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REGULATIONS OF AND CHALLENGES PRESENTED BY MICROPLASTICS AND OTHER EMERGING CONTAMINANTS

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AGENDA

- Microplastics 101
- Microplastics State of the Science
- Microplastics Regulations and Litigation
- Microplastics Potential Markets
- Other Emerging Contaminants of Concern

MICROPLASTICS – WHY DO WE CARE?

MICROPLASTICS – WHY DO WE CARE?

"I'm part human, part fish, and about ten per cent microplastics."

"Microplastics?"

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MICROPLASTICS 101

WHAT ARE MICROPLASTICS?

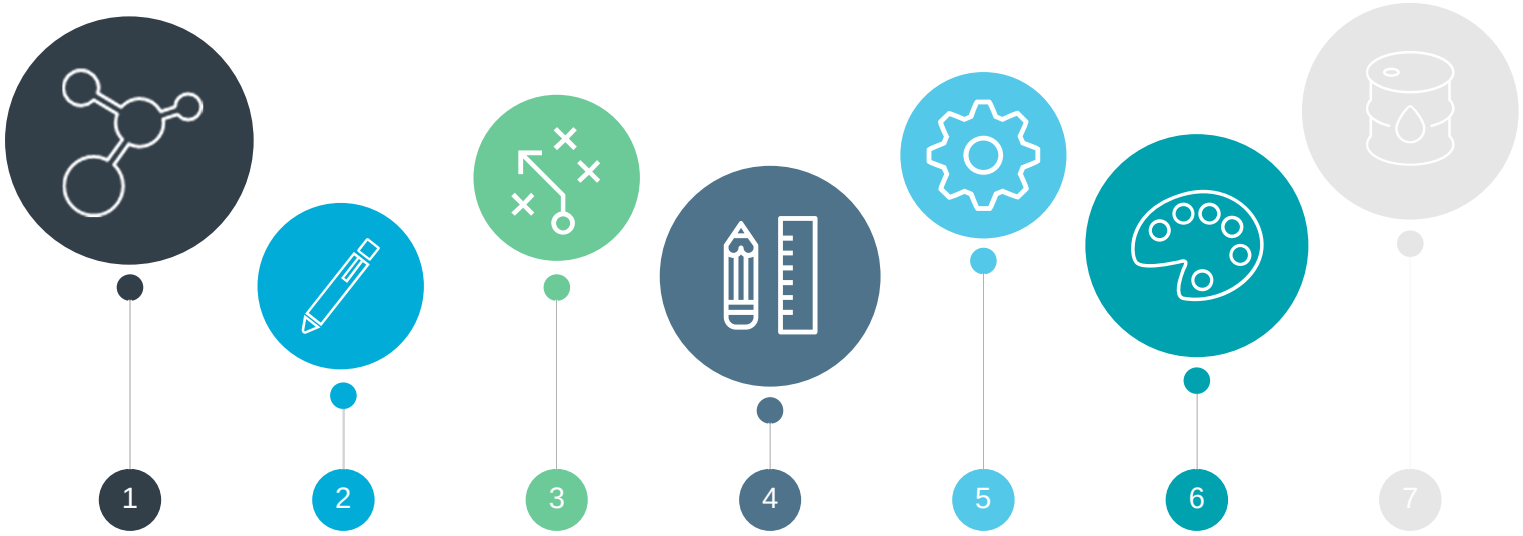
films
fibers
spheres
fragments
pellets

nanoplastics
microplastics

Small pieces of plastic that are less than 5 mm

PET
LDPE
HDPE
PS
PVC
PP

A DIVERSE SUITE OF CONTAMINANTS



1	2	3	4	5	6	7
Polymer	**Product Type**	**Morphology**	**Size**	**Additive**	**Color**	**Eco-toxin**
PET	Bottles	Pellets	< 5 mm	Stabilizers	Green	Heavy metals
LDPE	Bags	Fragments	< 1 µm	Colorants	Blue	DDT
HDPE	Containers	Spheres		Flame retardants	Red	PAHs
PV	Nurdles	Fibers		Fillers	Black	PCBs
PS	Microbeads	Films			Yellow	

