State of Illinois
Environmental Protection Agency

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2024 Microplastics Report

Illinois Environmental Protection Agency

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Introduction

This report aims to provide a comprehensive overview of the Illinois Environmental Protection Agency's (Illinois EPA) efforts to address the issue of microplastics in the state, as mandated by Public Act 103-0093, effective in the 2023 legislative session. In compliance with the Environmental Protection Act, Section 13.10, the Illinois EPA is required to make publicly available detailed information on the impacts of microplastics on aquatic life and human life, including descriptions of microplastics, federal and state regulatory actions, contact information for public inquiries, and links to reputable resources. This report encompasses an analysis of Agency actions related to microplastics, comparative analyses of actions in other states, and the latest guidance from the United States Environmental Protection Agency (U.S. EPA). This report seeks to fulfill these requirements by presenting current knowledge, regulatory actions, and strategies regarding microplastics and their impact on the environment.

Background and Sources of Microplastics

Microplastics are tiny plastic particles, between 1 nanometer (nm) and 5 millimeters (mm) in size, that have become a growing environmental concern due to their impact on human and ecological health. Particles larger than 5 mm are classified as macroplastics, while those smaller than 1nm are considered nanoplastics. Microplastics can be divided into two categories:

- **Primary microplastics:** These are manufactured in small sizes for specific uses, such as in cosmetics, glitter, and industrial coatings. Nurdles, small plastic pellets, are an example of this and are often used in manufacturing other products.
- **Secondary microplastics:** These result from the breakdown of larger plastic items, such as bottles and packaging, through environmental wear. Secondary microplastics make up the majority of microplastics found in the natural environment. They can also include fibers shed from synthetic textiles and clothing, or particles from the breakdown of tires on road surfaces.

Size is the only common parameter for microplastics since chemical composition and shape can differ extensively. The type of material the plastic is made from and method used to make the different types of plastic polymers results in a variety of additives, colorants, and other toxicants in a single piece of plastic. Plastic particles can take on countless shapes given their versatility of use: fibers, films, foams, beads or spheres, pellets, and fragments. The shape of secondary microplastics is influenced by the material it is made from, type of weathering, and time spent in the natural environment.

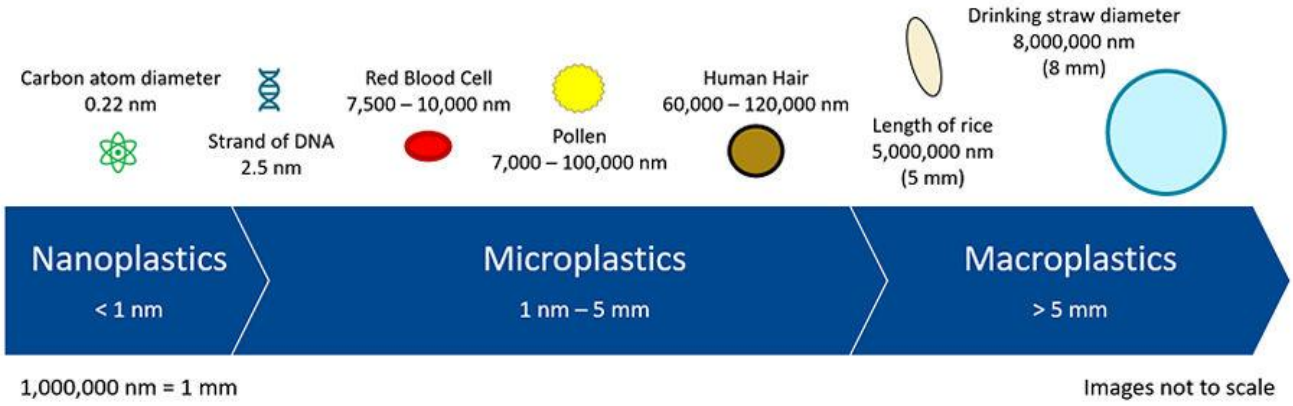

Figure 1. Examples of items comparable in size to microplastics.

