



Work Plan Implementation:

1,4-Dioxane in Personal Care and Cleaning Products

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Prepared by

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Safer Products and Workplaces Program

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Introduction

The Safer Consumer Products regulations define the process and criteria used by the Department of Toxic Substances Control (DTSC) to evaluate consumer products for possible designation as Priority Products. In that process, DTSC issues a Priority Product Work Plan (Work Plan) identifying the product categories to evaluate over a three-year period. DTSC then considers the product categories through the lens of the Work Plan’s stated policy goals (Figure 1).

Since issuing the 2018-2020 Work Plan,¹ DTSC has conducted a review of product categories, chemicals, and chemical classes that align with our policy goals. This document summarizes our preliminary findings on 1,4-dioxane in two of the Work Plan’s product categories – beauty, personal care, and hygiene products and cleaning products – and describes our concerns. Publication of this document signals the beginning of a dialogue with interested stakeholders, including manufacturers, nonprofit organizations, governments, and academia, to inform DTSC on the potential listing of specific consumer products containing 1,4-dioxane as one or more Priority Products subject to the requirements of the Safer Consumer Products regulations.

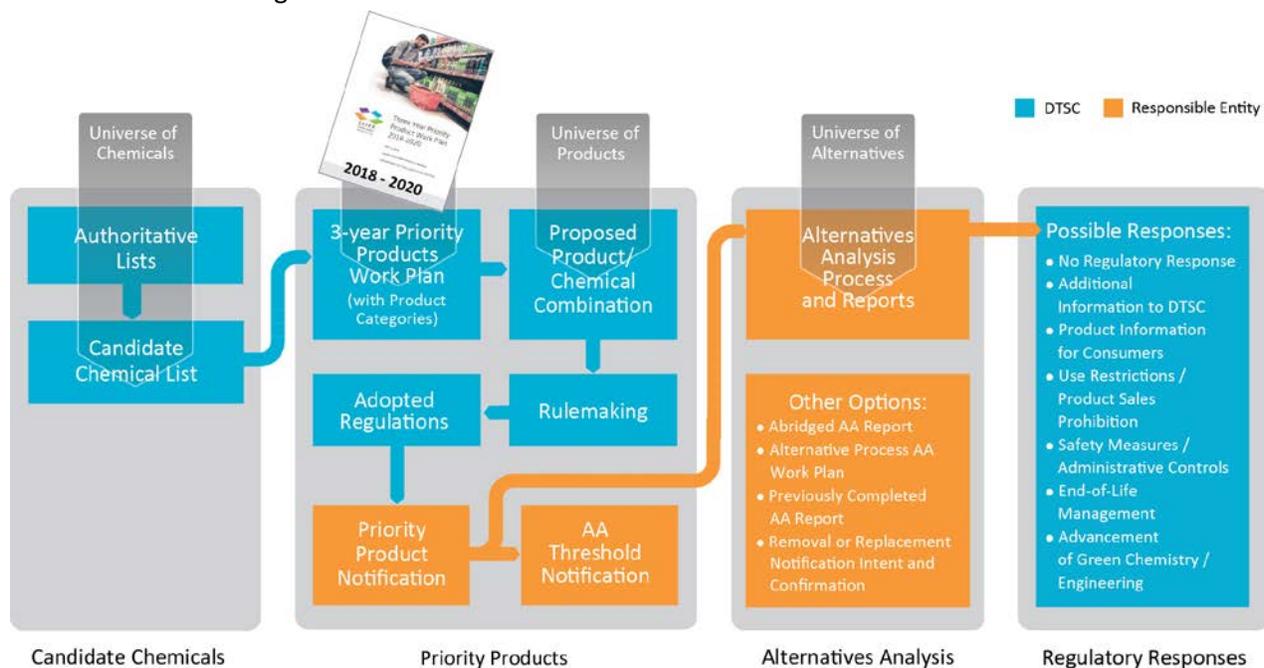


Figure 1. An overview of the Safer Consumer Products regulations.