Information Source: Rochman et al. 2019

TYPES OF MICROPLASTICS

PRIMARY MICROPLASTICS

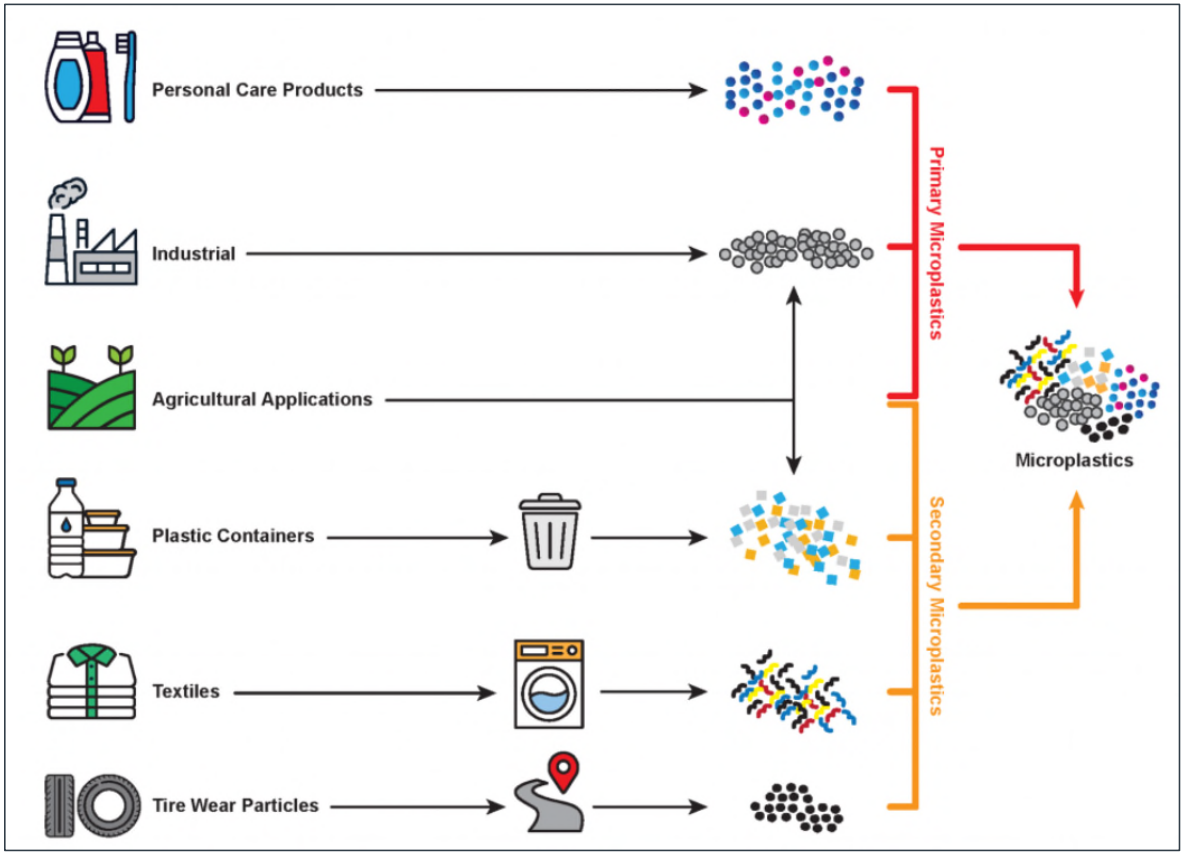
Small pieces of plastics that are purposely created by manufacturers to be smaller than 5 mm and enter the environment as such

SECONDARY MICROPLASTICS

Plastic fragments derived from the breakdown of larger plastic debris due to natural degradation

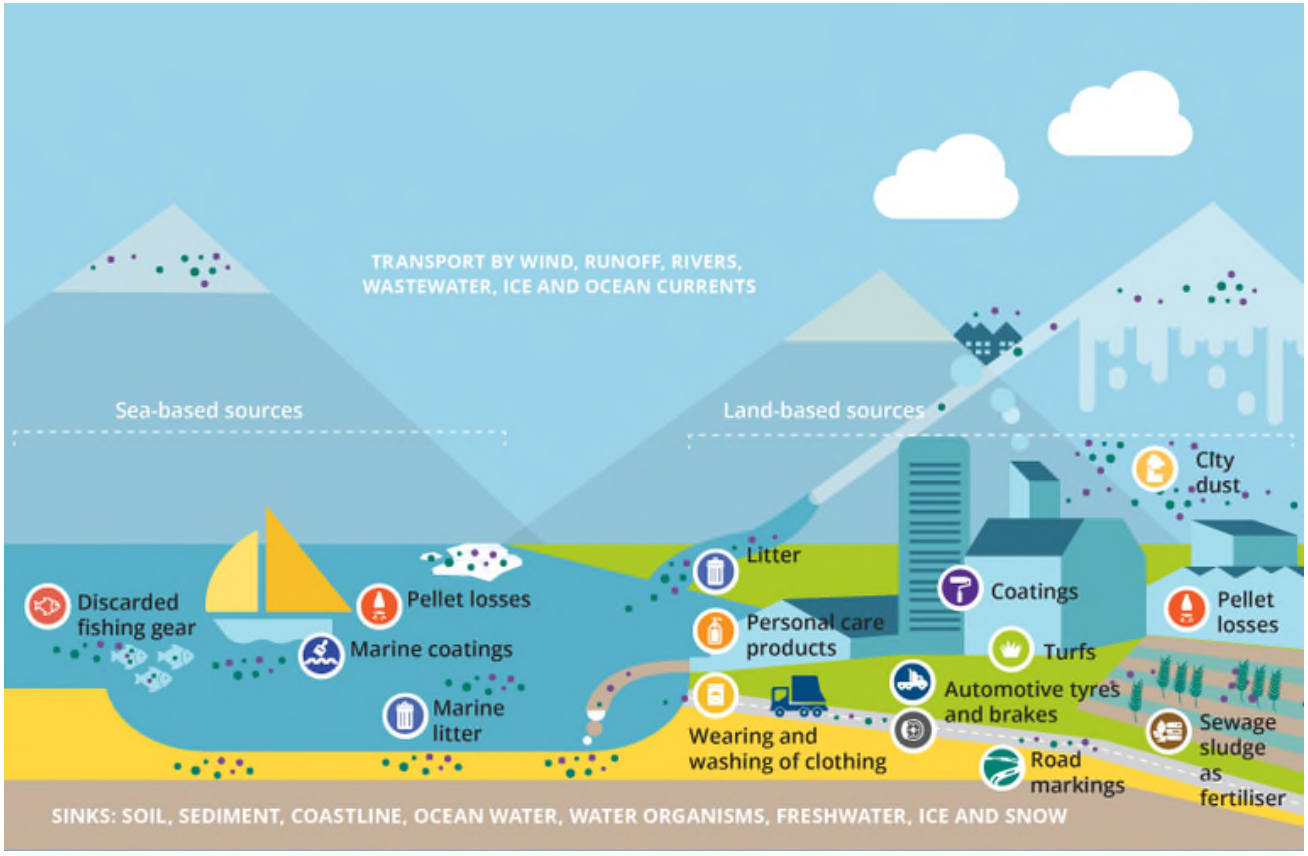
Image Sources: Bioplastic News, Earth911, Spoon University, One Green Planet

