Science & Technical Support Section's
SciFYI
King County
Department of Natural Resources and Parks
Water and Land Resources Division
A science section digest of current environmental issues in King County
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Why are Lake Washington fish contaminated with PCBs?

By Richard Jack and Jenee Colton

In 2002-2003, King County's Water and Land Resources (WLR) Division, in cooperation with the University of Washington, investigated the food web in Lake Washington. These studies included fish and invertebrate tissue testing for a large number of chemicals and documented high levels of polychlorinated biphenyls (PCBs) in multiple fish species. Based on these results, the Washington State Department of Health (WADOH) issued an advisory recommending limited consumption of northern pike minnow, yellow perch, and cutthroat trout because of high levels of PCBs (see **Table 1**). Since then, carp has also been added to the advisory.

TABLE 1.
Lake Washington Fish Consumption Advisory for PCBs

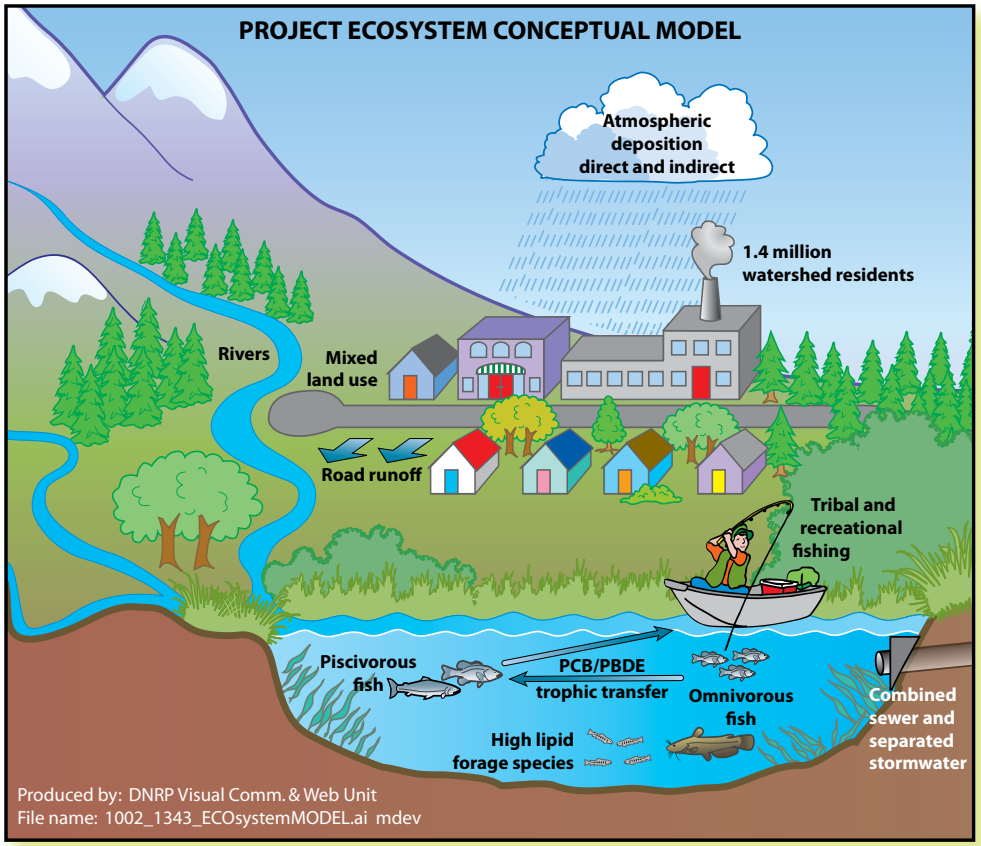
Species	Advisory
Northern Pikeminnow	Do Not Eat
Carp	Do Not Eat
Cutthroat Trout	Limit to 1 meal per month
Yellow Perch	Limit to 1 meal per week

Meal size varies with body weight with 8 oz. of uncooked fish assumed for a 160-pound adult. See WADOH website for details. www.doh.wa.gov/CommunityandEnvironment/Food/Fish/MealSize.aspx

The WLR Division recently completed a U.S. Environmental Protection Agency-funded study to investigate why Lake Washington fish have high levels of PCBs. This project was specifically designed to:

- Determine key pathways delivering PCBs to Lake Washington,
- Estimate the current amount (grams per year load) of PCBs entering Lake Washington each year,
- Estimate the minimum time necessary for fish tissue concentrations to meet WADOH consumption advisory thresholds after PCB load is reduced; and,
- Estimate size of PCB load reduction needed to remove fish consumption advisory.

Collection and testing of unfiltered water samples was necessary to provide data for analysis and modeling. Samples were collected



PCB pathways to Lake Washington, fish and citizens

from streams, rivers, combined sewer overflows [CSOs], stormwater discharges, floating bridge runoff, and atmospheric deposition as well as the lake itself.

Data from 146 PCB water samples were combined with modeled and existing flow data to develop annual loading estimates. Loading is the product of a chemical concentration multiplied by the volume. Total PCB loading to Lake Washington was estimated to be 672 grams/year; the relative proportions by pathway are shown in **Figure 1**.