BACKGROUND

DTSC's 2018-2020 Priority Product Work Plan¹ adopted policy goals to guide DTSC in prioritizing Priority Products. In considering the product categories in the Work Plan and our policy goals, DTSC identified 1,4-dioxane, a contaminant in certain beauty, personal care, hygiene, and cleaning products, as a Candidate Chemical that may warrant further research. 1,4-Dioxane addresses two policy goals in the Work Plan:

- the protection of children from exposure to harmful chemicals, especially carcinogens; and
- the protection of California's valuable and limited water resources.

1,4-Dioxane is a likely human carcinogen² that is highly mobile and persistent in water³ and is not removed by most standard forms of wastewater and drinking water treatment.⁴ DTSC is concerned about the potential adverse impacts to Californians, especially children and environmental justice communities, from exposure to 1,4-dioxane. Many personal care and cleaning products are washed down the drain during or after use, releasing 1,4-dioxane into wastewater. Removing 1,4-dioxane from wastewater is difficult and expensive, making it hard for California to beneficially reuse wastewater for drinking water.

DTSC is requesting additional information from stakeholders about potential adverse impacts from 1,4-dioxane in consumer products; its presence in personal care and cleaning products; and the feasibility of removing it from these products. Please see the **Questions to Stakeholders** section below for specific questions.

PRELIMINARY SCREENING RESULTS

Presence in Products

1,4-Dioxane is generated during production of ethoxylated surfactants and other raw materials often found in products such as shampoo, body wash, dish detergent, and laundry detergent.^{4,5} These products fall under the Work Plan's categories of beauty, personal care, and hygiene products, and cleaning products.

Hazard Traits

Public health agencies widely agree that 1,4-dioxane is a "likely"² or "possible"⁶ human carcinogen because it can cause cancer in multiple species of laboratory mammals exposed through ingestion or inhalation.^{2,7} Tumors arise in multiple organs in animals, so the carcinogenicity is likely based on multiple modes of action.^{3,6-8}

1,4-Dioxane is readily soluble and persistent in water.³ Due to its small molecular size and chemical properties, 1,4-dioxane does not stick to solids such as sludge, sediment, or carbon filters, and is not removed by most wastewater and drinking water treatment processes.

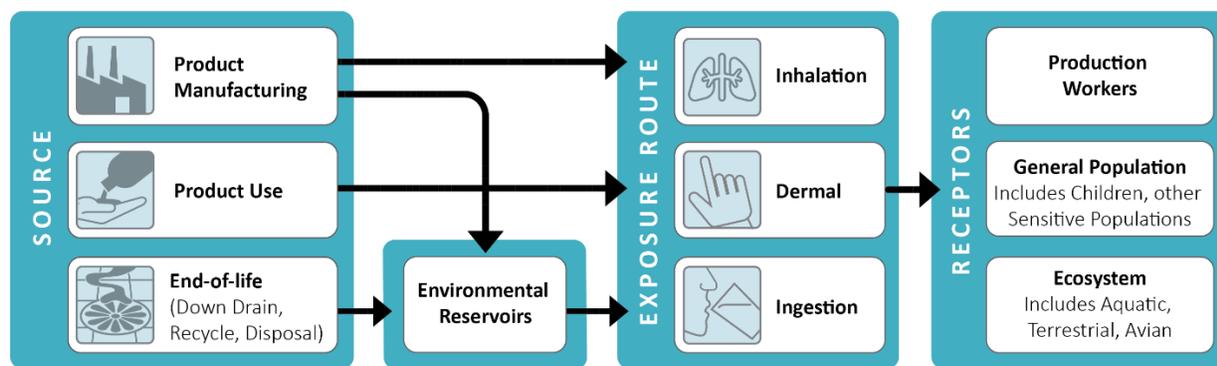


Figure 2. An overview of the 1,4-dioxane exposure pathways, with an emphasis on exposures related to the presence of 1,4-dioxane in consumer products. Environmental reservoirs include air, soil, and water reservoirs, and is inclusive of multiple subcategories such as landfills, wastewater treatment plants, drinking water, groundwater, and surface water. See Figure 4 for more details.

