**Microplastics:** NJ DEP's Approach to Evaluating Sources, Impacts, and Removal Technologies

Clean Water Council – March 2025 Sanjay Shah, Ph.D. Sanjay.Shah@dep.nj.gov

Division of Science & Research

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## What is Microplastics?

Particles that are greater than 1 nanometer (nm) and less than 5 millimeters (mm) in their longest dimension and comprised of solid polymeric materials to which chemical additives or other substances may have been added. Polymers that are derived in nature that have not been chemically modified (other than by hydrolysis) are excluded

"The California State Water Resources Control Board Adopted definition of microplastics in drinking water"

"Solid polymeric materials to which chemical additives or other substances may have been added, which are particles which have at least three dimensions that are greater than1 nm and less than 5,000 µm. Polymers that are derived in nature that have not been chemically modified (other than by hydrolysis)are excluded.."

## **Plastics Production and Waste Management**





(Data source: Geyer et al. 2017; Plastics Europe 2019).

Scott Coffin's 2021 presentation for Implementation of Senate Bill 1422 – Microplastics in Drinking Water

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## **NJDEP Microplastics Timeline**



2010s: Interest increases in MPs

2016: SAB Human Health Report 2018-2019 NJDEP CEC Program Coordination Meeting initiated

2020-2022 NJDEP ITRC Participation



2022-2023: Multiple NJDEP Research Projects Initiated 2023 SAB Report: Environmental Occurrence and Impacts 2024: NJ Microplastics Bill A4821/4823 Moving Forward: Meet Bill Requirements

## New Jersey Science Advisory Board: **Microplastics Workgroups**

<u>SAB Objective</u>: To provide independent peer review and advice with respect to scientific and technical issues regarding natural resources, flora and fauna, habitat conservation, restoration, regulation, and/or methodologies to monitor, protect, and infer critical information to achieve these objectives.



## Workgroup Members:

Human	Health	effects	(2016)	

- Mark Robson, Ph.D., M.P.H., and Impacts (2023): Chairperson
- Michael Greenberg, Ph.D.
- Gerald Kennedy, M.S.
- Howard Kipen, M.D., M.P.H. •
- Judith Klotz, Dr.P.H.
- Mark Maddaloni, Dr.P.H.
- Steven Marcus, M.D.
- Clifford Weisel, Ph.D.

Judith S. Weis, Ph.D. (Chair)

**Environmental Occurrence** 

- Beth Ravit, Ph.D.
- Keith Cooper, Ph.D.
- John Gannon, Ph.D.
- Dibs Sarkar, Ph.D.
- Brian Buckley Ph.D.

# Why do we care?

- Ubiquitous in the environment
- Accumulate and persist long time in the environment
- Contain harmful chemical contaminants and additives
- Consumed by humans and other organisms
- Cause adverse health impacts on humans and other organisms



## Microplastics-Sizes

Assunpink Creek Surface - Delaware River - Zone 1E Surface - Delaware River - Zone 2 Surface - Delaware River - Zone 2 Bottom - Neshaminy Creek Surface - Rancocas Creek Surface - Pennypack Creek Surface - Delaware River - Zone 3 Surface - Delaware River - Zone 3 Bottom - Frankford Creek Surface - Delaware River - Zone 4 Bottom - Schuylkill River Surface - Mantua Creek Surface -		Grab
Delaware River - Zone 5 Bottom - Brandywine Creek Surface - Christina River Surface -		
Assunpink Creek Surface - Neshaminy Creek Surface - Pennypack Creek Surface - Cooper River Surface - Frankford Creek Surface - Brandywine Creek Surface -		Net
	50-100 100-250 250-500 500-1000 1000-2000	

Size (micrometers) of MP collected at various sampling location in the Delaware Estuary and selected tributaries. (Branksy and Chen 2022) Lower size limit of microplastics on several studies reprint microplastics abundance in the environment:

Lower size reported in micrometer (# of studies)

- 10 (3)
- 25(1)
- 30(1)
- 35(1)
- 45(1)
- 250(1)
- >300(1)
- 500(1)

#### (Kooi & Koelmans, 2019)



## Microplastics- Shapes



https://www.yorku.ca/research/category/news/2021/05/lasson de-professor-combats-microplastic-contamination-in-lakeontario/



Shapes of MP collected at various sampling location in the Delaware Estuary and selected tributaries. (Branksy and Chen 2022)

## **Microplastics-Sources**

## Primary

## Secondary

# Microbeads in personal care products





Pre-production

pellets (nurdles)



Wear and Tear of tires



Fibers/filaments from





Fragmentation of consumer products





# Variety of Microplastics

- Additives (Plasticizers, Colorants, Reinforcements, Fillers, Flame retardants, Stabilizers...)
- Eco-toxicants or Environmental Contaminants (PAHs, PCBs, DDT, Heavy metals....)





