COU refers to the consumer use of these products. EPA would expect that if consumer DIYers were to use these products they would apply them in the same fashion as industrial users, on a smaller scale in a non-commercial setting.

This use was not reported to EPA in the 2016 or 2020 CDR cycles.

E.38 Consumer Use – Packaging, Paper, Plastic, Hobby Products – Packaging (Excluding Food Packaging), Including Rubber Articles; Plastic Articles (Hard); Plastic Articles (Soft); Other Articles with Routine Direct Contact During Normal Use, Including Rubber Articles; Plastic Articles (Hard)

This COU refers to the consumer use of DBP in various packaging, paper, plastic, and hobby products.

EPA notes that this use was reported as plastic and rubber products not covered elsewhere in the 2016 CDR reporting cycle and is intended to describe products such as phone covers, personal tablet covers, styrofoam packaging, and bubble wrap. EPA also expects that the type of products reported under this COU are likely to be both commercial and consumer in nature. This COU refers to the consumer use of these products.

Examples of CDR Submissions

In the 2016 CDR cycle, two companies reported the use of DBP in plastic and rubber products not covered elsewhere, which is listed as both "packaging (excluding food packaging), including rubber articles; plastic articles (hard); plastic articles (soft)" and as "other articles with routine direct contact during normal use, including rubber articles; plastic articles (hard)" in the 2020 CDR cycle (U.S. EPA, 2019b).

E.39 Consumer Use – Packaging, Paper, Plastic, Hobby Products – Toys, Playground, and Sporting Equipment

This COU refers to the consumer use of DBP in toys, playground, and sporting equipment. The COU includes the consumer use or storage of toys, playgrounds, and sporting equipment that contain DBP. The use also refers to the DIY building of home sporting equipment.

DBP can be used as a plasticizer to provide flexibility to toys. The Consumer Product Safety Improvement Act (CPSIA) of 2008 placed a prohibition on DBP that limited manufacturers' use of DBP in children's toys to 0.1 percent (U.S. EPA, 2019a). Toys containing DBP that were manufactured and/or processed prior to the CPSIA restriction in 2008 may still be in use. DBP is reported to be found downstream in tire crumb applications for playgrounds and turf (U.S. EPA, 2019f).

The consumer use was not reported to EPA in the 2016 or 2020 CDR cycles, but EPA expects the commercial toys, playground, and sporting equipment reported in the CDR cycles are available to consumers for use.

E.40 Consumer Use – Other Use – Automotive Articles

This COU refers to the consumer use of DBP in automotive articles. This COU includes the use of DBP-containing automotive articles in a consumer DIY setting or by consumers driving a vehicle.

DBP is used in various automotive applications. DBP is used in auto parts and equipment maintenance (MEMA, 2019). DBP was identified in 391 auto parts. In total, in the IMDS data system, DBP is listed in approximately 76,000 parts. These parts are found spread throughout the body/exterior, the interior, the powertrain, the chassis, and the electrical system, and include fuel tank assemblies, hose assemblies, wiring and computers, seat parts, and mats and carpeting (MEMA, 2019). DBP is reported to be found downstream in tire crumb applications for playgrounds and turf (Armada et al., 2022; U.S. EPA, 2019f). Consumers may be exposed to tires when handling tires for replacement on automobiles.

This use was not reported to EPA in the 2016 or 2020 CDR cycles.

E.41 Consumer Use – Other Uses – Chemiluminescent Light Sticks

This COU refers to the consumer use of DBP incorporated into chemiluminescent light sticks, sometimes referred to colloquially as glow sticks. EPA was notified that DBP is present in chemiluminescent light sticks as part of some governmental applications (U.S. EPA, 2020d). Chemiluminescent light sticks are also available to consumers and are typically advertised as "glow sticks;" the North Carolina poison control cites glow sticks containing DBP as a health hazard for consumers (NC Poison Control, 2023).

The consumer use was not reported to EPA in the 2016 or 2020 CDR reporting cycles.

E.42 Consumer Use – Other Uses – Lubricants and Lubricant Additives

This COU refers to the consumer use of DBP incorporated within lubricant products. DBP is used in products for consumer applications including synthetic lubricants and anti-seize compounds in automotive applications (NASA, 2020; U.S. EPA, 2020d; MEMA, 2019). EPA expects that the type of products for automotive applications reported under this COU are likely to be both commercial and consumer in nature. This COU encompasses only the consumer use of these products. For the consumer use of these products, EPA expects them to be poured or applied by consumers as part of DIY auto repair activities.

This use was not reported to EPA in the 2016 or 2020 CDR cycles.

E.43 Consumer Use – Other – Novelty Articles

This COU refers to the consumer use of DBP in adult novelty articles.