Exposure

1,4-Dioxane is present in many consumer products frequently used in the household and workplace. Most of the 1,4-dioxane in personal care and cleaning products frequently enters wastewater after product use (Figures 2 and 4). Industrial discharge often represents the largest source of 1,4-dioxane in wastewater, but consumer products contribute to continuous, low-level, widespread contamination of municipal wastewater with 1,4-dioxane when they are washed down the drain after use.⁹ Treated wastewater can contribute to 1,4-dioxane contamination of both surface water and groundwater used for drinking water.⁴ Additionally, treated wastewater is increasingly being beneficially reused for drinking water production.

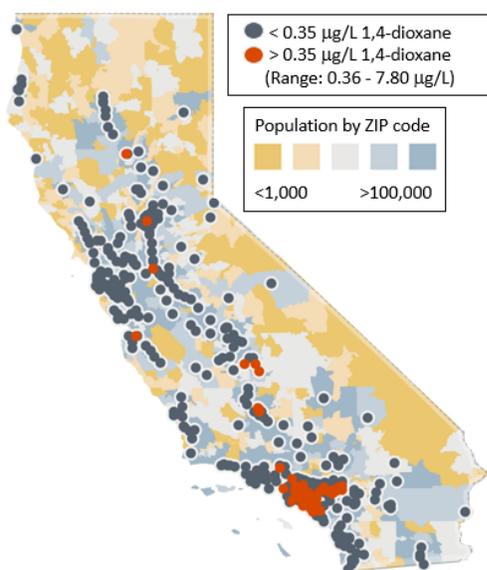


Figure 3. 1,4-Dioxane in California drinking water by ZIP code from UCMR3 (2013-2015).¹²

Exposure to 1,4-dioxane from drinking contaminated water is expected to be the dominant exposure pathway for the general human population.¹⁰ People are also exposed to a small amount of 1,4-dioxane during the use of contaminated consumer products. While the majority of 1,4-dioxane in drinking water is due to historical contamination of groundwater,¹¹ consumer products can also contribute to ongoing drinking water contamination when treated wastewater is released to groundwater and surface water or is used as a source of drinking water (Figure 4).^{4,9,11} Children, people with liver disease, and environmental justice communities that are already subject to other types of environmental pollution are of most concern for impacts from 1,4-dioxane in California. The major pathways for these potential exposures are illustrated in Figure 4.

Drinking water data collected across California for the U.S. Environmental Protection Agency's (U.S. EPA) third Unregulated Contaminant Monitoring Rule (UCMR3) indicates widespread exposure to 1,4-dioxane (Figure 3).¹² Detections of the chemical above the U.S. EPA's health-based reference concentration (0.35 micrograms per liter ($\mu\text{g/L}$), indicated by red circles in Figure 3)² and the State Water Resources Control

Board’s (State Water Board) notification level (1 µg/L)¹³ are concentrated in highly populated counties that represent at least 48 percent of the state’s population (Table 1)¹⁴ and contain many disadvantaged communities.¹⁵ Data from the State Water Board reflect similar trends in drinking water detections concentrated in these counties (Table 1).¹⁶

Potential for Adverse Impacts

Adverse impacts from exposure to 1,4-dioxane may be significant due to combined exposure from product use and drinking water. This is of particular concern for children and those with liver disease,¹⁷ who may be more sensitive to exposure to 1,4-dioxane than the general population. Environmental justice communities, which are already subject to socioeconomic and health stressors and other types of pollution,¹⁸ may be particularly impacted by the additional exposure to 1,4-dioxane from consumer products. As described above and in Figure 3, 1,4-dioxane contamination of drinking water in some of these communities exceeds levels of concern established by the U.S. EPA and the State Water Board.