SOURCES OF MICROPLASTICS



Source: ITRC

PATHWAYS OF MICROPLASTICS



THE NEXT PFAS?

- 9,000+ compounds with unique characteristics (hydrophobic, hydrophilic)
- Soluble
- Novel approaches have been developed to assess risk and exposure
- Only a subset of compounds can be analyzed using current methods

PFAS

- Diverse suite of contaminants
- Traditional fate and transport models inadequate
- Potential to bioaccumulate
- Persistent
- Ubiquitous nature requires specific procedures when sampling
- Risks to ecological and human health
- Implications for many industries

Both

- Extreme diversity in polymer type, size, shape, etc.
- Insoluble
- Uncertainty on toxicity drivers (physical vs. chemical)
- Additives/other environmental chemicals may add another layer of complexity
- Lack of standardized analysis methods

Microplastics

Information Source: Coffin et al. 2021

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STATE OF SCIENCE

SAMPLING AND ANALYSIS

Sampling

- Academic-driven
- ITRC Guidance document
- ASTM method
- CA – sampling protocols for drinking water
- QA/QC issues (plastics are everywhere)
- Volume and method can affect results

Analysis

- SOPs/lab accreditation only for drinking water
- Particle count vs polymer identification
- Common analytical methods
  - Raman and FTIR microscopy
  - QA/QC issues (plastics are everywhere)
  - Lower detection limit/size range
    - Raman: 1-20 µm
    - FTIR: 20 µm
- Emerging Raman techniques in nanometer range tested in bottled water (Qian et al., 2024)

Overall Data Conclusions

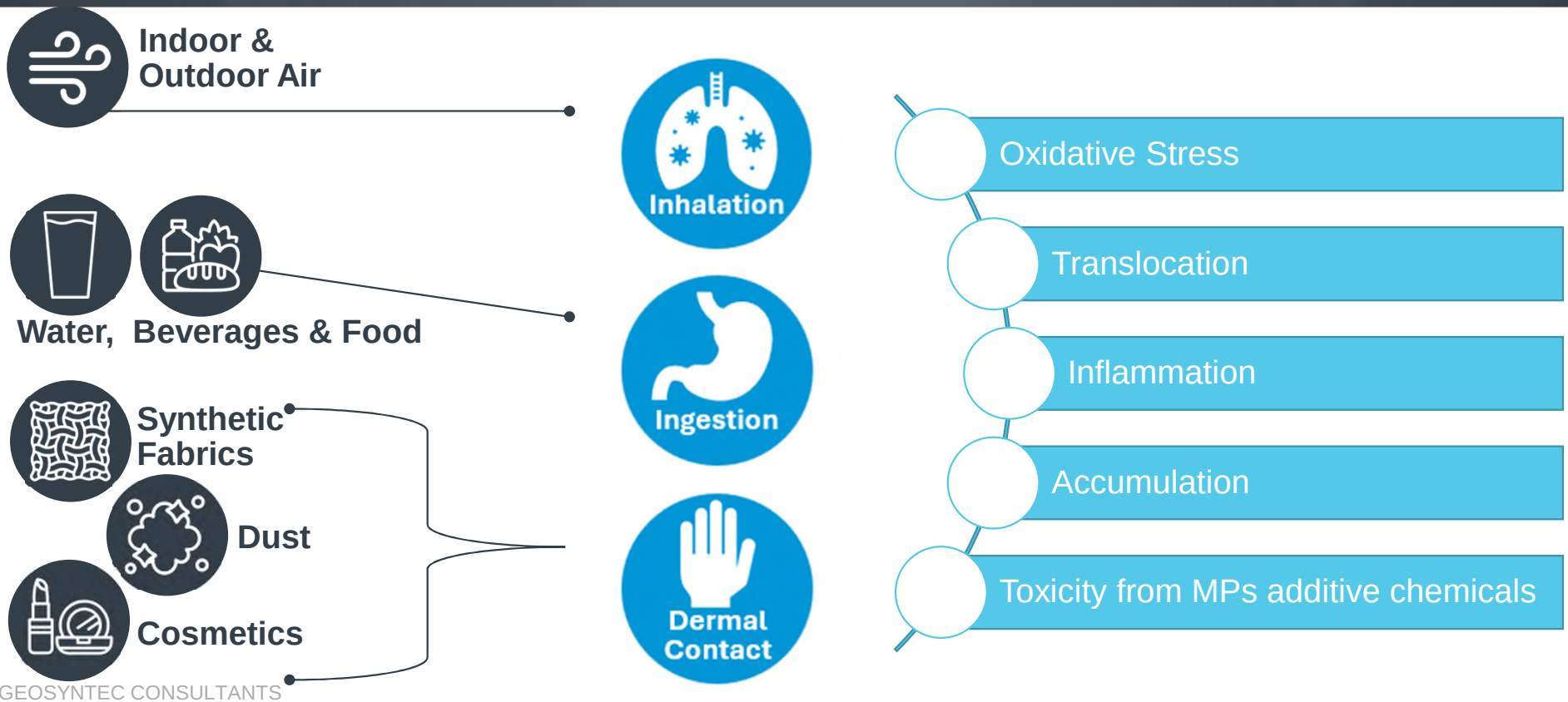
- It's a mess!
- Inconsistent units
  - Particle count
  - Mass
- Morphology and mass require different methods