Commercial production of plastics began almost a century ago and has been increasing ever since. Demand for a variety and number of plastic products increased during this time, and so did plastic waste. Plastic waste is estimated to have increased from 390,000 U.S. tons in 1960 to over 35 million U.S. tons in 2018 [U.S. EPA, 2024]. As a result, microplastics have been found across the globe in wildlife such as birds and fish, and in all environmental media.

Routes of Exposure

Various factors influence how microplastics degrade, including the type of plastic, environmental conditions, and the time it spends exposed to elements like water or sunlight.

Microplastics now contaminate natural environments worldwide, affecting wildlife and potentially entering human bodies through ingestion or inhalation.

Exposure pathways include:

- **Ingestion:** Microplastics are consumed when they contaminate food and water.
- **Inhalation:** Microplastic particles can enter the lungs through breathing, where they may have adverse health effects.

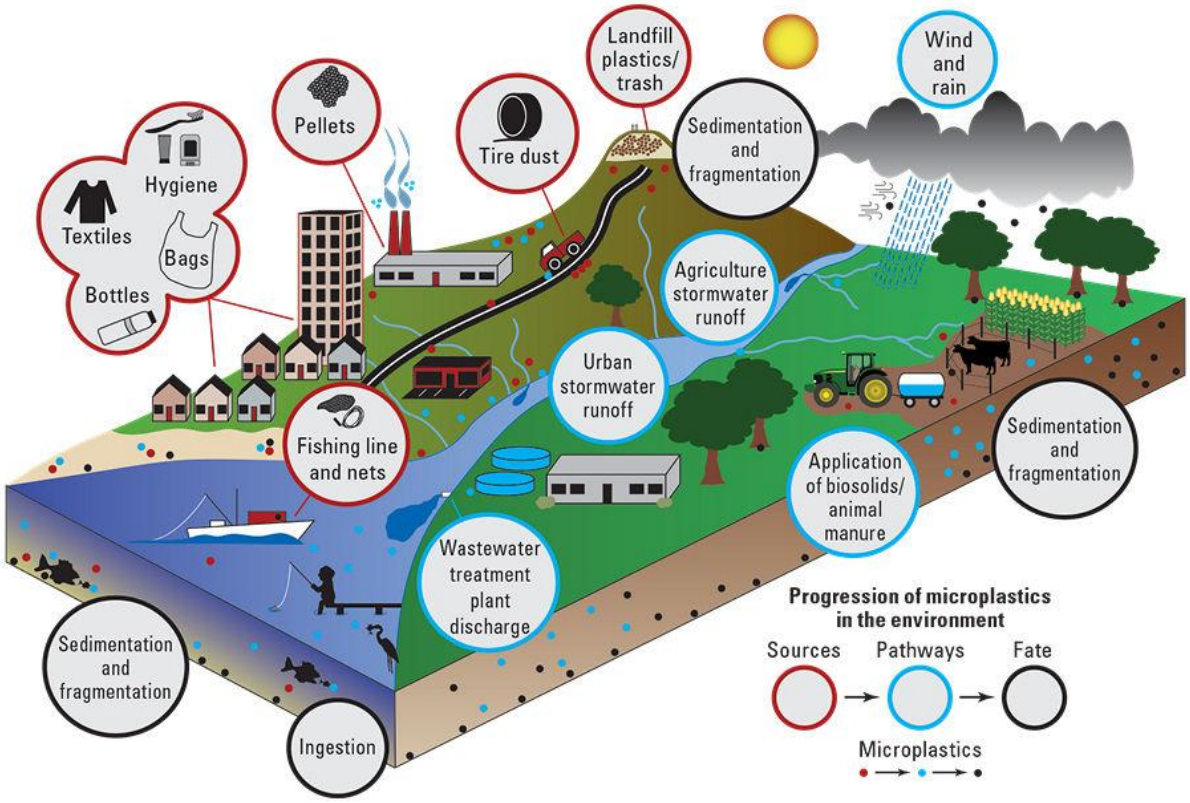

Figure 2. Microplastics Sources, Pathways and Fate Conceptual Diagram.
*Image credit: **Jeffrey L. Corbett, USGS***

Both marine and land animals can consume microplastics, which may eventually result in the microplastics being passed along the food chain to humans. Plastic packaging can also release microplastic particles into food when exposed to heat or other conditions. Because of their tiny size, microplastics can become airborne, raising the risk of inhalation. Additionally, some nanoplastics are small enough to be absorbed through the skin.

