Stormwater Impacts to Aquatic Species: Why We Care About Benchmarks

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ANCHOR QEA

Source: EPA, https://www.epa.gov/npdes/stormwater-smart-outreach-tools

Where Stormwater Flows, Everything Goes

Macroinvertebrates

- “Stream bugs” include insects, worms, crustaceans, snails, clams, etc.
- Indicators of biological health of stream systems
- Filter feeders and grazers
- Stormwater inputs change benthic macroinvertebrate composition, biomass, abundance, and diversity

Mosquitos

Worms

Caddisfly

Salmonids

- Salmon and trout species:
  - Chinook, coho, chum, pink, sockeye salmon
  - Bull, steelhead, cutthroat trout
- Anadromy: rear in freshwater, move to ocean to grow and mature, return to freshwater to spawn
  - Not all salmon and trout are anadromous
- Feed on macroinvertebrates, crustaceans, and fish
- Stormwater contaminants affect behavior and physiology

Killer Whales

- Different ecotypes
  - Transient (feed on marine mammals)
  - Resident (feed on fish, preferring Chinook salmon and other salmonids)
  - Offshore (feed on a variety of squid and fish)
- Resident populations (J, K, and L pod)
  - 75 individuals, as of December 2025
- Stormwater affects killer whale physiology, but to what extent is unknown