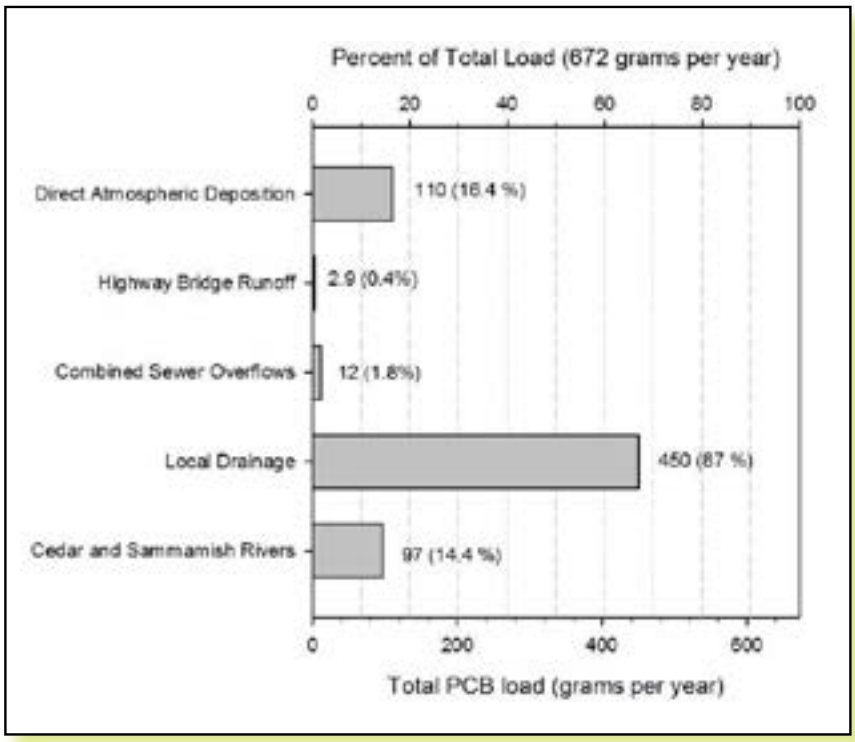


FIGURE 1.
Annual PCB load estimates for pathways to lake Washington.

The local drainage pathway represents both stormwater and base flow delivered to Lake Washington via streams. This pathway contributes the majority of the annual PCB load to the lake. Although stormwater only represents 40 percent of the annual water volume flowing into Lake Washington, 80 percent or more of the PCB load is from stormwater because of much higher PCB concentrations. The PCB loads delivered through direct atmospheric deposition on the lake surface and by the Cedar and Sammamish rivers are second in importance. Of the 672 grams / year total PCB load to the lake, an estimated 140 grams / year is exported from the lake outlet at the Montlake Cut. The remainder is buried in sediments or volatilizes (i.e. escapes to the air).

Water and Land Resources Division scientist developed a fate model to predict sediment and water concentrations given a certain PCB load. This was linked to a bioaccumulation model which predicted fish tissue concentration based on water and sediment concentrations. These linked fate and bioaccumulation models were used to describe the effects and timing of changes in load on fish tissues.

Based on the fate model, Lake Washington sediment and water PCB concentrations would decrease in response to theoretical and instantaneous PCB load reductions most dramatically within 20 years; sediment concentrations would continue to slowly decrease, assuming no other changes in PCB input or output to the lake, for about 40 years. While 20 to 40 years is a long time, in the absence of substantial watershed-wide efforts to reduce PCB loads, the existing fish consumption advisory is projected to remain indefinitely.

Despite a ban on the production and many uses of PCBs in the late 1970s, the fate and bioaccumulation modeling results estimate an 85 percent reduction in PCB loading is currently required to reduce Lake Washington fish tissue concentrations to safe levels and remove the existing WADOH fish consumption advisory. To progress toward reductions of this magnitude we recommend the following actions:

- Trace and identify ongoing PCB sources in current and historically used materials;
- Develop a statewide and/or regional PCB inventory in urban areas to enable targeted source control actions;
- Conduct outreach and engage decision-makers and the community in discussion about the current widespread sources of PCBs, and the financial and regulatory challenges inherent in controlling such sources, Evaluate the effectiveness of existing treatment technologies and best management practices for PCB removal; and,
- Develop models that estimate the contribution of atmospheric PCB deposition to stormwater runoff.

The full array of project products can be found at:
www.kingcounty.gov/environment/wlr/sections-programs/science-section/doing-science.aspx

WHAT ARE PCBs?

PCBs are one of a family of man-made organic chemicals known as chlorinated hydrocarbons. They were manufactured from 1929 until production was banned in 1979. Due to their non-flammability, chemical stability, high boiling point, and electrical insulating properties, PCBs were used in hundreds of industrial and commercial applications including electrical, heat transfer, and hydraulic equipment; as plasticizers in paints, plastics, and rubber products; in pigments, dyes, and carbonless copy paper; and many other industrial applications. PCBs persist in the environment today and are still found within materials that are in use.

Contributors to King County's Sci FYI

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Richard Jack is a water quality scientist within the King County Science and Technical Support Section with over 17 years of experience investigating water, sediment and tissue quality problems. He currently serves internal clients addressing contaminated habitat restoration projects, as section expert to the Wastewater Treatment Division on emerging contaminants, and supports source control investigations in the Lower Duwamish Superfund site.

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