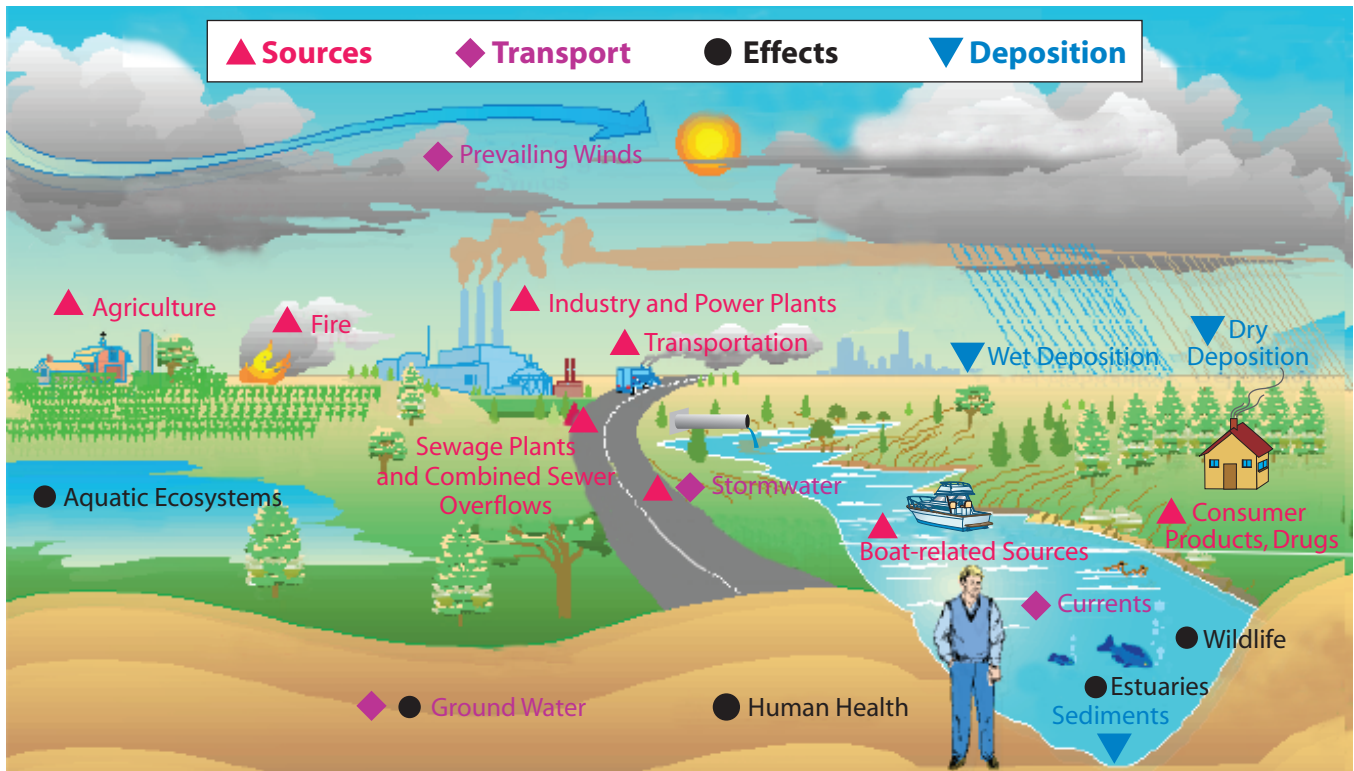


# SECTION FOUR

# Toxic Pollution



**Toxic Chemical Pathways.** Major toxic chemical pathways including sources, transport mechanisms, deposition, and effects are illustrated. Whether the toxics enter the watershed from point sources such as pipes, smokestacks, and internal combustion engines, or are transported and deposited by rain (wet deposition), wind (dry deposition) and stormwater runoff, toxic chemicals are finding their way into freshwater and marine aquatic ecosystems.