County	Max. detect (µg/L)	% of CA Population
Los Angeles	53	26%
Orange	26.7	8%
Santa Barbara	16	1%
Monterey	3.9	1%
San Diego	1.2	8%
Sacramento	1.1	4%

Table 1. Maximum detections of 1,4-dioxane in drinking water data from the State Water Board (2003-2018).¹⁶

The presence of 1,4-dioxane in wastewater may also adversely impact California’s valuable and limited water resources. Contamination of wastewater with 1,4-dioxane has required local water agencies to use specialized, costly treatments to meet 1,4-dioxane-related permit criteria.¹⁹ This could interfere with California’s ability to beneficially reuse wastewater for drinking water if agencies can’t meet these criteria. These challenges and associated costs will undoubtedly increase as the state works to beneficially reuse a larger portion of wastewater.²⁰

Next Steps

Alternatives Analysis Threshold

The Safer Consumer Products regulations require DTSC to set an Alternatives Analysis Threshold (AAT) for contaminants such as 1,4-dioxane in proposed Priority Products. When a contaminant is present at concentrations below that threshold, manufacturers are required to submit an AAT Notification instead a full Alternatives Analysis Report. To establish an AAT for 1,4-dioxane, DTSC needs to understand how completely 1,4-dioxane can be removed from products, or from ethoxylated ingredients, using available removal technologies. We must also understand the lowest level that can be reliably detected in products and ethoxylated ingredients. DTSC will seek stakeholder input on these topics at a public meeting in Sacramento and will consider this input along with our research results in setting an AAT.

Public Engagement

DTSC is asking stakeholders to address the questions listed in Themes 1-3 below. Written comments can be submitted via the online information management system, [CalSAFER](#). In addition, DTSC will have two public meetings with stakeholders and invited participants:

- The first will be on Friday, June 28, in Whittier, California, and will focus on questions in Theme 1 regarding potential adverse impacts from the presence of 1,4-dioxane in consumer products. The

agenda will include time for presentations by interested stakeholders. If you are interested in presenting at this meeting, please contact Anne-Cooper Doherty at anne.doherty@dtsc.ca.gov or 916-324-1088 by Monday, June 10.

- The second will be held in Sacramento, California, on Wednesday, August 21. It will focus on Themes 2 and 3 related to the presence of 1,4-dioxane in consumer products and factors that could inform an AAT. This meeting will include a panel discussion as well as a time for public comment.

Additional details about these public meetings will be available on our [Workshops and Events Webpage](#). We will close our comment period following the second public meeting. This stakeholder engagement process will help inform additional research that may result in the proposal of one or more Priority Products. Please monitor our [Priority Products Work Plan Implementation webpage](#) for updates on this topic.

QUESTIONS TO STAKEHOLDERS

Theme 1. Potential 1,4-dioxane adverse impacts

- Are there indicators of adverse impacts to public health or the environment as a result of 1,4-dioxane in personal care and cleaning products?
- What concerns exist about the presence of 1,4-dioxane in wastewater?
- What challenges does 1,4-dioxane pose to California's ability to beneficially reuse wastewater or produce drinking water?

Theme 2. Presence of 1,4-dioxane in personal care and cleaning products

- What types of personal care and cleaning products, including household and commercial/institutional uses, are contaminated with 1,4-dioxane, and which types have the highest levels?
- What levels of 1,4-dioxane are present in personal care and cleaning products in California? Do these levels vary across price ranges or markets within California?
- What alternatives to ethoxylated surfactants are currently available for personal care and cleaning products? What are the challenges associated with using non-ethoxylated surfactant alternatives in these product categories?

Theme 3. Alternatives Analysis Threshold

- How well can 1,4-dioxane generation be controlled during production of ethoxylated ingredients?
- What are the best approaches to remove 1,4-dioxane from surfactants or other ingredients in personal care and cleaning products?
- Can 1,4-dioxane be completely removed from ethoxylated ingredients used in personal care and cleaning products? If not, what is the minimum level achievable?
- What is the minimum level of 1,4-dioxane that is consistently achievable in personal care and cleaning products, both those that contain ethoxylated ingredients and those that do not?

- What methods are currently available for measuring 1,4-dioxane in formulated consumer products? What is the lowest reliably quantifiable level of 1,4-dioxane that can be determined in products using these methods?

