Control of Toxic Chemicals in Puget Sound

Identification and Evaluation of Water Column Data for Puget Sound and Its Ocean Boundary

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Cover photo: Puget Sound

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Identification and Evaluation of Water Column Data for Puget Sound and Its Ocean Boundary

by

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Waterbody Numbers:

WA-18-0010 – Strait of Juan de Fuca (East)
WA-19-0010 – Strait of Juan de Fuca (West)
WA-01-0010 – Strait of Georgia
WA-PS-0230 – Puget Sound (North-Central)
WA-PS-0240 – Puget Sound (Central)
WA-PS-0270 – Puget Sound (South-Central)
WA-PS-0100 – Hood Canal (North)
WA-PS-0250 – Hood Canal (South)

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List of Acronyms

Following are acronyms and abbreviations used frequently in this report. Those used infrequently are not included.

BEHP	Bis(2-ethylhexyl)phthalate
DDT	Dichloro-diphenyl-trichloroethane
Ecology	Washington State Department of Ecology
EIM	Environmental Information Management database (Department of Ecology)
EPA	U.S. Environmental Protection Agency
KCDNR	King County Department of Natural Resources
MDL	Method detection limit
PAH	Polynuclear aromatic hydrocarbon
PBDE	Polybrominated diphenylether
PCB	Polychlorinated biphenyl
PCDD	Polychlorinated dibenzo-p-dioxin
PCDF	Polychlorinated dibenzofuran
TEQ	Toxic equivalent quotient (or concentration)
WAC	Washington Administrative Code

Abstract

This report summarizes the readily available data collected since 1995 on selected toxic chemicals in the water column of the Strait of Juan de Fuca, Strait of Georgia, and Puget Sound.

The Washington State Department of Ecology compiled a total of 15,000 potentially relevant sampling records. These data are needed to estimate the flux (movement) of toxic chemicals between the ocean boundary and Puget Sound.

The data will be used in the Puget Sound Toxicant Transport and Fate Box Model which will predict the effects of contaminant loadings on concentrations of toxic chemicals in the water column, fish, and other animals.

Data were sought for selected toxic heavy metals, persistent organic compounds, pesticides, and hormone disruptors. The metals data appear adequate to estimate fluxes at the ocean boundary and to provide representative water column concentrations for some cells of the Puget Sound box model. There is much less data on organic contaminants. The most useful data are for polychlorinated biphenyls (PCBs) and polybrominated diphenylethers (PBDEs) in the Strait of Georgia.

It is recommended that sampling be conducted for all of the organic chemicals and chemical groups of concern in the Strait of Juan de Fuca and Strait of Georgia boundary waters, as well as selected Puget Sound locations. There are gaps in the metals data for the Strait of Juan de Fuca, South Sound, and Hood Canal that should also be addressed through sampling.

Acknowledgements

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- Dr. Peter Ross (Fisheries and Oceans Canada) provided water column data from the Strait of Georgia.
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  - Randy Shuman (King County).
  - Mike Letourneau (U.S. Environmental Protection Agency).
  - Scott Redmond (Puget Sound Partnership).

Introduction

A number of environmental data compilation and analysis efforts are underway to support the Puget Sound Partnership's Action Agenda to control the influx of toxic chemicals to Puget Sound. The overall effort is being conducted in two phases.

Phase 1 consists of the recently published report *Phase I: Initial Estimate of Toxic Chemical Loadings to Puget Sound* (Hart Crowser et al., 2007). The Phase I project assessed toxic chemical loading from surface runoff, direct atmospheric deposition, publicly-owned treatment works, industrial discharges, and combined sewer overflows. Estimates were made on a broad geographical scale, in many cases using generic chemical concentration and flow data.

Phase 2 efforts are intended to refine the loading estimates, examine chemical transport and fate, and provide some of the foundation for assessing risks to human health and the ecosystem. One of the projects being conducted in Phase 2 was to review available water column data for toxic chemical for use in estimated chemical fluxes at the ocean boundaries to Puget Sound (i.e., the Strait of Juan de Fuca and the Strait of Georgia). Because very little information was available, the project was expanded to include other areas of Puget Sound.

Data from the boundary straits and Puget Sound are needed for the Puget Sound Toxicant Transport and Fate Box Model, currently under development. The model will predict the effects of toxic contaminant loadings on the concentrations of those contaminants in the waters and biota of Puget Sound. (www.ecy.wa.gov/programs/wq/pstoxics/f_subtask.html).

This report summarizes efforts to identify, obtain, and evaluate existing data on selected toxic chemicals in the water column of the Strait of Juan de Fuca, Strait of Georgia, and Puget Sound. Toxic chemicals in bottom sediments and biota are being assessed through separate Phase 2 projects.

Methods

Chemicals of Concern

Table 1 is the list of chemicals and chemical classes of concern from the Phase I report.

This list was based on recommendations by the Chemicals of Concern technical work group. It is comprised of chemicals typically found on short lists of prominent contaminants in the aquatic environment, with the possible exception of nonylphenol. Relative to other chemicals on the list, nonylphenol has only recently been recognized as having adverse health implications due to its endocrine disrupting characteristics.

