

# The sky is falling (less) onto Puget Sound

October 4 2010

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Research by PNNL scientists Jill Brandenberger and Gary Gill is helping to identify sources of toxic pollution in the Puget Sound. Credit: Pacific Northwest National Laboratory

Most toxic pollution falling onto Puget Sound's waters has decreased – some by as much as 99 percent – below earlier estimates, according to a region-wide study. Despite the overall decline, the study found that industrial areas like Tacoma still have the Puget's Sound's highest air-deposited contamination levels.

The study, by researchers at the Department of Energy's Pacific Northwest National Laboratory and Texas A&M University at Galveston, found the amount of trace metals like arsenic, lead and copper falling onto the Tacoma region have decreased significantly since PNNL last measured air-deposited pollution there in 1991. But other contaminants like mercury showed a more modest decline of just 35

percent.

"Regulations and increased public focus on pollution prevention appear to be paying off," said the study's lead researcher, PNNL marine chemist Jill Brandenberger. "But our awareness of some chemicals wasn't very high when those initial laws were passed decades ago. As a result, chemicals like flame retardants weren't included, allowing them to accumulate in the Puget Sound."

The study is helping the Washington state Department of Ecology update its measurements of all toxic sources for Puget Sound. Gov. Christine Gregoire and the state Legislature charged the Department of Ecology and the Puget Sound Partnership with restoring the Sound, which is burdened with pollutants and other problems. To do that, officials need to know how much and where pollution is entering the Sound. This prompted the Department of Ecology to measure toxics in the entire Puget Sound through projects such as the PNNL-led study.

## **Trace metals down, Tacoma's industrial area above average**

Pollution, unfortunately, doesn't often stay put. It's transported between the land, water and air when nature moves it. One way it moves is through atmospheric deposition, or when pollution falls from the sky and onto the surface of water or land.

To measure air-deposited pollutants throughout the region, researchers placed collection stations at eight sites on the Puget Sound shoreline between August 2008 and October 2009. Equipment at each site collected various types of toxic chemicals falling from the sky along with rain. The collected rain was analyzed at PNNL's Marine Sciences Laboratory in Sequim and by oceanographer Patrick Louchouart at

Texas A&M University at Galveston.

The study shows that about 770 pounds of arsenic, 2,400 pounds of lead and 6,000 pounds of copper are currently deposited onto the Sound annually. That's significantly less than initial estimates that the Department of Ecology developed in 2007 with data from PNNL's previous Tacoma study and a scientific literature review. The initial estimates predicted that 6,800 pounds of arsenic, 68,000 pounds of lead and 68,000 pounds of copper were being deposited onto the Sound each year.

Tacoma, like the rest of the Puget Sound, also experienced an overall decrease in contaminants. But data collected near the Port of Tacoma on Commencement Bay stuck out like a sore thumb, Brandenberger said. That site, on the bay's southwestern end, consistently recorded higher deposition rates than the rest of the Sound. For example, the daily deposition rate of copper and lead was 10 times higher there than any other place measured in Puget Sound.

Researchers reasoned that industrial activities – including paper milling and oil refining– and cars passing on nearby Interstate 5 increased that site's pollution levels. The high pollution levels were also limited to the area close to industrial activity. There was significantly less pollution at a second Tacoma area station placed on the opposite end of Commencement Bay.

"Industrial activities can create a significant spike in pollution within a small area," Brandenberger said. "It's important to note that the Port of Tacoma site probably isn't the only one on the Sound with such high air-deposited pollution levels; it just happened to be the only industrial site in this study."

## **Mercury on a more gradual decline**

Airborne mercury contamination, on the other hand, showed a less dramatic decrease from the state's earlier estimates. Data collected in this study showed about 44 pounds of mercury are deposited onto the Puget Sound each year, compared to the 68 pounds predicted before.

But mercury's numbers might not be a reflection of the effectiveness of local or national environmental laws. Instead, mercury in the Puget Sound could be coming from afar. The heavy metal tends to travel in the air as a gas or very small particles. Such behavior allows mercury to move extremely long distances –even over entire continents and oceans – via the atmosphere.

## **PBDE: New chemical on the block**

New to this study was a class of chemicals called polybrominated diphenyl ethers, also known as or PBDEs. PBDEs have been used as flame retardants since the 1970s, but they've only recently come under scrutiny for accumulating in humans and wildlife. Previous research indicated they may cause problems in the liver and thyroid and alter brain development. Washington state banned the use and manufacturing of some PBDEs in 2007.

This study showed that between 35 to 53 pounds of PBDEs enter the Puget Sound directly from the air each year. It's unknown if that represents a decrease or an increase, however, as PBDEs weren't measured throughout the Puget Sound until this study. But current measurements are consistent with recent data collected for other research projects in Vancouver, British Columbia.

## **Into the woods**

The study also helped identify the sources of some of the Puget Sound's

pollution. Researchers examined a particular group of cancer-causing contaminants known as PAHs, or polycyclic aromatic hydrocarbons. PAHs are made when fuels like petroleum and wood are burned. The team analyzed the makeup of PAHs collected on the Sound to determine what is being burned in the region.

They found a large percentage of the region's PAH pollution comes from wood. Most major metropolitan areas have PAHs floating in the air that are mostly made from coal or petroleum combustion. But many Puget Sound residents rely heavily on burning wood to heat their homes. And the region experiences frequent weather inversions that cause air to hover over the same location for long periods, causing the emissions from the wood stoves to stick around longer. Seasonal fires in the Northwest's forests also likely influence the kind of PAHs found in Puget Sound rainfall, the researchers noted.

## **Focusing on water runoff**

But air-deposited contamination isn't the largest source of pollution on the Sound, the study suggested. Brandenberger and colleagues compared this study's data to information collected during previous PNNL research on Puget Sound sediments. Air-deposited contamination levels were just 1 to 5 percent of some pollutants found in the Sound's sediments during the previous study, they noted. The researchers hypothesized that the Puget Sound watershed – which includes hills that slope into the Sound and water runoff that collects pollutants as it rolls down those hills – to be the largest pollution source.

"The atmosphere is a source of toxics for [Puget Sound](#)," Brandenberger said. "But this study shows that we should focus more on limiting pollutants in stormwater runoff."

**More information:** Brandenberger, J.M., P. Louchouart, L-J Kuo,

E.A. Crecelius, V. Cullinan, G.A. Gill, C. Garland, J. Williamson, and R. Dhammapala. "Control of Toxic Chemicals in Puget Sound, Phase 3: Study of Atmospheric Deposition of Air Toxics to the Surface of Puget Sound," [www.ecy.wa.gov/pubs/1002012.pdf](http://www.ecy.wa.gov/pubs/1002012.pdf)

Provided by Pacific Northwest National Laboratory

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