EPA Region 10 Dive Unit

Demonstration of polyethylene device passive sampling, Lower Duwamish River, Seattle, WA

What: The Region 10 dive unit was asked to help plan and execute deployment and retrieval of passive sampling devices in the Lower Duwamish River to help demonstrate whether these devices could be useful in determining the bioavailability of PCBs on the river bottom in porewater and near bottom river water. A century of heavy industrial use has left the waterway contaminated with toxic chemicals from many sources – industries along its banks, stormwater pipes, and runoff from upland activities, streets and roads. Pollution in the river sediments includes polychlorinated biphenyls (PCBs), dioxins/furans, carcinogenic polycyclic aromatic hydrocarbons (cPAHs), and arsenic. Many of these chemicals stay in the environment for a long time, and have built up to unsafe levels in resident fish and shellfish. Because of contamination, state and local health departments warn against eating crab, shellfish, or bottom-feeding fish from the Lower Duwamish River. Migratory salmon are considered safe as they move quickly through the waterway into the Green River watershed.

Why: As part of this project, the EPA R10 Dive Unit assisted Principle Investigators from the U.S. Army Corp. of Engineers (ACOE), Seattle District, and the Massachusetts Institute of Technology (MIT). The objective of this investigation as described below is paraphrased from ACOE Draft Work Plan dated October 19, 2012.

The estimated surface-weighted average concentration of PCBs in LDW sediment across the waterway is currently ~ 380 µg/kg total PCBs (bulk). The current surface water concentration is ~ 1.2 ng/L total PCBs. These estimated average concentrations are predicted to decrease significantly post-cleanup (to include dredging & capping) over the next five to ten years. These reductions in bulk sediment PCBs concentrations are predicted to reduce benthic tissue concentrations and therefore associated human health risk. Animal tissue concentrations are estimated using a food web model, which uses equilibrium partitioning calculations to translate bulk sediment PCBs concentrations into freely-dissolved PCBs (FD-PCBs) concentrations in sediment porewater, and are directly correlated with tissue concentrations. Therefore, understanding the relationship between bulk sediment and FD-PCBs concentrations in LDW is important, and this study will directly measure FD-PCBs over a range of bulk PCBs sediment concentrations relevant to LDW cleanup.

Polyethylene (PE) passive samplers sorb FD-PCBs in sediment porewater and provide a direct measure of FD-PCBs concentrations *in situ*. It has previously been shown that PE can absorb organic chemicals like PCBs (Fernandez et al., 2009a). Furthermore, by using internal standards (i.e., performance reference compounds) impregnated in the PE before deployment, the samplers' incomplete equilibration with the sediments can be corrected (Fernandez et al., 2009b). Such PE samplers, when extracted and analyzed by GCMS, can measure pore water concentrations of individual PCB congeners down to about 1 pg/L. Consequently, total Arochlor concentrations found by summing the PCB homologues will have a sensitivity near 0.1 ng/L, a very difficult concentration to measure by analyzing pore water directly.

These data will inform and refine the Food Web Model in a range that is only calculated and not measured with respect to porewater. This would improve the relationship between predicted future sediment conditions and estimated biological response during the remedy which has been a focus of concern. Also, these data will serve as a partial baseline for the anticipated demonstration (by others) of activated carbon as a technological adjunct to Enhanced Natural Recovery in the waterway. There is a need for site-specific data to provide a sense of how the current (pre-construction) range of sediments fare in terms of FD-PCB and present-day amounts of soot and char

(i.e., black carbon). The data collected would thus provide beginnings of a framework for the Remedial Design phase of the LDW which could inform (at a later time) measurements of "dosing rates" of activated carbon (AC) and measures of pore-water FD-PCB reduction. With this new data, the food web model can be refined thereby improving the ecological and human health risk assessments.

Where: The survey was conducted in the Lower Duwamish River (see figure below).

When: Deployment occurred in November, 2012 and retrieval in January 2013, and again in July and October 2014.

How: Divers used surface supplied diving equipment and drysuits, drygloves, and full face masks to remain isolated from the contaminated diving environment. Decontamination took place as divers returned to the vessel. Divers placed and retrieved) passive samplers at the end of a submerged tagline attached to a fixed point (e.g. a piling) and invisible from the surface to prevent tampering. Core samples were taken of near surface sediments for further lab analysis.

Equipment: EPA vessel Monitor was used as the dive platform. Divers utilized surface supplied equipment to enhance the safety of the dive, and allow for extended bottom times as necessary.

Results: Photos, video, were conveyed to the project team, including EPA, USACE, and MIT staff. Data may be used to evaluate the ability of carbon based sediment amendments to further bind PCBs in place, as well as evaluate progress of other alternatives to remove available PCBs from the waterway.