Composition of microplastics collected at sampling locations in the Delaware Estuary and selected tributaries. ACR = Acrylic, AZL = Azlon, CEL = Cellulosic, KEV = Kevlar, NYL = Nylon, PBT = Polybutylene Terephthalate, PE = Polyethylene, PHX = Polyhexamethylene, PLY = Polyester, PP = Polypropylene, PS = Polystyrene, PTFE = Polytetrafluoroethylene, PUR = Polyurethane, PVC = Polyvinyl Chloride, PVS = Polyvinyl Stearate, RAY = Rayon, UNK = Unknown. . (Branksy and Chen 2022)

## Sources

## **Point Source**

Discernible, confined and discrete conveyance

Includes rolling stock, concentrated animal feeding operations, or vessels or other floating craft

## Non-point Source

Does not meet the legal definition of point source

Includes land runoff, precipitation, atmospheric deposition, drainage, seepage, excess fertilizers, herbicides and insecticides, oil and grease and toxic chemical from urban runoff



# Human Health Microplastics SAB Report (2015)



Approved by the NJDEP Science Advisory Board <u>Members of the Public Health</u> <u>Standing Committee include:</u>

- Mark Robson, Ph.D., M.P.H., Chairperson
- Michael Greenberg, Ph.D.
- Gerald Kennedy, M.S.
- Howard Kipen, M.D., M.P.H.
- Judith Klotz, Dr.P.H.
- Mark Maddaloni, Dr.P.H.
- Steven Marcus, M.D.
- Clifford Weisel, Ph.D.

An example of.... "state-level environmental protection agencies have begun assessing the public health implications of microplastics and nanoplastics" – Smith et al. (2018. 5:375)

# Human Health Microplastics SAB Report (2015)

Public health standing committee report: based on information (peer-review literature, authoritative reports, media reports, and legislation) published through September 2015

#### 1. What are the routes of human exposure?

<u>Responses</u>: oral exposure most likely route, potential for inhalation exposure (wave action, atmospheric fallout) <u>Recommendations</u>: focus on ecological exposures in NJ (media, aquatic species); monitor on-going research efforts

#### 2. What does the current science indicate in terms of adverse human health effects?

<u>Responses</u>: plausible that exposure to micro/nanoplastics may cause adverse human health effects (based on ecological observations)

<u>Recommendations</u>: monitor research in nanoparticle toxicology

#### 3. Is this issue a concern for New Jersey?

<u>Responses</u>: micro/nanoplastics are a putative issue for New Jersey

<u>Recommendations</u>: put into perspective of other environmental issues; monitor on-going research efforts

## Microplastics in Aquatic Environments SAB Report (2023)

#### NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION SCIENCE ADVISORY BOARD

#### FINAL REPORT

Microplastics in the aquatic environment: Sources, occurrences, and currently known risks

> Prepared for: Commissioner Shawn LaTourette

**Prepared by:** Ad Hoc Microplastics Work Group

Approved by: <u>NJDEP SCIENCE ADVISORY BOARD</u> <u>Members of this Ad Hoc SAB</u> <u>Committee include:</u>

- Judith S. Weis, Ph.D. (Chair)
- Beth Ravit, Ph.D.
- Keith Cooper, Ph.D.
- John Gannon, Ph.D.
- Dibs Sarkar, Ph.D.
- Brian Buckley Ph.D.

## **SAB Microplastics**

Reports:

## Microplastics in Aquatic Environments SAB Report (2023)

Charge questions posed by the NJDEP Bureau of Environmental Analysis, Restoration and Standards

- 1. What does the current science on microplastics (and nanoplastics) indicate in terms of **adverse effects on aquatic life** and aquatic ecosystems?
- 2. What are the **primary sources** of these contaminants to rivers and streams specific to New Jersey; which forms of plastic cause the **most harm**; and which forms are most feasible for **prevention**, **source reduction and/or exposure reduction**?
- 3. What **technical steps** should the DEP take to understand and manage microplastics and nanoplastics?
- 4. To what extent does this issue currently affect New Jersey's water quality/designated use characterizations, tourism, economy, and Environmental Justice communities? \*The Department is interested in any research findings and papers that could support the Department in developing policy related to the above.
- 5. Are there any **research initiatives** that the SAB would recommend pertaining to the contaminants of emerging concern in addition to the ongoing initiatives (e.g. municipal wastewater treatability, analytical methods for municipal wastewater)?

## <u>What does the current science on microplastics indicate in terms</u> of adverse effects on aquatic life and aquatic ecosystems?

## **Key points:**

A suite of contaminants, not "a" contaminant.