Adapted from National Science and Technology Council Committee on Environment and Natural Resources, Air Quality Research Subcommittee, 1999.

## Introduction

Toxic chemicals are the major stressor impairing Maine’s marine and estuarine waters (DEP 2008). The toxic chemicals addressed by CBEP’s indicators include two primary types of pollutants: (1) heavy metals and (2) organic chemicals like polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), pesticides, and dioxins and furans – bonded forms of carbon, hydrogen and other atoms. Those organic chemicals break down slowly into their component parts, but as they do, they and their metabolites (breakdown products) can be toxic to living organisms. Since the 2005 *State of the Bay* report and the 2007 report *Toxic Pollution in Casco Bay*, CBEP has added a new class of contaminant chemicals to the indicators it

monitors: “contaminants of emerging concern,” chemicals that have not traditionally been monitored or regulated. Those include persistent organic chemicals like polybrominated diphenyl ethers (PBDEs) and perfluorinated chemicals (PFCs) as well as pharmaceuticals and personal care products (PPCPs). Such contaminants are being found worldwide in aquatic environments, including Casco Bay.

Major pathways by which toxic chemicals enter the environment are illustrated in the diagram above. Sources of the toxic chemicals found in Casco Bay include the following:

- **PAHs**, the most common toxic contaminants in the Bay, come primarily from combustion of fossil fuels and wood, but oil, fuel spills, and asphalt are also sources.



- **PCBs** are potent carcinogens formerly used in electric transformers and other industrial applications. While they were banned in the 1970s, they are still found in old landfills and dumps, and are present at high levels in the Fore River.
- **Planar PCBs** are the most toxic form of PCBs, and commercial PCB mixtures are their source (Tanabe *et al.* 1987).
- **Pesticides** are largely carried from lawns and fields to water bodies through stormwater runoff. Although banned since 1972, the pesticide DDT and its toxic breakdown products still persist in the environment.
- **Dioxins and furans** are formed when organic material is burned in the presence of chlorine. Incineration, pulp paper manufacturing, coal-fired utilities, diesel vehicles and metal smelting are all sources of dioxin in the environment. Although the pulp mill discharging waste into the Presumpscot River stopped doing so in 2000, dioxins and furans still reach the Bay through atmospheric deposition.
- **PBDEs** are organic contaminants used as flame retardants in a variety of consumer products. They enter the environment through runoff, municipal waste incineration and sewage outflows, as well as by leaching from consumer products, sewage sludge applied to land as bio-solids, and industrial discharges (Kimbrough *et al.* 2009).
- **PFCs** are heat-resistant, slippery industrial chemicals that are used, for example, as water, stain and grease repellants (*e.g.*, Teflon). They are released into the environment through manufacturing processes, as well as through industrial and consumer use.
- **PPCPs** include over-the-counter and prescription drugs, as well as personal hygiene and beauty products like soaps, hairspray and sunscreen. When consumers wash off, excrete, or discard such products down drains, they can pass through septic systems and wastewater treatment plants into the environment.
- **Butyltins** are toxic organometallic compounds, molecules in which metal is bonded to a carbon atom in an organic molecule. Butyltins enter the Bay's sediments primarily from marine anti-fouling paints.



- **Heavy metals** are dense metallic elements such as lead, mercury, arsenic, cadmium, silver, nickel, selenium, chromium, zinc and copper. Because they do not break down over time, metals delivered from point sources, stormwater runoff, or atmospheric deposition can accumulate in the environment. In addition, metals can bind with organic chemicals forming organometallic compounds such as methyl mercury and butyltin, which can be highly toxic. Sources of heavy metals include vehicle emissions, industrial processes, coal combustion, weathering of metal pipes, and incineration (CBEP 1996).

The following three indicators report on toxic chemical monitoring programs that CBEP and its partners and collaborators are undertaking in Casco Bay.

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