This COU is describing adult sex toys that are available for consumer use in the United States. Although the U.S. Food and Drug Administration (FDA) classifies certain sex toys (such as vibrators) as obstetrical and gynecological therapeutic medical devices, many manufacturers label these products "for novelty use only" and are not subject to the FDA regulations (Stabile, 2013). This same study indicated tested concentrations of phthalates between 24 and 49 percent of the tested sex toys for creating a softer, more flexible plastic (Stabile, 2013), and EPA assumed that the concentration of DBP in these products to be analogous to the overall content of the mix of phthalates tested and found in this study.
This use was not reported to EPA in the 2016 or 2020 CDR cycles.

E.44 Disposal

For purposes of the DBP risk evaluation, this COU refers to the DBP in a waste stream that is collected from facilities and households and are unloaded at and treated or disposed at third-party sites. Each of the COUs of DBP may generate waste streams of the chemical. This COU also encompasses DBP contained in wastewater discharged by consumers or occupational users to POTW or other, non-POTW for treatment, as well as other wastes. DBP is expected to be released to other environmental media, such as introductions of biosolids to soil or migration to water sources and through waste disposal (*e.g.*, disposal of formulations containing DBP, plastic and rubber products, textiles, and transport containers). Disposal may also include destruction and removal by incineration (U.S. EPA, 2021b). Additionally, DBP has been identified in *EPA's Hydraulic Fracturing for Oil and Gas: Impacts from the Hydraulic*

Fracturing Water Cycle on Drinking Water Resources in the United States, December 2016 document to be a chemical reported to be detected in produced water, which is subsequently disposed (U.S. EPA, 2016a). Recycling of DBP and DBP-containing products is considered a different COU. Environmental releases from industrial sites are assessed in each COU and are not considered as part of the Disposal COU. Activities and releases associated with the use of DBP in propellants in articles, or components of articles subject to Section 4181 of the Internal Revenue Code of 1954, which are outside the scope of the definition of "chemical substance" TSCA section 3(2)(B)(v), are not considered as part of the Disposal COU.

Activities and releases associated with the use of dibutyl phthalate in propellants in articles, or components of articles subject to Section 4181 of the Internal Revenue Code of 1954, which are outside the scope of the definition of "chemical substance" TSCA section 3(2)(B)(v), are not considered as part of the disposal COU.

Appendix F DRAFT OCCUPATIONAL EXPOSURE VALUE DERIVATION

EPA has calculated a draft 8-hour existing chemical occupational exposure value to summarize the occupational exposure scenario and sensitive health endpoints into a single value. This calculated draft value may be used to support risk management efforts for DBP under TSCA section 6(a), 15 U.S.C. § 2605. EPA calculated the draft value rounded to 0.6 mg/m^3 for inhalation exposures to DBP as an 8-hour time-weighted average (TWA) and for consideration in workplace settings (see Appendix F.1) based on the acute, non-cancer human equivalent concentration (HEC) for developmental toxicity (*i.e.*, decreased fetal testicular testosterone).

TSCA requires risk evaluations to be conducted without consideration of costs and other non-risk factors, and thus this draft occupational exposure value represents a risk-only number. If risk management for DBP follows the finalized risk evaluation, EPA may consider costs and other non-risk factors, such as technological feasibility, the availability of alternatives, and the potential for critical or essential uses. Any existing chemical exposure limit used for occupational safety risk management purposes could differ from the draft occupational exposure value presented in this appendix based on additional consideration of exposures and non-risk factors consistent with TSCA section 6(c).

This calculated draft value for DBP represents the exposure concentration below which exposed workers and ONUs are not expected to exhibit any appreciable risk of adverse toxicological outcomes, accounting for PESS. It is derived based on the most sensitive human health effect (*i.e.*, decreased fetal testicular testosterone) and exposure duration (*i.e.*, acute) relative to benchmarks and a standard occupational scenario assumption of an 8-hour workday.

EPA expects that at the draft occupational exposure value of 0.05 ppm (0.6 mg/m^3), a worker or ONU also would be protected against developmental toxicity from intermediate and chronic duration occupational exposures if ambient exposures are kept below this draft occupational exposure value. The Agency has not separately calculated a draft short-term (*i.e.*, 15-minute) occupational exposure value because EPA did not identify hazards for DBP associated with this very short duration.

NIOSH 5020 and OSHA 104 analytical methods can be used for detecting DBP in air.

The Occupational Safety and Health Administration (OSHA) set a permissible exposure limit (PEL) as an 8-hour TWA for DBP of 5 mg/m^3 (OSHA, 2020). EPA located several occupational exposure limits for DBP (CASRN 84-74-2) in other countries (IFA, 2022). Identified 8-hour TWA values ranged from 0.58 mg/m^3 in Germany, New Zealand, and Poland to 10 mg/m^3 in South Africa. Additionally, EPA found that New Zealand and the United Kingdom have an established occupational exposure limit of 0.58 and 5 mg/m^3 (8-hour TWA) in each country's code of regulation that is enforced by each country's worker safety and health agency.

F.1 Draft Occupational Exposure Value Calculations

This appendix presents the calculations used to estimate draft occupational exposure values using inputs derived in this draft risk evaluation. Multiple values are presented below for hazard endpoints based on different exposure durations. For DBP, the most sensitive occupational exposure value is based on non-cancer developmental effects and the resulting 8-hour TWA is rounded to 0.6 mg/m^3.