SAMPLING AND ANALYSIS CONSIDERATIONS

- Data quality objectives – why is this data being collected and what is it being used for?
- What analytical method to use
  - Do we need particle counts only or also polymer identification?
  - Microscopy – particle counts only; very labor intensive; may use staining which is inaccurate
  - FTIR/Raman – spectral based methods provide particle counts and polymer identification, but not mass.
- What size range needs to be detected
  - Standardized methods reliably detect down to 20 µm (samples split into 500 µm, 212 µm, 20 µm size fractions)

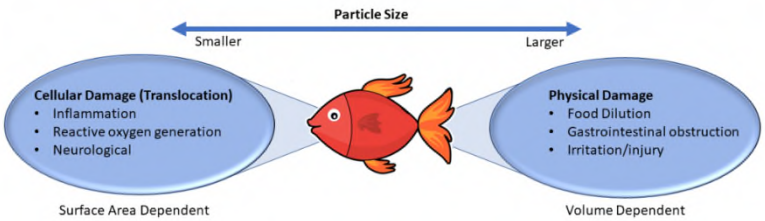
Bottom line – spectral methods are more accurate

HUMAN HEALTH



ECOTOXICOLOGY

- Exposure pathways – uptake, trophic transfer, dermal
- What drives toxicity – chemical or physical? (Physical is current focus)
- Toxicity studies focus on aquatic environments
  - Existing effects data is a mix of size ranges, shapes, polymers, with a mix of different reporting units
  - Effects data not comparable to “environmentally relevant data”
  - Limited polymers, sizes, and relevant endpoints
- Rescaling/realignment recommendation
  - Super confusing
  - Aligns tox test data to “environmentally relevant concentrations” (based in Europe)
- Hypothesized mechanisms of toxicity
  - Food dilution and tissue translocation
  - Size dependent!



AQUATIC LIFE THRESHOLDS

California has draft aquatic life thresholds (Mehinto et al 2022) – these are not promulgated and not enforceable.

- Used tox data available prior to 2022, questionable quality
- Combined freshwater and marine effects data
- Included all endpoints (should focus on population level)
- Confidence intervals span two magnitudes of order
- Used data rescaling and realignment (unsure if appropriate)

Table 2 Proposed microplastics toxicity thresholds for food dilution, relevant for particle sizes between 1 and 5000 µm

Threshold	Particles/L (95% CI)	Mass (mg)/L (95% CI)
Threshold 1- "Investigative monitoring"	0.3[a]	0.05[a]
Threshold 2- "Discharge monitoring"	3 (0.3 to 66)	0.4 (0.05 to 11)
Threshold 3- "Management planning"	5 (0.4 to 219)	0.9 (0.07 to 36)
Threshold 4- "Source control measures"	34 (3 to 859)	6 (0.4 to 141)