For those chemicals listed in Table 1 as totals or as sums – PCBs, PAHs, DDT and metabolites, dioxin/furan TEQs, and PBDEs – data on the individual chemicals are preferred for modeling. Specific properties (e.g., octanol-water partition coefficient or K_{ow}) of individual chemicals or congeners within a group may result in large differences in transport mechanisms and fate among chemicals, particularly with respect to accumulation in biota.

Data on oil or petroleum was not sought for similar reasons and because of a lack of consistency in reporting units across studies (e.g., hydrocarbon ID, oil & grease, total petroleum hydrocarbons).

Table 1. Chemicals of Concern (modified from Hart Crowser et al., 2007).

Chemical of Concern	Category Addressed	Harm or Threat
Organics		
Total PCBs[1]	PCBs	Target of fish consumption advice; accumulation in fish, birds, mammals; associated with sediment toxicity and benthic community impairment.
Low molecular weight PAHs[2]	PAHs	Liver lesions and reproductive impairment in fish from urban bays; associated with sediment toxicity and benthic community impairment.
Carcinogenic PAHs[3]		Liver lesions and reproductive impairment in fish from urban bays; associated with sediment toxicity and benthic community impairment.
Other high molecular weight PAHs[4]		Liver lesions and reproductive impairment in fish from urban bays; associated with sediment toxicity and benthic community impairment.
Sum of DDT and metabolites DDE and DDD	Pesticides	Accumulation in fish, birds, and mammals; associated with sediment toxicity and benthic community impairment.
Triclopyr		Category thought to affect salmonids and stream health.
Total dioxin TEQs[5] from dioxins & furans	Dioxins and furans	Accumulation in birds and mammals; furans associated with sediment toxicity and benthic community impairment.
Bis(2-ethylhexyl)phthalate	Phthalate esters	Category shown to accumulate in fish, invertebrates, and sediment of urban waterways at levels triggering sediment cleanup activities.
Total PBDEs[6]	PBDEs	Accumulation in sediments, fish, and harbor seals.
Nonylphenol	Hormone disrupting chemicals	Category thought to cause reproductive impairment observed in fish from urban bays.
Oil or petroleum product[7]	--	Kills and reduces fitness of marine organisms.
Metals		
Arsenic	Metals	Associated with sediment toxicity and benthic community impairment.
Cadmium		Accumulation in shellfish.
Copper		Associated with sediment toxicity and benthic community impairment; affects salmonids and stream health.
Lead		Associated with sediment toxicity and benthic community impairment.
Mercury		Target of fish consumption advice; associated with sediment toxicity and benthic community impairment.
Zinc		Increasing concentrations may threaten aquatic resources.

[1] Sum of congeners, sum of Aroclors, etc. to be normalized as part of the project.
[2] Per WAC 173-204-320 this includes the low molecular weight PAHs: acenaphthene, acenaphthylene, anthracene, fluorene, naphthalene, and phenanthrene.
[3] Per EPA this includes the high molecular weight PAHs: benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, and indeno(1,2,3-c,d)pyrene.
[4] WAC 173-204-320 high molecular weight PAHs not on the EPA list of carcinogenic PAHs includes: benzo(g,h,i)perylene, fluoranthene, and pyrene.
[5] Toxic Equivalents, the combined toxicity of a mixture of polychlorinated dibenzodioxins (PCDDs) and –furans (PCDFs).
[6] Polybrominated diphenylethers, sum of congeners to be normalized as part of the project.
[7] Specified as crude oil, specific refined product (e.g., diesel, gasoline, heavy fuel oil) or analytical result as TPH-D or TRPH to be normalized as part of the project.

Data Selection

This effort focused specifically on marine water column data for 16 of the 17 chemicals and chemical groups in Table 1. The criteria for data selection were as follows.

Age of Data

Chemical concentrations in marine waters have changed over time, particularly for highly-regulated or recently banned chemicals. Also, during the mid-1990s, commercial and government laboratories developed new analytical methods that improved their ability to detect low concentrations of toxic metals and organic compounds. Therefore, only data collected since 1995 were considered to be representative of current conditions and, consequently, gathered for this project.

