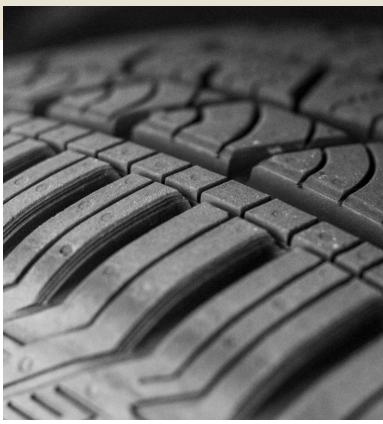
PUGET SOUND INSTITUTE
UNIVERSITY of WASHINGTON

SCIENTIFIC RESEARCH PRIORITIES ABOUT TOXICS
in Puget Sound

The Toxics in Fish Implementation Strategy is a recovery plan for addressing chemical pollution in Puget Sound. The Implementation Strategy outlines research and management actions to reduce contamination levels of PAHs, PBDEs, PCBs, and endocrine disrupting compounds and other chemicals of emerging concern (CECs) in several Puget Sound indicator species (the Toxics in Aquatic Life Vital Sign).



TOP 5 RESEARCH PRIORITIES FOR 6PPD-Q

During the prioritization process detailed in the Research Agenda Update 2024/2025 report, five 6PPD-Q research topics[1] were identified as most important for the region:

- Investigate toxicity of 6PPD-Q in various species, and across trophic levels, including microbial communities, algae, aquatic plants, terrestrial organisms (e.g., amphibians, reptiles, birds), mammals, and humans.
- Investigate sublethal impacts of tire-related chemicals to both acutely-affected and implications for survival.
- Identify additional product sources of 6PPD, 6PPD-Q, and other PPDs (e.g., tire reefs, crumb-rubber, indoor mats, etc.). Study the toxicity, degradation products, and occurrence of other PPDs.
- Identify safe alternatives to 6PPD (either within the PPD chemical family or non-PPD alternatives) that provide required antiozonant, antioxidant, and anti-fatigue protection to tires. What are the toxicity, transformation products, and environmental trade-offs of these alternatives?
- What is the effectiveness of stormwater control measures (SCMs) such as street sweeping, catchment/management, biochar-enhanced SCMs, and permeable pavement, across various land uses at reducing 6PPD-Q loadings? Does air transport impact effectiveness?

[1] Each of the top five 6PPD-Q research priorities were adapted from ITRC (2024): ITRC (Interstate Technology & Regulatory Council). (2024). *6PPD & 6PPD-quinone*. Interstate Technology & Regulatory Council, Tire Anti-degradant (6PPD) Team. Washington, D.C. https://6ppd.itrcweb.org/

TOP 7 RESEARCH PRIORITIES FOR VITAL SIGN

During the prioritization process detailed in the Research Agenda Update 2024/2025 report, seven questions pertaining to the Toxics in Aquatic Life Vital Sign were identified as most important for the region:

- Are biosolids a significant source of CECs, including PFAS, to the surface water/groundwater/Puget Sound?
- What are the primary loading pathways for toxic contaminants, including CECs, to "enter the Sound (e.g., runoff/CSOs vs. post-processing sewage [outfalls])"? (p. 1)[2]
- Where are the geographic priorities for stormwater retrofits necessary to intercept road-derived toxics (6ppd, PAHs, etc.) to protect salmonid populations in Puget Sound (i.e. coho and chinook), especially important prey populations for Southern Resident Killer Whales?
- What biomarkers (cellular, molecular, genetic) can be used to monitor effects of chemical exposure in various organisms (fish, shellfish, etc.)?
- What are the cumulative effects of pharmaceuticals, CECs, and legacy contaminants (PCBs, PAHs, PBDEs, etc.) exposures on species in Puget Sound?
- What is the cumulative impact of toxics, mixtures, and other stressors (e.g., temperature, pathogens) on species, including salmon?
- What are the priority compounds in stormwater?

How do priorities connect to management?

Biomarkers are bodily indicators of the health of a human, fish, or other animal. Understanding which biomarkers in Puget Sound species are connected to toxic pollution would enable scientists and managers to more directly monitor chemical impacts and help identify toxic hotspots and relevant management actions.