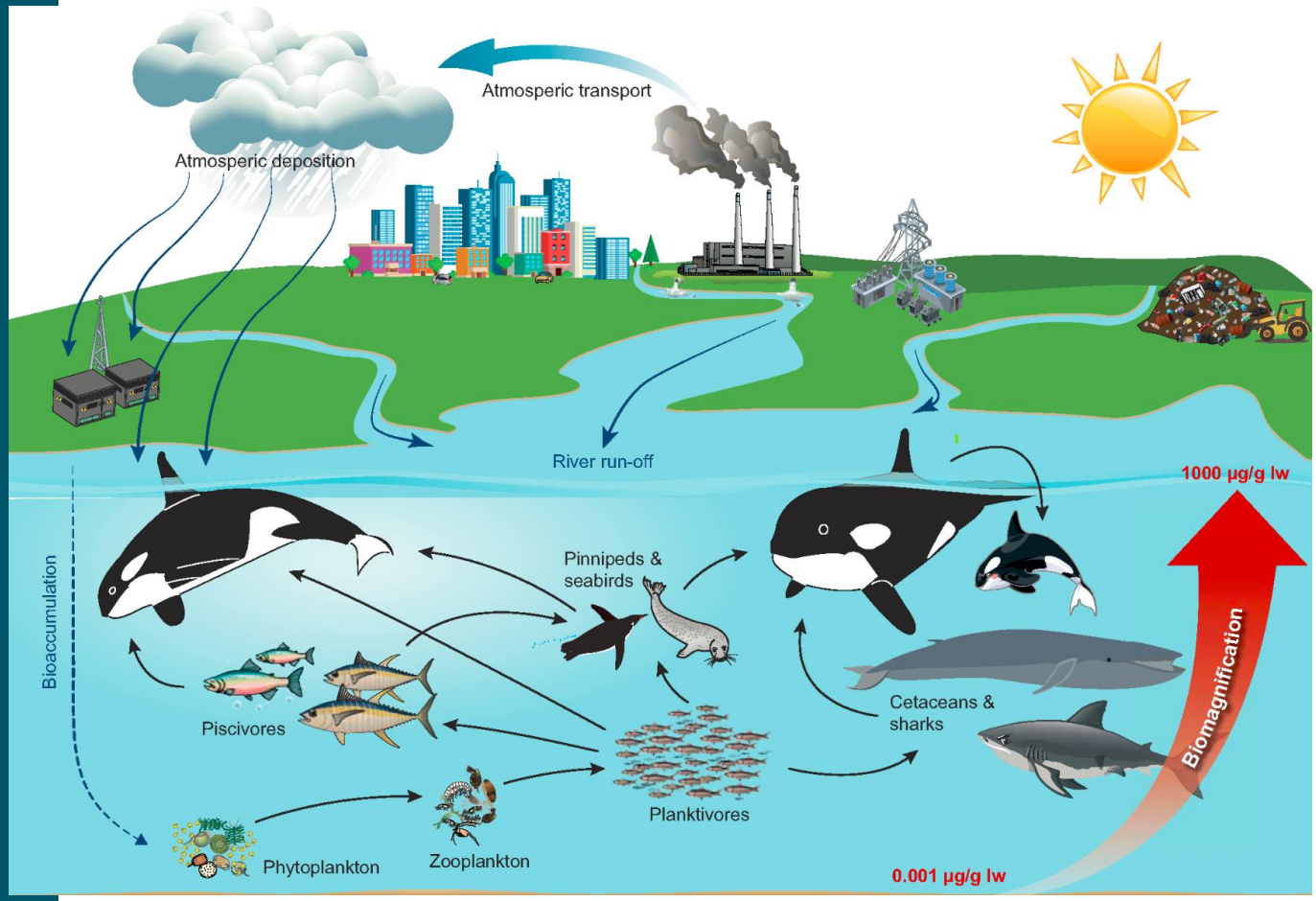
Impacts on Aquatic Organisms

Biomagnification

- Increasing concentration of toxins as they move up the food chain

Bioaccumulation

- Buildup of toxins within an individual over time
- Absorbs a toxic substance faster than it can eliminate it



Source: https://ar.inspiredpencil.com/pictures-2023/fall-food-web-whale

“Canary in the Coal Mine”

- Trigger species that are particularly sensitive to a contaminant
  - Canary, carbon monoxide
  - Bald eagles, DDT
  - Bumblebee, pesticides
  - Coho salmon, 6PPD-quinone

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Stormwater Contaminants

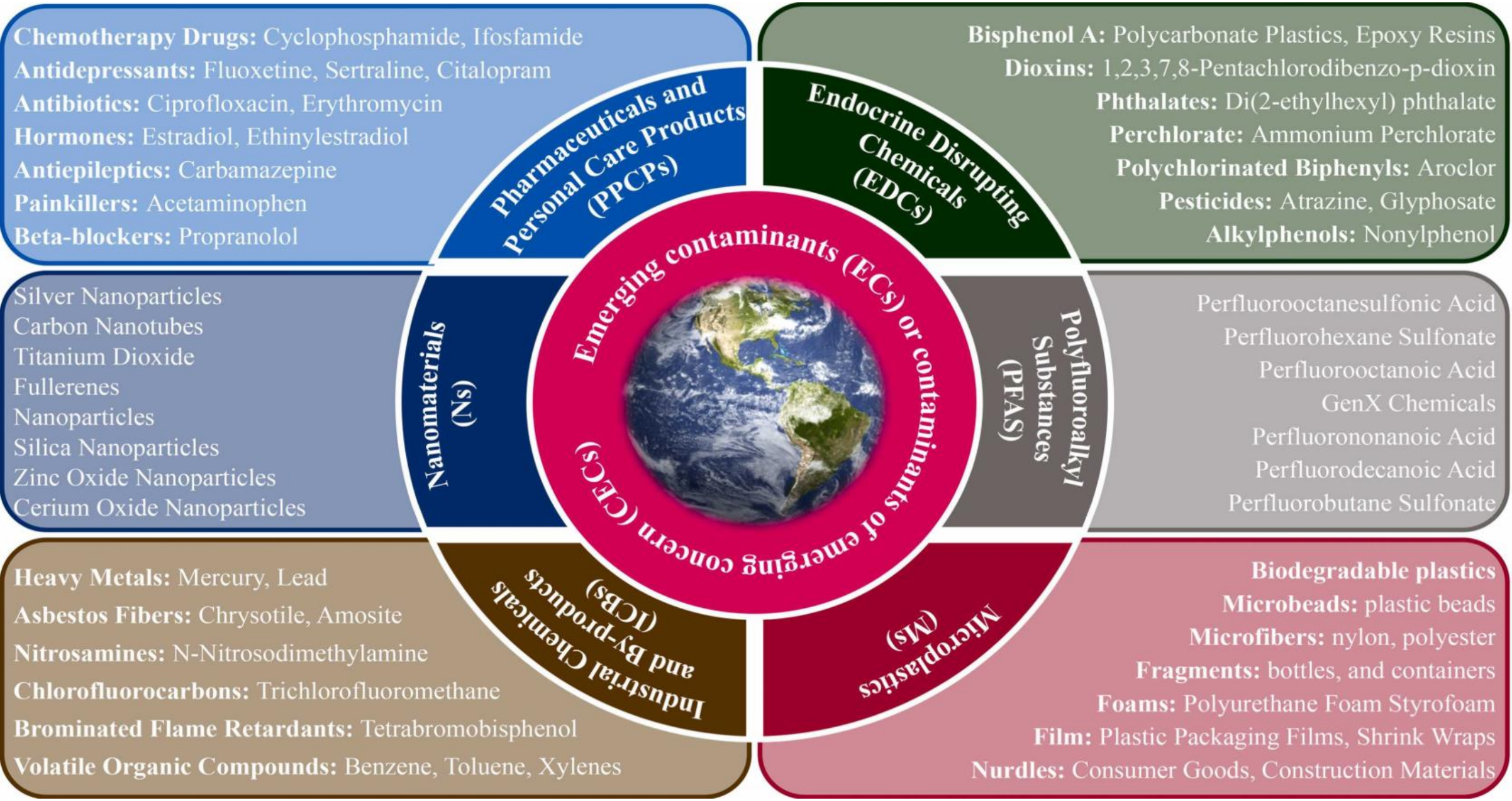
Metals (copper, zinc, mercury, nickel, cadmium, etc.)