Draft Acute Non-Cancer Occupational Exposure Value

The draft acute occupational exposure value (EV_{acute}) was calculated as the concentration at which the acute MOE would equal the benchmark MOE for acute occupational exposures using Equation_Apx F-1:

Equation_Apx F-1.

$$EV_{acute} = \frac{HEC_{acute}}{Benchmark\ MOE_{acute}} * \frac{AT_{HECacute}}{ED} * \frac{IR_{resting}}{IR_{workers}} =$$

$$\frac{1.0\ ppm}{30} * \frac{\frac{24h}{d}}{\frac{8h}{d}} * \frac{0.6125\frac{m^3}{hr}}{1.25\frac{m^3}{hr}} = 0.05\ ppm$$

$$EV_{acute}\left(\frac{mg}{m^3}\right) = \frac{EV\ ppm * MW}{Molar\ Volume} = \frac{0.05\ ppm * 278.35\frac{g}{mol}}{24.45\ \frac{L}{mol}} = 0.6\ \frac{mg}{m^3}$$

Draft Intermediate Non-Cancer Occupational Exposure Value

The draft intermediate occupational exposure value ($EV_{intermediate}$) was calculated as the concentration at which the intermediate MOE would equal the benchmark MOE for intermediate occupational exposures using Equation_Apx F-2:

Equation_Apx F-2.

$$EV_{intermediate} = \frac{HEC_{intermediate}}{Benchmark\ MOE_{intermediate}} * \frac{AT_{HEC\ intermediate}}{ED*EF} * \frac{IR_{resting}}{IR_{workers}}$$

$$= \frac{1.0\ ppm}{30} * \frac{\frac{24h}{d} * 30d}{\frac{8h}{d} * 22d} * \frac{0.6125\frac{m^3}{hr}}{1.25\frac{m^3}{hr}} = 0.07\ ppm = 0.8\ \frac{mg}{m^3}$$

Draft Chronic Non-Cancer Exposure Value

The draft chronic occupational exposure value ($EV_{chronic}$) was calculated as the concentration at which the chronic MOE would equal the benchmark MOE for chronic occupational exposures using Equation_Apx F-3:

Equation_Apx F-3.

$$EV_{chronic} = \frac{HEC_{chronic}}{Benchmark\ MOE_{chronic}} * \frac{AT_{HEC\ chronic}}{ED*EF*WY} * \frac{IR_{resting}}{IR_{workers}}$$

$$= \frac{1.0\ ppm}{30} * \frac{\frac{24h}{d}*\frac{365d}{y}*40\ y}{\frac{8h}{d}*\frac{250d}{y}*40\ y} * \frac{0.6125\frac{m^3}{hr}}{1.25\frac{m^3}{hr}} = 0.07\ ppm = 0.8\ \frac{mg}{m^3}$$

Where:

AT_{hecate}	=	Averaging time for the POD/HEC used for evaluating non-cancer acute occupational risk based on study conditions and HEC adjustments (24 h/day).
$AT_{HECintermediate}$	=	Averaging time for the POD/HEC used for evaluating non-cancer intermediate occupational risk based on study conditions and/or any HEC adjustments (24 h/day for 30 days).
$AT_{HECchronic}$	=	Averaging time for the POD/HEC used for evaluating non-cancer chronic occupational risk based on study conditions and/or HEC adjustments (24 h/day for 365 days/year) and assuming the same number of years as the high-end working years (WY, 40 years) for a worker.
$Benchmark\ MOE_{acute}$	=	Acute non-cancer benchmark margin of exposure, based on the total uncertainty factor of 30
$Benchmark\ MOE_{intermediate}$	=	Intermediate non-cancer benchmark margin of exposure, based on the total uncertainty factor of 30
$Benchmark\ MOE_{chronic}$	=	Chronic non-cancer benchmark margin of exposure, based on the total uncertainty factor of 30
EV_{acute}	=	Acute occupational exposure value
$EV_{intermediate}$	=	Intermediate occupational exposure value
$\mathrm{EV}_{\mathrm{chronic}}$	=	Chronic occupational exposure value
ED	=	Exposure duration (8 h/day)
EF	=	Exposure frequency (1 day for acute, 22 days for intermediate, and 250 days/year for chronic and lifetime)
HEC	=	Human equivalent concentration for acute, intermediate, or chronic non-cancer occupational exposure scenarios
IR	=	Inhalation rate (default is 1.25 m^3/h for workers and 0.6125 m^3/h assumed from “resting” animals from toxicity studies)
$Molar\ Volume$	=	24.45 L/mol, the volume of a mole of gas at 1 atm and 25 °C
MW	=	Molecular weight of DBP (278.35 g/mole)
WY	=	Working years per lifetime at the 95th percentile (40 years).

Unit conversion:
1 ppm = 11.38 mg/m^3 (see equation associated with the EV_{acute} calculation)