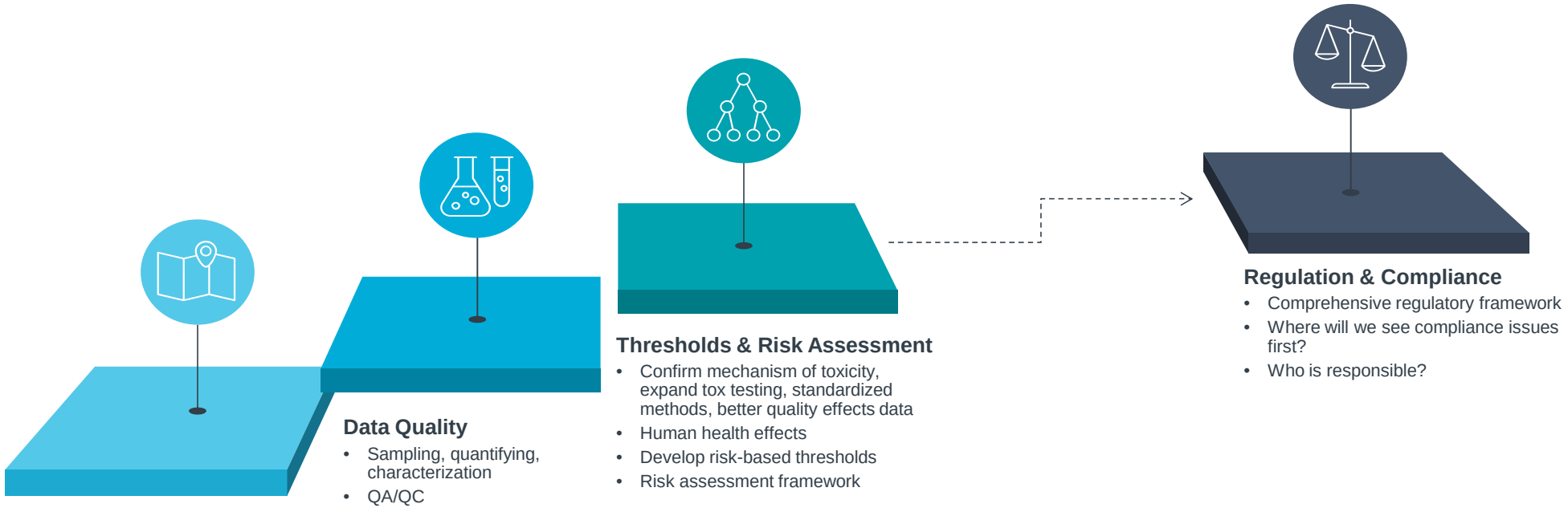
[a] Threshold 1 is the lower 95% CI of the HC5 calculated for Threshold 2, therefore confidence intervals cannot be reported for this threshold

Table 3 Proposed microplastics toxicity thresholds for tissue translocation, relevant for particle sizes between 1 and 83 µm

Threshold	Particles/L (95% CI)	Mass (mg)/L (95% CI)
Threshold 1- "Investigative monitoring"	60[a]	10[a]
Threshold 2- "Discharge monitoring"	312 (57 to 4680)	51 (10 to 770)
Threshold 3- "Management planning"	890 (118 to 19,000)	146 (19 to 3120)
Threshold 4- "Source control measures"	4110 (493 to 69,100)	676 (81 to 11,400)

[a] Threshold 1 is the lower 95% CI of the HC5 calculated for Threshold 2, therefore confidence intervals cannot be reported for this threshold

UNDERSTANDING DATA GAPS & CHALLENGES



Fate & Transport

- Background/ambient concentrations
- Terrestrial environments and other media

Data Quality

- Sampling, quantifying, characterization
- QA/QC
- Data reporting

Thresholds & Risk Assessment

- Confirm mechanism of toxicity, expand tox testing, standardized methods, better quality effects data
- Human health effects
- Develop risk-based thresholds
- Risk assessment framework

Regulation & Compliance

- Comprehensive regulatory framework
- Where will we see compliance issues first?
- Who is responsible?

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REGULATIONS

CURRENT STATE OF U.S. REGULATIONS

Federal

- Microbead-Free Waters Act (2015)
- Proposed:
  - Microplastics Act of 2020
  - Break Free from Plastic Pollution Act (2021)
  - Plastic Pellet Free Waters Act (2021)
  - Farewell to Foam Act (2023)
  - Plastic Pellet Free Waters Act (2024)
  - Research for Healthy Soils Act (2025)
  - Microplastics Safety Act (2025)

State

- California
  - California Safe Drinking Water Act: Microplastics (2018)
  - California Ocean Protection Council: Statewide Microplastics Strategy (2018)
  - California Statewide Microplastics Strategy (2022)

On the Horizon

- New Jersey, New York, Michigan have proposed legislation
- California proposed to add microplastics to the Candidate Chemicals List (2023)
- California DTSC proposed adding MPs to Safer Consumer Products Program (2025)
- Many state bills related to macroplastics