More details:
http://yosemite.epa.gov/r10/cleanup.nsf/sites/lduwamish
http://www.facebook.com/EPADivers

Video coverage of 2012 survey:
King 5: http://www.king5.com/news/environment/EPA-divers-install-sensors-to-track-Duwamish-River-contamination-179402851.html

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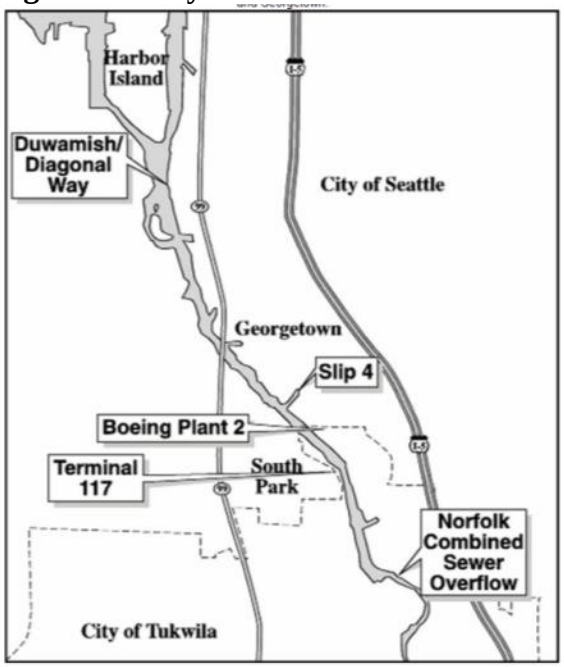
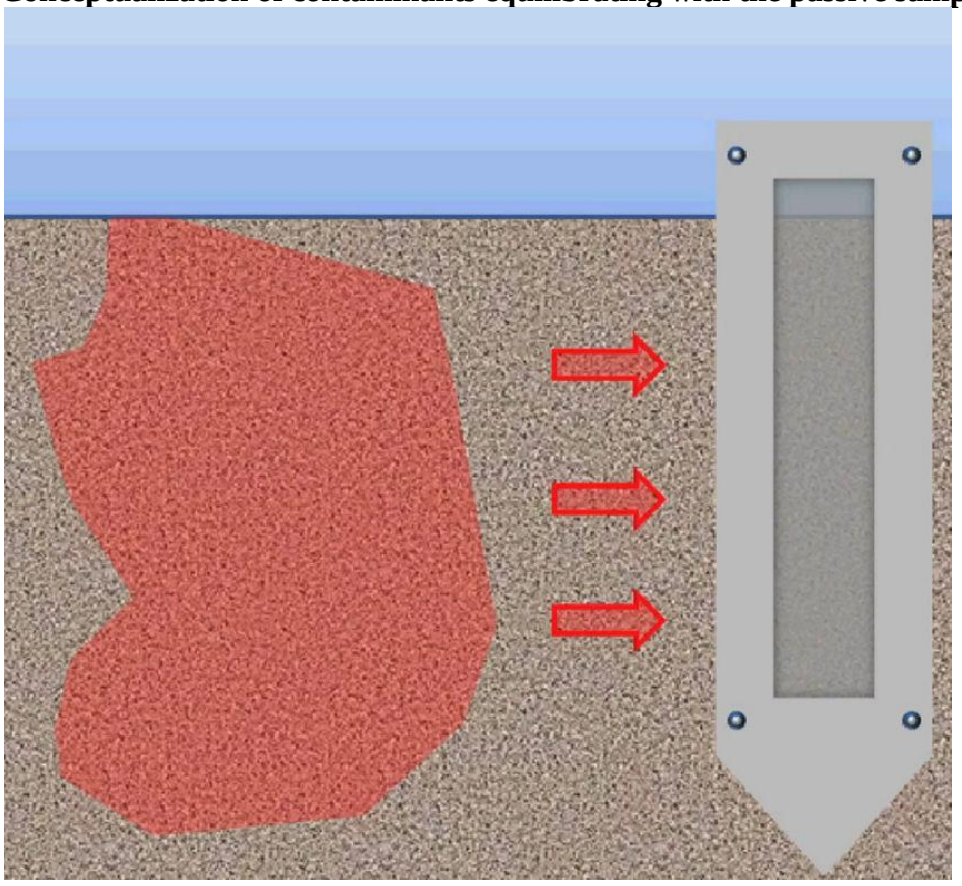
Photos/Figures:

Figure of study area



Conceptualization of contaminants equilibrating with the passive sampler media



Close up of passive sampler

Taking a core tube to the bottom to obtain a near surface sediment sample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HD