Nutrients (phosphorus, nitrogen, ammonia, etc.)

Pesticides, herbicides, fungicides

Petroleum products

Suspended sediment



Source: Li, X., X. Shen, W. Jiang, Y. Xi, and S. Li, 2024. "Comprehensive review of emerging contaminants: Detection technologies, environmental impact, and management strategies." *Ecotoxicology and Environmental Safety* 278:116420

Water Quality Metric: Turbidity

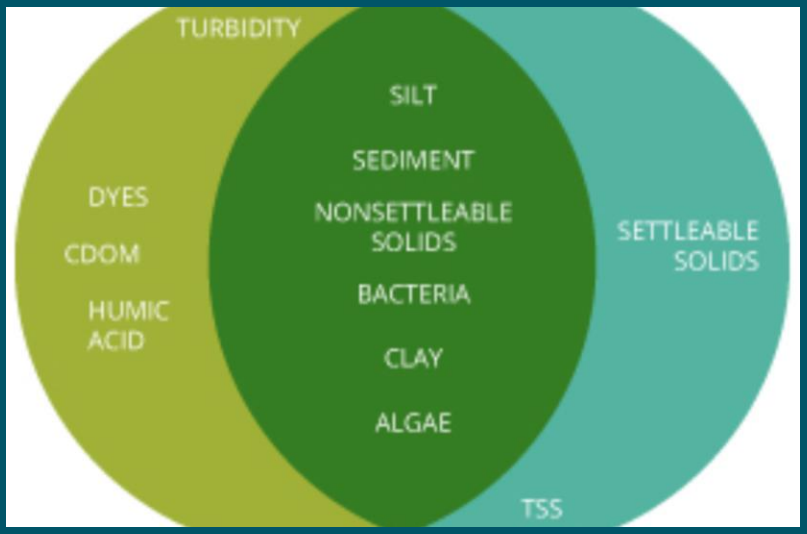
Turbidity is the measure of water clarity

- Fish
  - Decreased light penetration
  - Hinders visibility (predation)
- Affects other water quality parameters
  - Increased temperature
  - Reduced dissolved oxygen
  - Increased nutrient concentrations

Water Quality Metric: Suspended Sediment

Total suspended solids (TSS) is the concentration of suspended particles, including soil particles (clay, silt, organic matter), algae, and microscopic organisms