[2] Stormwater Strategic Initiative. (2021b, February 5). *Toxics in Puget Sound red flags workshop Q&A* [Workshop sessions]. Toxics in Puget Sound Red Flags Workshop, Puyallup, WA, United States. https://pspwa.app.box.com/s/m4ww5rzli8fdl4u10dwb0p3rrfi05p20/file/900070648408

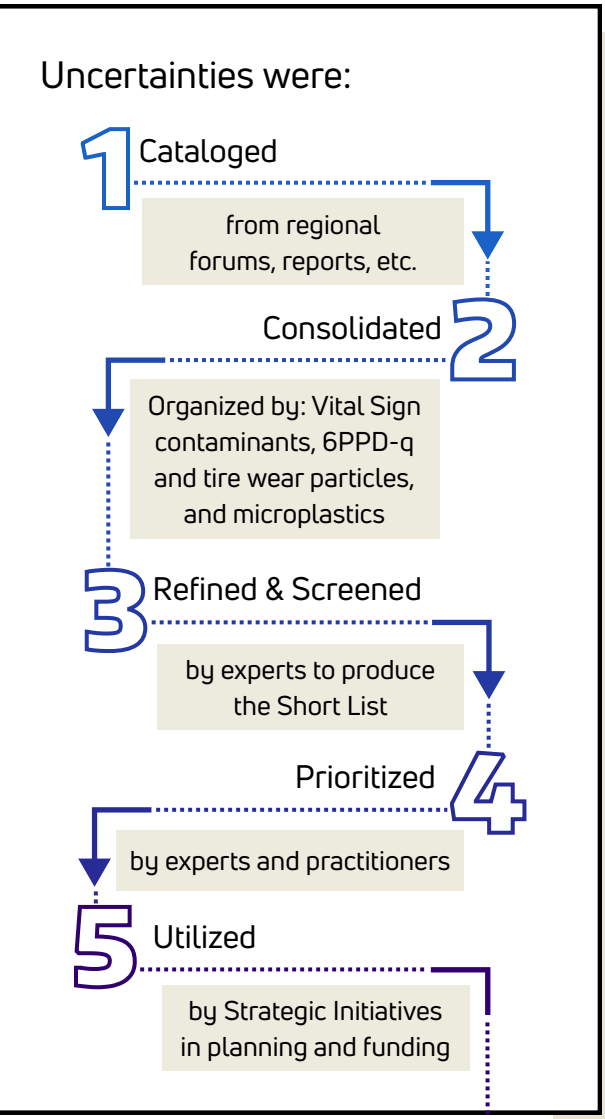
TOP 5 RESEARCH PRIORITIES FOR MICROPLASTICS

During the prioritization process detailed in the Research Agenda Update 2024/2025 report, five microplastics research topics were identified by experts as most important for the region:

- Develop/adopt a standard analytical method/protocol for microplastics in Washington State, including a focus on tire wear particles.
- What is the relative distribution of microplastic sources (e.g., fishing gear, clothes, etc.) and the primary pathways (e.g., stormwater, aerial deposition, in water activity, etc.) of microplastics in Puget Sound?
- What is the distribution of microplastics among different matrices (e.g., sediment, fish, water) in Puget Sound?
- What is the toxicology of microplastic fibers across a range of types, sizes, and species?
- How effective are stormwater BMPs (e.g., trash capture devices) at removing microplastics?

How do priorities connect to management?

There is currently limited information on the amount of microplastics in different parts of Puget Sound. Regulators and managers need to know the abundance and types of microplastics, and where they accumulate, to understand potential impacts to fish and options for management actions.



Process Diagram, describing the methodology used to determine top research priorities

PROCESS

When the Toxics in Fish Implementation Strategy was developed in 2019, the University of Washington Puget Sound Institute (PSI) curated a toxics research agenda composed of prioritized uncertainties that regional experts identified as barriers to management and recovery actions. In 2024, PSI re-engaged with researchers and practitioners to update the toxics research agenda.

Experts prioritized scientific uncertainties that were most critical for improving management and planning activities in Puget Sound (see process diagram and the Research Agenda Update 2024/2025 report for more details). Distinct but parallel processes identified research and monitoring priorities for three topic areas: the Vital Sign contaminants, 6PPD-Q, and microplastics.

Research to address these priority questions will improve regional understanding of the sources, occurrence, and impacts of chemical pollution, and identify effective mitigation measures to reduce harm. The full toxics research agenda is documented in PSI's Grand Uncertainties Matrix, a database of research priorities for Puget Sound recovery as part of the National Estuary Program and Puget Sound Geographic Program.

LEARN MORE

Learn more about PSI's work to identify priority research questions for Puget Sound at our Research Agenda webpage. Researchers and funders are encouraged to pursue projects that will contribute new information related to these toxics research priorities; this research agenda aims to mobilize and coordinate regional research activity to resolve knowledge gaps. Please contact Sandra Dorning at sdorning@uw.edu with any questions about the research agenda, its management context, or its development.

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