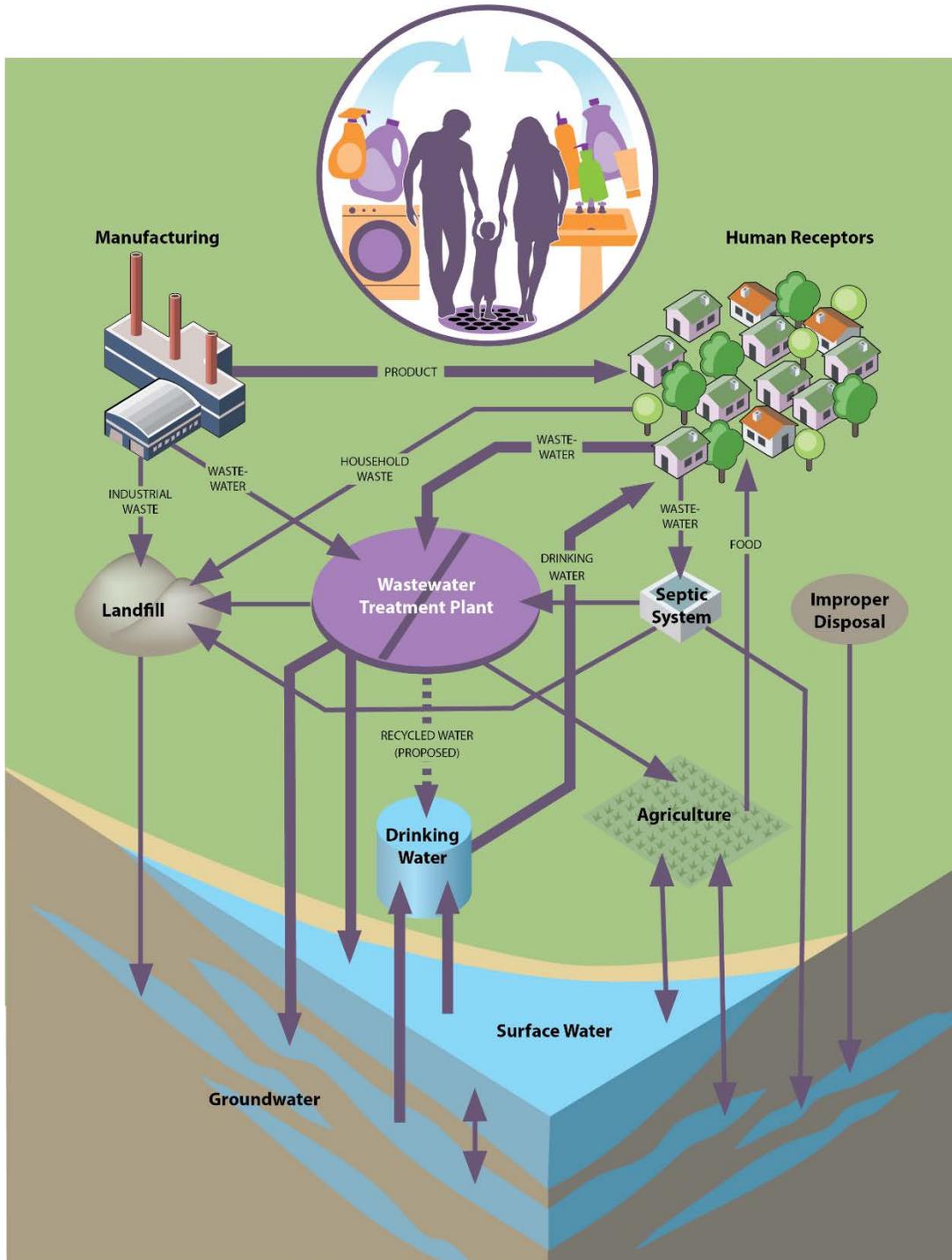


Figure 4. Exposure pathways of 1,4-dioxane, focusing on exposures most relevant for consumer products. Bold arrows emphasize the potential impacts of consumer products on the drinking water exposure pathway. The dotted line relates to the future direct use of treated wastewater as drinking water.

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