Multiple factors influence adverse impacts

Associated chemicals (e.g. phthalates), biofilms, and adsorbed chemicals also impact potential effects



# **Documented effects**

Reduced growth and photosynthesis in phytoplankton. Many studies found no effect

Impaired mobility, reproduction, development in zooplankton.

Smaller, weathered particles are generally more toxic.

Fibers more damaging than spheres in crustaceans Impaired feeding, growth, behavior, reproduction and development. Some studies find no effect

Mollusks showed gill and digestive gland effects Weathered more toxic than virgin, vector for transfer of toxic chemicals.

Tissue damage and altered physiology in fish species (larval and adult)



# What technical steps can NJDEP take?

California has two senate Bills with big impact: S.B. 1263 and S.B. 1422 California Ocean Protection Council released <u>Statewide Microplastics Strategy</u>:



NJ SAB: "We endorse adopting similar strategies to address the issue of micro- and nanoplastics pollution in the State of New Jersey"

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# **Current NJDEP Status & Actions**

## NJDEP efforts to address microplastic issues:

- Address legislative Bill A4821/4823
- Internal program coordination of contaminants of emerging concern
- Interacting with experts through calls & meetings

USEPA, ITRC Microplastics Team, California EPA, commercial entities with new technology (PolyGone at Atlantic County Utilities Authority)

- Hiring of subject matter experts with microplastics experience
- Initiating research projects with Academic and Federal partners



## New Jersey Legislation A4821/4823 – Microplastics in Drinking Water

•Initiation: Within 30 days of the act's effective date

•Completion: No later than three years from the act's effective date

•**Objective:** Evaluate the feasibility and benefits of microplastics removal technologies

#### •Scope of Study:

- 1. Impact of microplastics on health and environment
- 2. Origin and migration of microplastics
- 3. Benefits of removal technologies
- 4. Available technologies and their costs
- 5. Performance capacity and efficiency of technologies
- 6. Current usage of technologies in NJ, other states, and countries
- 7. Disposal methods for removed microplastics
- 8. Feasibility of financial incentives and partnerships
- 9. Evaluation criteria for proposals



## New Jersey Legislation A4821/4823 – Microplastics in Drinking Water

### Implementation, Reporting, and Public Awareness

#### Implementation:

- Pilot projects authorized and facilitated by the department
- Stakeholder engagement involving experts, industry representatives, and the public

#### **Reporting:**

- Report to be submitted to the Governor and Legislature within three months after the study's conclusion
- Recommendations for legislative, executive, and other actions

#### **Public Awareness:**

- Public education campaign on microplastics' threats and removal technologies
- Establishment of grant and incentive programs
- Coordination with the Department of Health for further evaluations if health risks are identified



# **Collaborations with Rutgers University**

### NJDEP and Rutgers University partnership with Dr. Nicole Fahrenfeld:



## Rutgers Wastewater Treatment Plant Sampling Conceptual Sketch

Investigating microplastics at different stages of treatment in three WWTP (2023-2025)

Assess the occurrence of MPs

Determine mass flows

Evaluate overall & partial percent removals during the WW Treatment Process

Identify type and quantity of MPs emitted in effluent

The Division of Science & Research is contracting additional research support to evaluate MP origins, fate & transport, health impacts, and available remedial technologies (2025-2026)



# Determination of concentrations of 6PPDq in surface water

Division of Science & Research, Fish & Wildlife, Bureau of Freshwater & Biological Monitoring:

- Sites focused on trout population shifts
  - Identified as impaired or reference based on fish population data- IBI results, loss of Brook trout, and/or documented fish kills during rain events
  - 4 impaired sites and 3 reference sites
- Timing: October 2023 to correlate with Brook trout spawning
- Sampling windows
  - 24 hours composite using ISCO autosamplers programmed to begin sampling when rainfall was expected to begin.





# NJDEP Active Projects: Groundwater sampling to assess feasibility of microplastic collection and analysis.

#### NJ Geologic & Water Survey and United States Geological Survey:

NJDEP is working with water suppliers to sample wells to characterize the presence and distribution of MPs in groundwater

#### Research Goals:

- Assess the presence of microplastics in groundwater of New Jersey aquifers.
- Difficulty of MP sample collection.
- Effectiveness of laboratory analysis.

Ongoing efforts with USGS to define methods and determine occurrence in ambient groundwater throughout the State.



# Other active agencies

- Delaware River Basin Commission is investigating MPs in Delaware River
- Human health studies at Rutgers University (multiple professors)
  - RU recently awarded \$3.2 million from NIH

Final Thought: There's a growing team of State scientists taking an interest and following the latest science on MP occurrence and toxicity.

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#### **Rutgers Receives \$3.2 Million From NIH to Study Micronanoplastics in the Digestive System**



Researchers will look at the potential health hazards of ingested plastic particles on the intestine and other organs and tissues



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## **Division of Science and Research**

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