The potential human health effects of microplastics are still being explored. Research has consistently shown that microplastics may impair immune function, increase inflammation and oxidative stress, and cause damage to organs such as the liver, kidneys, and lungs.

Microplastics can be harmful when inhaled or ingested, with effects depending on the physical characteristics and chemical composition of the particles. When swallowed, smaller particles can pass into the gastrointestinal system and interfere with nutrient absorption. Inhalation of smaller particles can lead to respiratory issues and inflammation.

The size and shape of microplastics also influence the degree to which toxins and microbes attach to them. For instances, fragment particles with more surface area can carry more biofilms, bacteria, and viruses. Certain types of plastics, like low-density or soft varieties such as polyethylene and polypropylene, are more likely to absorb chemicals. Current findings suggest that both the chemicals and organic pollutants adhering to microplastics may pose risk to human health, though this varies based on size, shape, and material.

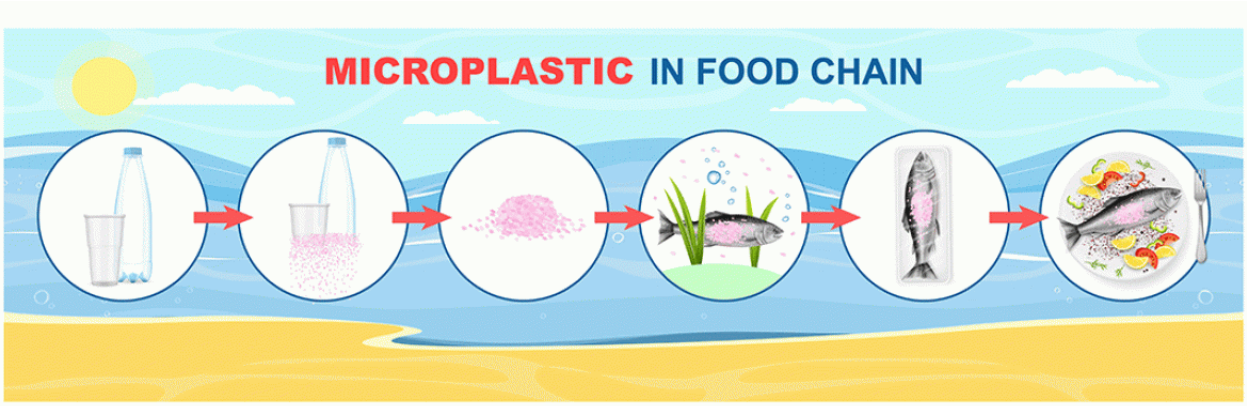

Figure 3. Example of microplastics in the food chain.

The U.S. EPA is conducting extensive research to address the growing concern of plastic pollution, specifically focusing on microplastics and nanoplastics. The research spans various domains, including the development of methods for characterizing, quantifying, and evaluating the health effects of these plastics in aquatic environments.

Human Health Effects

The health effects of microplastics are still being identified. The most consistently reported health effects in current scientific research include decreased immune response, increased inflammation and oxidative stress, and organ effects including changes in liver, kidney, and lung tissue. Research on long term health effects is ongoing.

Health effects from ingestion and inhalation of microplastics can vary greatly based on the physical and chemical composition of the microplastic particles. When ingested, smaller particles may be absorbed into the GI tract, and increased amounts can leave less room for nutrients and food to be absorbed. When inhaled, smaller particles are more likely to enter cells in the lungs and cause inflammation in the respiratory system.