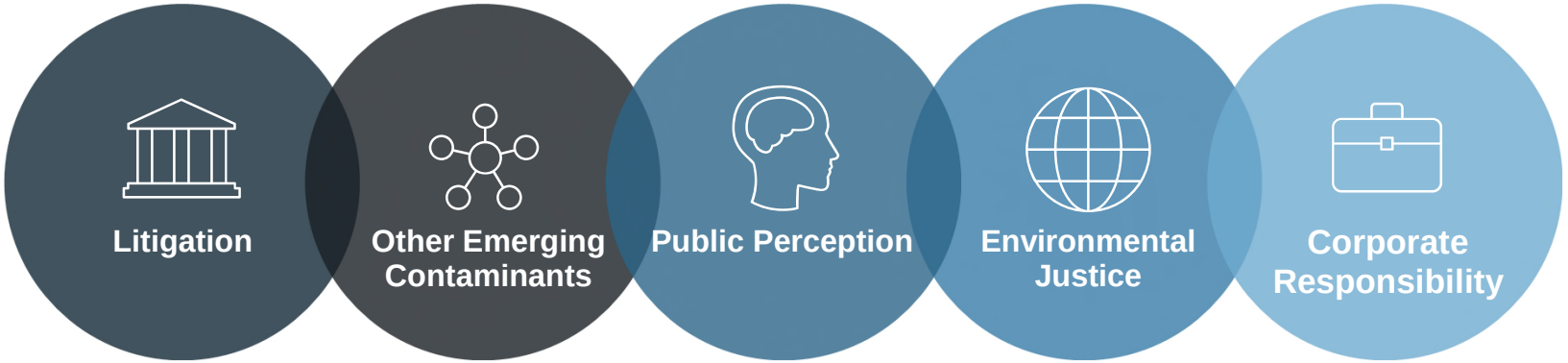
CALIFORNIA IS LEADING THE WAY…

- **2018: California Safe Drinking Water Act: Microplastics**
  - ✓Adopted first definition for microplastics in drinking water in 2020
  - ✓Adopted standardized methods for testing microplastics in drinking water in 2021
  - ✓Set up first accreditation program for microplastics analysis
  - ✓Approved a policy handbook for testing microplastics in drinking water sources in 2022
  - ✓Approved to test water supplies for microplastics over 4 years
  - ❑Issue notification level to aid in results interpretation

- **2018: California Ocean Protection Council: Statewide Microplastics Strategy**
  - ✓Published Statewide Microplastics Strategy in 2022

Image Sources: California Water Board, SCCWRP, California OPC, Shutterstock

OTHER DRIVERS



What's the tipping point?

FORMOSA LITIGATION

- Nurdles – pre-production pellets
  - Made of different polymers and contain various additives
  - Released during production or in transit
  - Not classified as pollutants or hazardous materials
- Formosa Plastics Corporation (Lavaca Bay, Texas)
  - Formosa discharging millions of nurdles into nearby creek and bay
  - Lawsuit filed against Formosa in 2017 by private citizen; data collected by citizen science group
  - June 2019 – judge ruled that discharge of nurdles violates CWA, Formosa must stop discharge and remediate
  - Formosa continues to pay fines for additional discharge, remediation in progress

OTHER LITIGATION

Case	Date, Location	Lawsuit Basis
Charleston Waterkeeper et al v. Frontier Logistics LP, Case No. 2:2020cv1089	2020; District of South Carolina	Discharge of plastic pellets – case settled and defendant must prevent further release of pellets
PennEnvironment, Inc. and Three Rivers Waterkeeper v. BVPV Styrenics LLC and Styropek USA, Inc., Case No. 2:23-cv-0267-NR	2023; District of Pennsylvania	Release of plastic pellets into Raccoon Creek and the Ohio River 2024 – Styropek announced the facility is closing.
People of the State of New York, by Letitia James, Attorney General of the State of New York v. Pepsico, Inc	2023; Supreme Court of New York	NY AG alleges that Pepsi is 'endangering environment and public health with plastic pollution' due to single use plastics found in Buffalo River

OTHER LITIGATION

Case	Date, Location	Lawsuit basis
Daly v. Danone Waters of America, LLC, No. 1:2024cv02424 - Document 22 (N.D. Ill. 2024)	2024; Northern District of Illinois	Misleading consumers with labeling of “natural” water. Judge dismissed the case citing FDA definition of spring water which does not address MPs.
Slowinski et al v. BlueTriton Brands, Inc., No. 1:2024cv00513	2024; Northern District of Illinois	Misleading consumers with labeling of “natural spring water” water; violates Illinois’ consumer fraud law. Judge dismissed the case citing FDA definition of spring water which does not address MPs.
Miller et al. v. Philips North America LLC, Case No. 3:24-cv-03781 and Cortez et al. v. Handi-Craft Company Inc., Case No. 3:24-cv-03782	2024; Northern District of California	Failure to warn consumers that baby bottles leach MPs when heated and are marketed as “BPA free” giving false security. Judge dismissed - plaintiff could not identify MP threshold level.
Cheslow v. S.C. Johnson & Son, Case No. 3:25-cv-03655	2025; Northern District of California	Consumers are misled regarding product safety and falsely marketed that products are “microwave safe”

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POTENTIAL MARKETS

POTENTIAL MARKETS AND AREAS OF SUPPORT

- Chemical/product manufacturers
- Tires/rubber
- Industrial water/process engineering
- Water/Wastewater
- Stormwater
- Agriculture/biosolids
- Solid waste/recycling facilities
- Food & beverage, food packaging

- Mitigation
- Product testing/consumer safety
- Lifecycle assessment
- Site characterization/Risk assessment
- Remediation
- Legal

POTENTIAL COMPLIANCE ISSUES

Where might we start seeing compliance issues for microplastics?