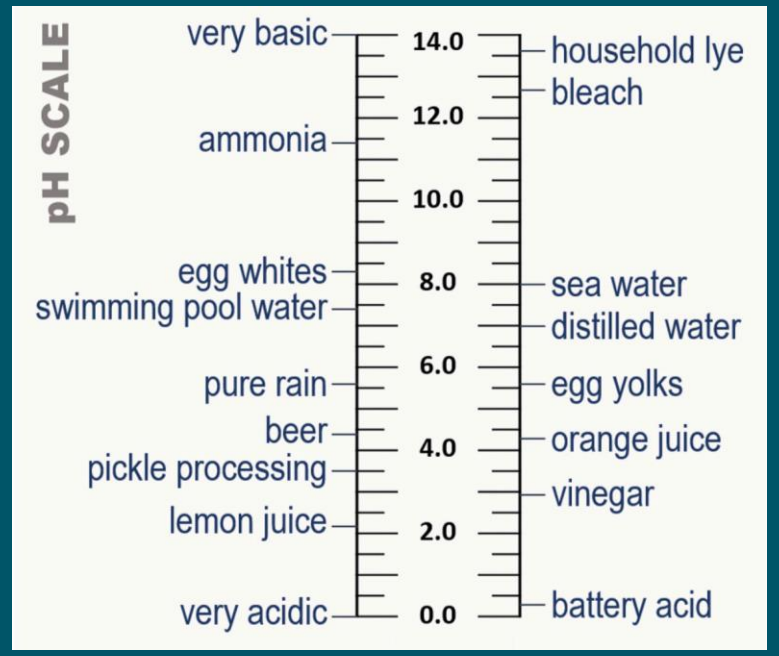
- Macroinvertebrates:
  - Clogs filter-feeding systems
- Fish
  - Clog fish gills
  - Reduce fish resistance to disease
  - Alter egg and larval development

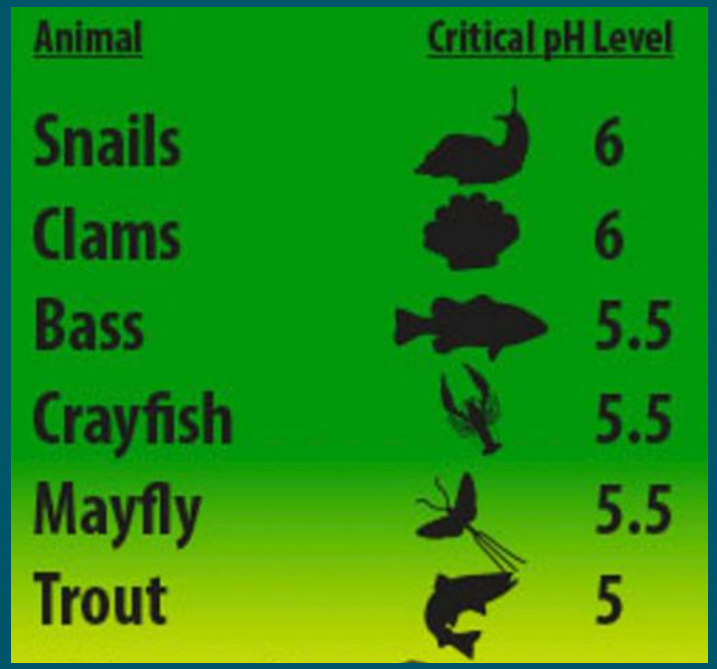


Water Quality Metric: pH

pH is the concentration of hydrogen ions (H+) in a sample and is measured to determine the acidity of water

- Macroinvertebrates
  - Damage shell and exoskeleton
- Fish
  - Damage skin and gills
  - Eggs
- Water quality parameters
  - Metals are more soluble at lower pH





Contaminant: Copper

Source: vehicle brake pads, roofing materials, treated wood, and pesticides

- Macroinvertebrates
  - Metal bioaccumulates
  - Reduces biomass and diversity
- Salmonids
  - Olfaction and homing abilities
  - Predator avoidance and prey detection
  - Social interaction

Contaminant: Zinc

Source: moss control products, roofing and building materials, vehicle tire and brake wear, and chain-link fencing

- Acutely toxic to freshwater organisms at low concentrations
- Outcompete other essential elements (calcium)
- Changes in plant growth, cellular damage, and reproductive problems
- Toxicity related to pH

Contaminant: PFAS

"Forever chemicals" are intentionally designed not to break down naturally

- Found in blood of people and animals
- Research ongoing on harmful health effects in humans and animals
- Thousands of PFAS chemicals found in many different consumer, commercial, and industrial products

Contaminant: 6PPD-quinone

Source: 6PPD is a chemical that prevents tires from degrading and reacts with ozone to create 6PPD-quinone

- Recent CEC with ongoing research to inform regulatory levels and extent of aquatic impacts
- Acute toxicity risks, particularly in coho salmon
- New research on lethal and sublethal exposure on coastal cutthroat trout

What questions do you have?