The different shapes and sizes of microplastics influence the amount of toxins and microbes that can adhere to their surface. Fragment particles, for example, have greater surface area compared to pellets of similar size. This increased surface area provides more room for the formation of biofilms containing toxins as well as harmful bacteria and viruses. Low-density or rubbery plastics, such as polyethylene and propylene, have higher chemical absorption. Current research suggests that organic and chemical pollutants that adhere to microplastics may have an effect on human health. Consequently, the hazards associated with microplastics are broad because they are unique to the particle size, shape, and composition.

Common Items Containing Plastics	**Ways to Reduce Exposure**
Shopping and grocery bags, saran wraps, case wraps, and bubble wraps	• Use reusable or cloth bags • Opt for beeswax wraps • Return plastic bags and wraps to certain retail stores for recycling
Single-use plastic tableware, lids, straws, and drink stirrers	• Decline single-use plastic items • Choose compostable or reusable materials
Clothing made with synthetic fabrics such as nylon, polyester, acrylic, and spandex	• Choose untreated cotton, wool, or silk fabrics • Wash full loads of laundry, use cold water, wash less often, and line dry • Use microfiber filters or fiber catching devices when washing
Cosmetics, dental products, feminine hygiene products, diapers, and wipes	• Choose plastic-free packaging such as shampoo bars and toothpaste tablets • Avoid products containing plastic microbeads or glitters • Use reusable feminine hygiene products and cloth diapers
Plastic bottles, tubs, and jars	• Choose plastic-free packaging • Recycle curbside

Litter	• Pick up plastic waste and dispose of in proper receptacles

Characterization and Quantification of Microplastics

U.S. EPA researchers are working toward developing accurate, reliable, and reproducible methods for detecting and quantifying microplastics and nanoplastics in environmental samples.

Key Areas of Focus:

- **Plastic Separation:** Developing methods to differentiate plastics from organic and inorganic contaminants.
- **Plastic Extraction:** Extracting microplastics from environmental samples without damaging the plastics through harsh chemicals or heat.
- **Monitoring Programs:** Establishing ongoing monitoring programs, particularly in regions like the Chesapeake Bay, to assess plastic pollution levels.

Researchers utilize advanced analytical chemistry techniques to measure total microplastic levels and analyze various plastic polymers found in water and sediment.

Human Health Impacts Research Methods

The U.S. EPA is advancing its research into how microplastics, particularly nanoplastics, affect human health and aquatic life.

- **In Vitro and Computational Approaches:** The development of both in vitro (laboratory-based) and computational models to assess the health impacts of microplastic exposure.
- **Cellular Uptake and Clearance:** Investigating how microplastics are absorbed and processed by cells, using methods such as cell creatures.

Aquatic Life Impacts Research Methods

- **Toxicological Impacts:** Identifying the toxic effects of both biodegradable and non-biodegradable microplastics on aquatic life.
- **Coral Growth:** Evaluating how microplastics, in combination with elevated temperatures, affect coral growth.
- **Fish Diet:** Examining how microplastic exposure impacts fish diets and overall biological functions.

State Microplastics Regulations & U.S. EPA Guidance

In the U.S., there is a lack of specific federal, state, and local regulations targeting microplastics, despite their widespread presence in the environment and in human tissue. Some initiatives, such as bans on microbeads in cosmetic products, do exist, but regulating microplastics remains challenging due to the diverse nature of plastic formulations and the various sizes of microplastics and the particles.

The U.S. EPA does not regulate microplastics in drinking water, and there are no maximum contaminant levels or secondary contaminant levels for states to use. As of now, the human health effects of microplastics are still largely unknown, and the U.S. EPA has not developed a health-based threshold for microplastics in drinking water.

Many state and local efforts instead focus on broader plastic waste reduction measures, such as banning single-use plastics and promoting recycling programs. States like Maine and Oregon have introduced laws requiring producers to manage recycling programs, which, although not directly targeting microplastics, aim to reduce overall plastic pollution, which leads to microplastic contamination.