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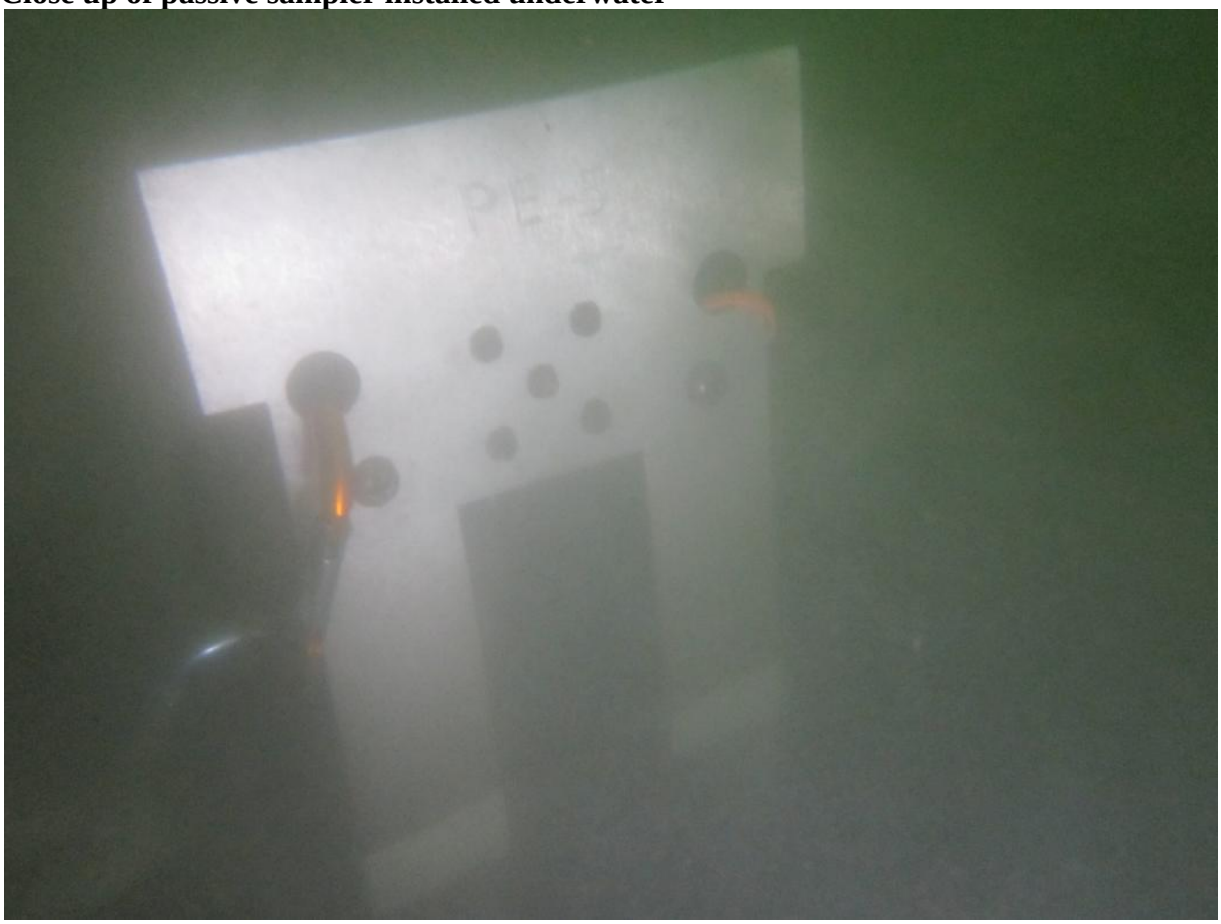
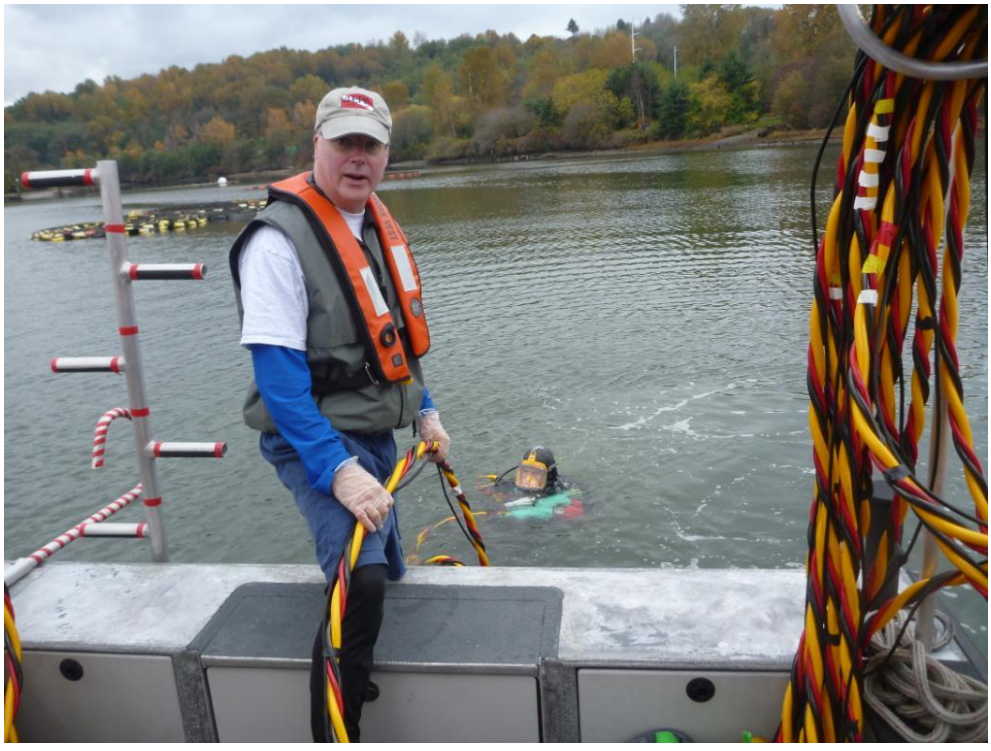
Conducting decon of the diver with a focus on areas that trap sediment

