Toxic Contaminants of Sediments in Puget Sound

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John Dohrmann is a Technical and Policy Specialist with the Puget Sound Water Quality Action Team, responsible for a variety of issues, including sediment contamination. John was with the Puget Sound Water Quality Authority, the precursor to the Action Team, and was the lead staff for sediment issues during the development of the *1987 Puget Sound Water Quality Management Plan.* John was the Authority's Planning director when the *1991 Puget Sound Water Quality Management Plan* was approved by the Environmental Protection Agency as the first Comprehensive conservation and Management Plan to be completed under the National Estuary Program. John has been active in the National Estuary Program, participating in numerous technical meetings and training conferences. John has been working on sediment contamination for over 20 years. His first job in Washing State, in 1976, was monitoring the use of contaminated sediments as fill during the construction of a container terminal by the Port of Seattle. John worked on environmental issues for the Port of Seattle from 1976 until he joined the Water Quality Authority in 1985. Before moving to Seattle, John spent six years with the National Marine Fisheries Service in Woods Hole, Massachusetts, and Narragansett, Rhode Island. John has a bachelor's degree in fishery biology from New College, studied biological oceanography at the University of Washington, and plays lead alto sax for the Capital Area Concert Band.

TOXIC CONTAMINATION OF SEDIMENTS IN PUGET SOUND

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Nestled between the Cascade and Olympic Mountains in northwest Washington, the Puget Sound basin covers more than 16,000 square miles. Eighty percent of the area is land and the rest water. Puget Sound was carved by glaciers to depths of over 900 feet and has close to 2250 miles of shoreline. The Sound receives its deep, salty water from the Pacific Ocean. Circulation is driven by an average annual fresh water input of 39 million acre-feet and mixed by a daily tide range of almost 12 feet (at Seattle). Within Puget Sound are many large bays, creating a system of estuaries within the estuary.

The industrial history of Puget Sound is only 150 years old. By measuring chemical concentrations from sediment layers in cores, scientists have shown that the concentrations of toxic chemicals in sediments follow the history of discharges. Figure 1 shows how lead concentrations averaged over several stations in Puget sound have changed over time. This is the "background" level. Concentrations are much higher in hot spots in urban bays and industrial areas.

Concentrations of toxic chemicals in urban hot spots have been shown to harm a variety of marine life. Benthic populations are significantly altered and fish have high tissue levels and suffer liver lesions from exposure to toxic chemicals. For example, a study of the effects of toxic contamination along the west coast (Myers et al. 1993) found that an English Sole caught in Elliott Bay in Puget Sound was 34 times as likely to have liver neoplasms as English Sole caught in the Nisqually Reach, a relatively clean area of Puget Sound.

Public outrage over toxic contamination of sediments was a key factor in the establishment of the Puget Sound National Estuary Program. During the early 1980s, scientists reported that toxic chemicals in sediments were causing diseases in fish and health departments issued warnings not to each fish from urban areas. Public concern about toxic chemicals in dredged material led to the closing of several disposal sites. In 1985, the Puget Sound Water Quality Authority was established and directed to develop a comprehensive management plan for Puget Sound. The *1987 Puget Sound Water Quality Management Plan* was adopted in December 1986. Puget Sound became part of the National Estuary Program in 1988.

The Puget Sound Water Quality Management Plan, which is the Comprehensive Conservation and Management Plan for Puget Sound, sets the following goal for addressing sediment contamination:

> **"To reduce and ultimately eliminate adverse effects on biological resources and humans from sediment contamination throughout the Sound by reducing or eliminating discharges of toxic contaminants and by capping, treating or removing contaminated sediments."**

The strategy for achieving this goal is to: (1) classify sediments that cause adverse biological effects and significant human health risks; (2) implement Sound-wide controls on sources of contaminants causing sediments to fail the sediment standards; (3) provide rules and sites for disposal of dredged materials; and (4) expand the urban bay program to provide for additional source control and consideration of cleanup actions for existing areas of high sediment contamination levels.

The Washington Department of Ecology adopted sediment management standards for marine sediments in Puget Sound in 1991. They are published as a rule in Chapter 173.204, Washington Administrative Code. The standards consist of chemical concentrations plus bioassays. The sediment management standards also include cleanup screening levels which are used to designate hot spots for remedial actions.

Although the data from sediment cores show that concentrations of several contaminants have declined since coal went out of favor as home heating fuel and clean air and clean water laws were adopted, more source control is needed. Sediment standards are being considered when new NPDES permits are written and many point source dischargers have been required to survey the sediments around their outfalls. This information will be used to include additional treatment in future permits. Stormwater management requirements are being placed on new developments. Combined sewer overflows and existing urban stormwater systems are some of the most serious ongoing sources.

The Puget Sound Plan sees navigation dredging as a positive opportunity to clean up historic sediment contamination. A multi-agency project developed new sites for unconfined open water disposal of clean sediments plus the testing and decision standards for those sites. Material that is unsuitable for the open water sites has to go to confined disposal. Standards for confined disposal sites have been developed but each dredging project must establish its own confined disposal site. The Corps of Engineers, in cooperation with state and federal partners, is currently finishing a study of options to provide multi-user confined disposal sites (Army Corps of Engineers and Washington Department of Ecology, in press).

The Washington Department of Ecology has compiled a database of all available measurements of sediment contamination and used it to identify sites needing cleanup. The best available estimate is that out of 3,200 square miles of submerged lands, 6.4 square miles are so contaminated as to require active cleanup. One square mile can be addressed through capping in place. The other 5.4 square miles will require dredging of between 3.9 and 12.4 million cubic yards. The larger dredging volume would cover a football field with a pile half a mile high.

Sediment cleanups are occurring under state and federal superfund statutes, clean water act authorities, natural resource damage claims, navigation dredging and voluntary efforts. There is a shortage of confined disposal sites. This causes disposal to be expensive. This makes cleanup expensive, leading to delays while people fight over their shares of the cost. Because cleanup is expensive, landowners fear expensive liability if they allow a disposal site on their land. This fear of liability leads to a more severe shortage of disposal sites, further fueling the cycle of high

costs and delays. In addition, we lack a stable source of funds to pay the public share of cleanups.

Puget Sound has made significant progress in addressing toxic contamination of sediments. We have adopted sediment standards and modernized our approach to dredged material characterization and disposal. We have identified sites that need cleanup and have general agreement on cleanup techniques. The main barriers to achieving the goal are the lack of disposal sites for cleanups, lack of funding for the public share of cleanup, and the problems that historic contamination causes in identifying and correcting ongoing sources.

Web sites for further information:

Puget Sound Action Team	www.wa.gov/puget_sound/
Washington Department of Ecology	www.wa.gov/ecology/sea/smu/sediment.html
Seattle District Corps of Engineers	www.nws.usace.army.mil/dmmo/homepage.htm
National Marine Fisheries Service	www.nwfsc.noaa.gov/pubs/nwfscpubs.html

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Lead Concentration

sediment dry weight