Illinois was one of the first states to take action against plastics in 2015, and has since joined 16 other states in urging the National Oceanic and Atmospheric Administration to regulate microfiber pollution. Illinois has passed the following legislation to further reduce plastic use in the state:

- Public Act 098-0638 - bans the manufacture and sale of microbeads in personal care products, such as cosmetics, toothpaste, and facial cleansers beginning in 2018
- Public Act 102-1081 - amends the Illinois Procurement Code to ensure State agencies are purchasing compostable or recyclable foodware instead of single-use plastic disposable foodware for use at State parks and natural areas
- Public Act 103-0470 – requires State agencies to track single-use plastic disposable foodware purchases and replace polystyrene foam disposable food service containers with compostable or recyclable options beginning in January 2025
- Public Act 103-0093 - mandates Illinois EPA to create a public website with information on microplastics, and to prepare report on the topic for the Illinois General Assembly

Federal Regulations

Specific federal programs take steps towards reducing plastic waste in waters. These include the following:

- **Microbead-Free Waters Act of 2015:** Bans the use of microbeads in cosmetics.
- **Save our Seas 2.0 Act (2020)**: Supports research on microfiber pollution and the development of prevention strategies.
- **Clean Water Act**: Provides mechanism for regulating plastic debris in waterways, indirectly helping to reduce microplastics.

In addition, the 2022 bipartisan Infrastructure Investment and Jobs Act designated $50 billion toward drinking water and wastewater improvements, including emerging contaminants such as microplastics.

In 2023, U.S. EPA released a Draft National Strategy to Prevent Plastic Pollution outlining three primary objectives—reduce plastic pollution during production, increase reuse and composting of materials, and capture and remove plastic pollution from the environment to prevent it from entering waterways. Altogether, these measures provide innovative approaches to preventing and reducing plastic pollution.

Additional State Regulations

- **SB 1422 (California):** Mandates testing for microplastics in drinking water.
- **SB 1263 (California):** Develops a statewide microplastic strategy.
- **H.P. 1146 (Maine):** Recycling mandates putting responsibility on producers for managing plastic waste.

International and Tribal Efforts

Internationally, the European Union and Canada are advancing regulations to address microplastics, with Canada listing plastics as a toxic substance. Tribes in the U.S. follow EPA regulations but have initiated local plastic reduction strategies and cleanup programs, particularly in marine environments. These efforts illustrate a growing focus on managing plastic pollution to mitigate the generation of microplastics, although regulations directly targeting microplastics are still in their early stages.

Interstate Technology & Regulatory Council (IRTC) 2021 Microplastics Survey

In 2021, IRTC conducted a survey to gather information on state's efforts to regulate microplastics. The survey aimed to understand the current state of microplastic regulation, including monitoring practices, detection, the establishment of standards or criteria, and specific guidance aimed at minimizing microplastics discharges into surface water or other environments.

- **Survey Responses:** A total of 43 responses were received from 26 states and one U.S. territory, with some states providing multiple responses from different agencies. The survey indicated that most states have not begun monitoring for microplastics, with only four of 26 states reporting active sampling efforts, primarily focusing on ambient water and sediment. A few states have also monitored stormwater, permitted discharges, fish tissue, and wild animal tissue.
- **Development of Microplastics Criteria:** The survey highlighted the early stage of microplastic regulation across most states. None of the states surveyed reported having established criteria or standards for microplastics in any environmental media. Moreover, 67% of states indicated they were not currently considering developing microplastics standards. However, eight states reported that they might adopt or consider microplastics criteria in the future, driven by legislative mandates or agency initiatives.
- **Future Outlook:** As scientific understanding of the risks associated with microplastics continues to evolve, more states are expected to develop regulations. Updates to state microplastics will be provided periodically and can be found on the ITRC website.