Close up of passive sampler installed underwater



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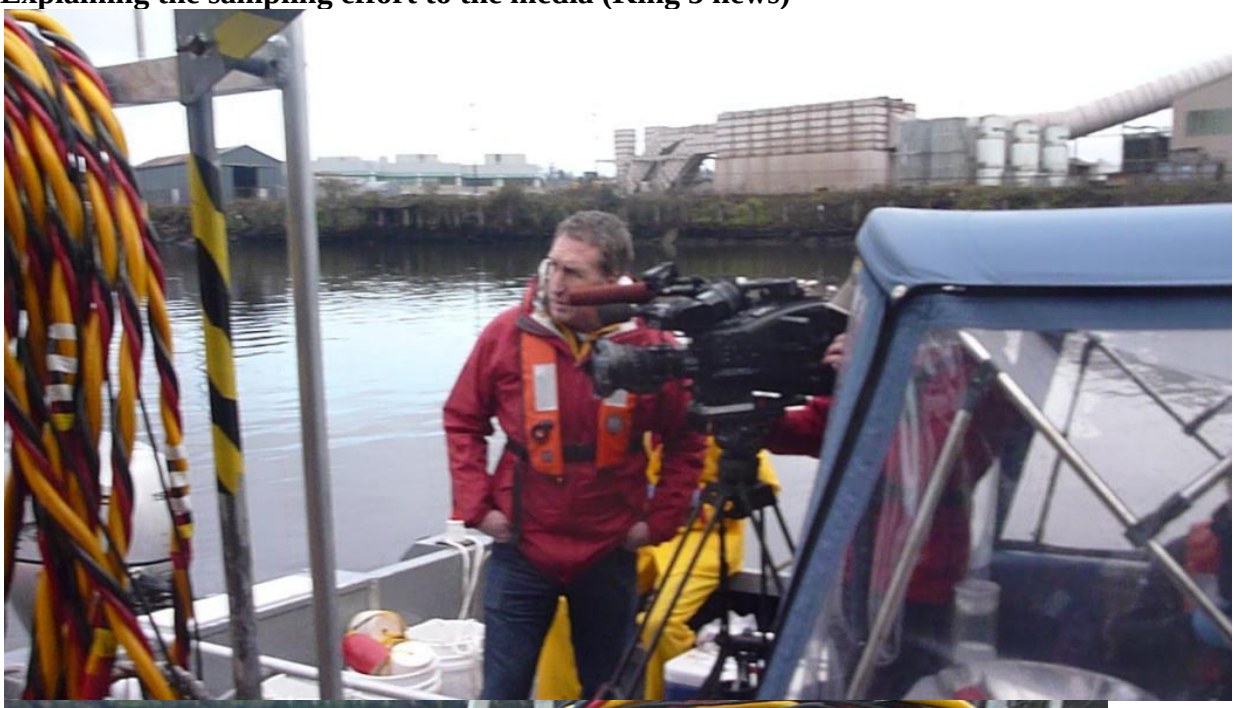
Explaining the sampling effort to the media (King 5 news)



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