Stormwater

Permitting

Best Management Practices

Industrial & Municipal Wastewater

Pretreatment

Discharge requirements

Biosolids

Waste Management

Landfills

Leachate management

Materials Recovery Facilities

Food & Beverage

Drinking water

Bottled water

Food processing & packaging

Agriculture

Manufacturing

Industrial processes

Spill prevention

Product safety

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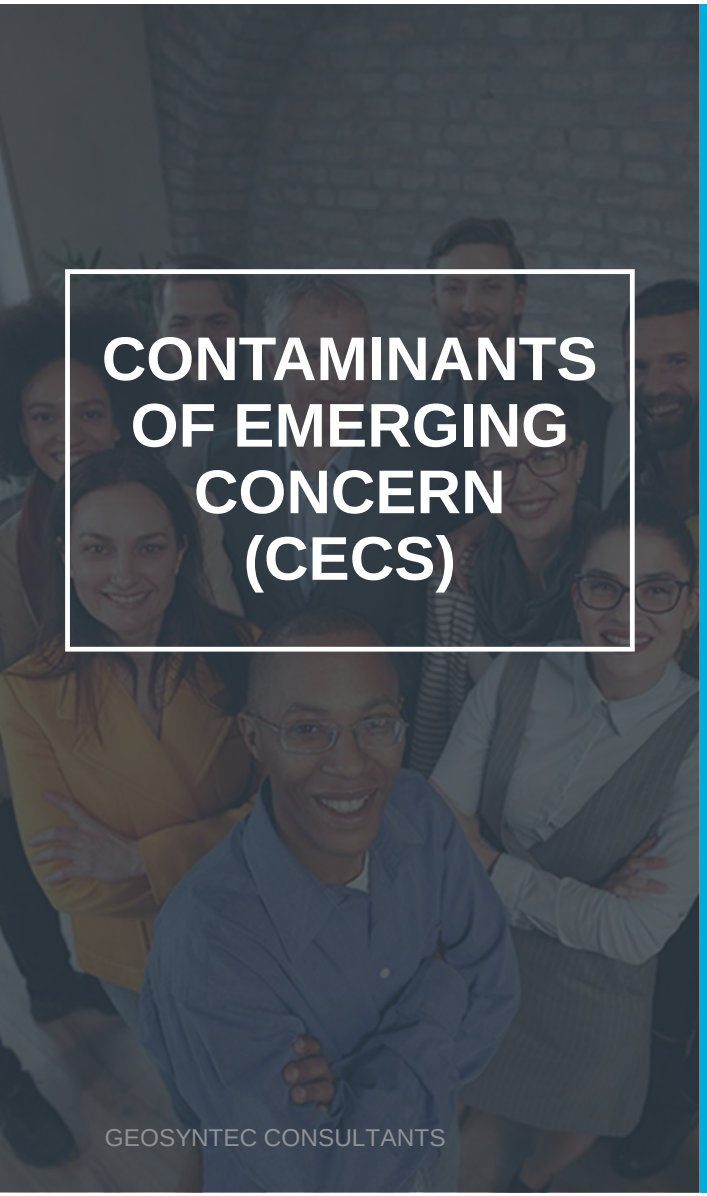
OTHER CONTAMINANTS OF EMERGING CONCERN

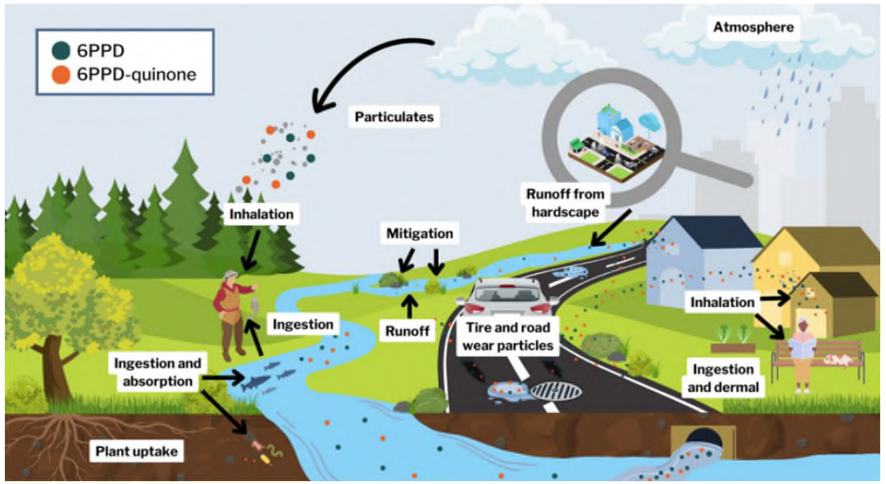


CONTAMINANTS OF EMERGING CONCERN (CECS)

- Tirewear particles (falls under MP umbrella)
- 6PPD and 6PPD-quinone (6PPD-q)
- Pharmaceuticals
- Personal care products
- Cyanotoxins/harmful algal blooms