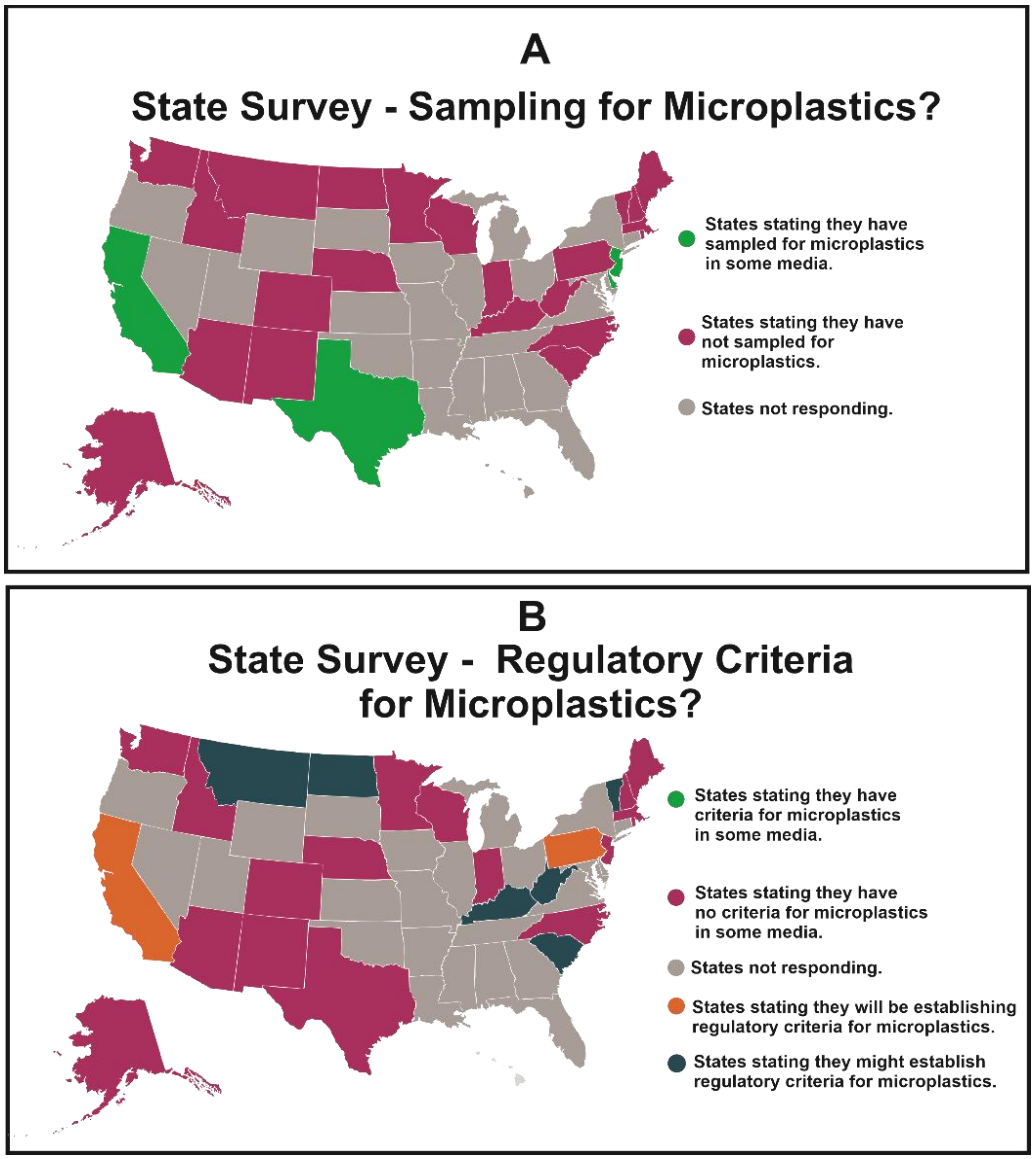

Figure 4. Summary of Key responses from the ITRC State Survey (2021).

Conclusion

The EPA's comprehensive research efforts aim to develop accurate methods for tracking and analyzing microplastic pollution. By focusing on both human health and aquatic life, the EPA is addressing the far-reaching consequences of microplastics in the environment, working towards solutions for mitigating their harmful impacts.