6PPD-Q HISTORY

- 6PPD-q was identified as a chemical that causes acute mortality in coho salmon in Pacific Northwest in 2020
- 6PPD is an anti-oxidant used to prevent rubber from degrading due to ozone and oxygen; it's used in all tires
- 6PPD transforms into 6PPD-q
- 6PPD-q has been found to affect other fish species



Source: ITRC & Washington State Department of Ecology

6PPD-Q REGS

Federal – EPA

- Advance Notice of Proposed Rulemaking under TSCA (https://www.govinfo.gov/content/pkg/FR-2024-11-19/pdf/2024-26894.pdf)
- Draft laboratory method draft laboratory method for detection of 6PPD-quinone in surface water and stormwater (Draft EPA Method 1634)
- Acute 6PPD-q and 6PPD Aquatic Life Screening Values for Freshwater

State – Washington

- Numeric Water Quality Criteria for 6PPD-Q
- SB 5931: designates 6PPD-containing tires as a priority product under the Safer Products for Washington program

State – California

- DTSC designation of motor vehicle tires containing 6PPD as a priority product under the Safer Consumer Products.

PHARMACEUTICALS AND PERSONAL CARE PRODUCTS

- EPA Emerging contaminants “PPCPs”
- Any pharmaceuticals; disinfectants, sunscreen, cosmetics
- Sources: WWTP, landfill leachate, biosolids, runoff, drinking water
- Sorption in sediment; sed acts as a sink and accumulates PPCPs
- More persistent in sediment compared to SW
- Persistent, bioaccumulative, toxic (PBTs)
- Endocrine disrupters
- EPA developed a White Paper Aquatic Life Criteria for Contaminants of Emerging Concern: Part I Challenges and Recommendations (2008)

CYANOBACTERIA/HARMFUL ALGAL BLOOMS

- Cyanobacteria – microscopic, photosynthetic organisms found in naturally in aquatic systems
- Can multiple rapidly to create blooms & may produce toxins
  - Harmful cyanobacterial blooms (HCBs)
  - Benthic HCBs – form mats on sediment surface
- HCBs more frequent and severe in nutrient-rich waters, stable water column, warm temps (hello, Florida ☹)
- Can impact aquatic and wildlife, can result in fish kills
- Human health risks
  - Inhalation, ingestion, dermal contact
  - Toxicity threshold values - EPA

CEC LINKS

- ITRC 6PPD-q Guidance Document: https://6ppd.itrcweb.org/
- ITRC CEC Framework: https://cec-1.itrcweb.org/
- USEPA CEC including Pharmaceuticals and Personal Care Products: https://www.epa.gov/wqc/contaminants-emerging-concern-including-pharmaceuticals-and-personal-care-products
- ITRC Harmful Cyanobacterial Blooms: https://hcb-1.itrcweb.org/ and https://hcb-2.itrcweb.org

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CONCLUSIONS

MICROPLASTICS KEY TAKEAWAYS

Current State of Science

- Standard sampling & analysis methods are still being developed.
- No human health thresholds; draft aquatic life thresholds (not promulgated, use with caution).
- Many challenges due to the complexities of microplastics

Regulations and Litigation

- Microplastic regulations limited to California and drinking water, but expect more to follow
- Lawsuits on industrial releases of plastic pellets and packaging

Looking to the Future

- Sampling & analysis methods and relevant thresholds will need to be established before we can begin to develop a regulatory/compliance framework.

THANK YOU!

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Illinois Laws Related to Microplastics

Section 52.5 of the Illinois Environmental Protection Act, 415 ILCS 5/52.5: banned the manufacture and sale of microbeads in personal care products such as cosmetics, toothpastes, and facial cleansers beginning in 2018.

Section 45-23 of the Illinois Procurement Code, 30 ILCS 500/45-23: requires State agencies to purchase compostable or recyclable foodware instead of single-use plastic disposable foodware for use at State parks and natural areas, beginning in 2023.

Section 13.10 of the Illinois Environmental Protection Act, 415 ILCS 5/13.10: mandated Illinois EPA to create a public website with information on microplastics,[1] and to prepare a report on the topic for the Illinois General Assembly by October 1, 2024.

State Entities Single-Use Plastic Reporting Act, 30 ILCS 567/1 – 567/999; 30 ILCS 500/45-24: 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.

Small Single-Use Plastic Act, Public Act 103-0934: bans hotels from providing single-use plastic bottles containing personal care products in bathrooms beginning in July 2025.

Pending:

HB 1600, Single Use Plastic Foodware Reduction Act

- Sitting in Senate Assignments and could be acted on during veto session, but unlikely.

HB 3278, Stormwater Pollution Prevention Plan (Plastic Pellets)

- Sitting in Senate Assignments and could be acted on during veto session, but unlikely.

SB 1872, Single-Use Plastic Bag Reduction Act

- Re-referred to assignments; likely will not see this language voted upon again.

HB 2955, PFAs

- Froze upon making it to the Senate after amendment added microplastics.

[1] See https://epa.illinois.gov/topics/water-quality/microplastics.html