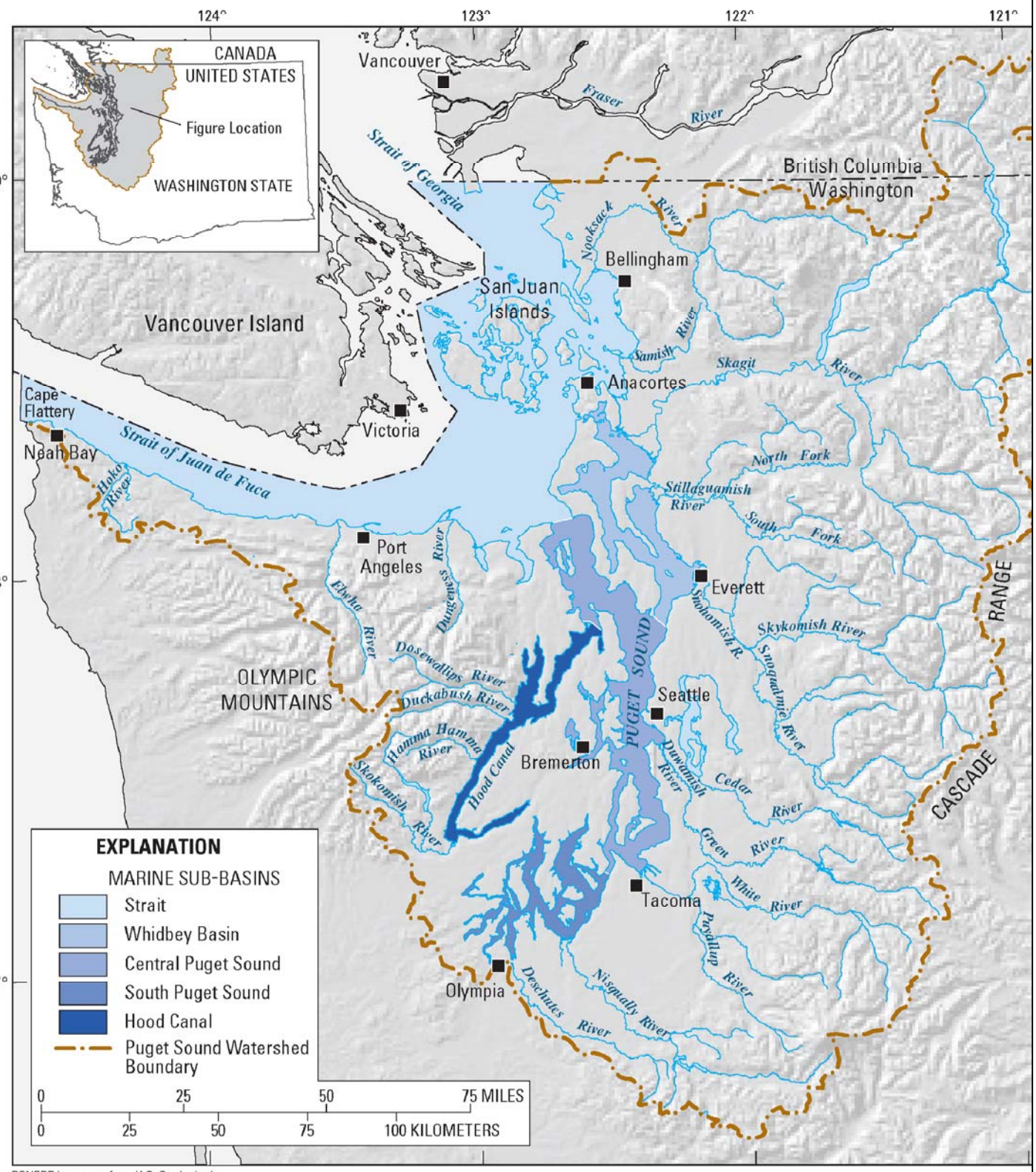
Locations

Puget Sound (Figure 1) is the largest fjord-like estuary in the continental United States. It consists of a series of interconnected deep (average depth of 140 meters or 460 feet) underwater basins separated by ridges called sills. These basins include the deep Main Basin (up to 280 meters [920 feet] deep) and the shallower South Sound, Hood Canal, and Whidbey Basins. Admiralty Inlet connects Puget Sound to the Pacific Ocean through the Strait of Juan de Fuca. Phase I used the term "Puget Sound" to describe all of Puget Sound, Hood Canal, Strait of Juan de Fuca, and Strait of Georgia within the state of Washington. The box model addresses only a portion of Puget Sound (Figure 2)

There are no formal locations for the oceanic boundaries to Puget Sound. For present purposes, the Strait of Juan de Fuca boundary could be approximated by a north-south line between the Olympic Peninsula and Vancouver Island, about midway between Neah Bay and Port Angeles, WA. The Strait of Georgia boundary could be approximated by an east-west line between the Washington mainland and Vancouver Island (roughly Bellingham, WA to Duncan, BC).

Toxic chemical data to feed the Puget Sound box model would ideally be centered in each of the 14 cells of the model. However, the expectation that most of the data would be found in highly contaminated urban bays, particularly near cleanup sites, was recognized early in the project.

Figure 1. Greater Puget Sound Area Showing Subbasins (from Hart Crowser et al., 2007).
(See next page.)



PSNERP base map from U.S. Geological Survey digital data 1:2,000,000, 1972
Albers Equal-Area Conic Projection
Standard parallels 47° and 49°, central meridian 122°
Washington shaded relief, USGS, 30 meter DEM
British Columbia shaded relief, NASA, SRTM 90 meter

N

Phase 1 - Initial Estimate of Toxic Chemical Loadings to Puget Sound

Regional Map of Puget Sound and Surrounding Area

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Figure 1

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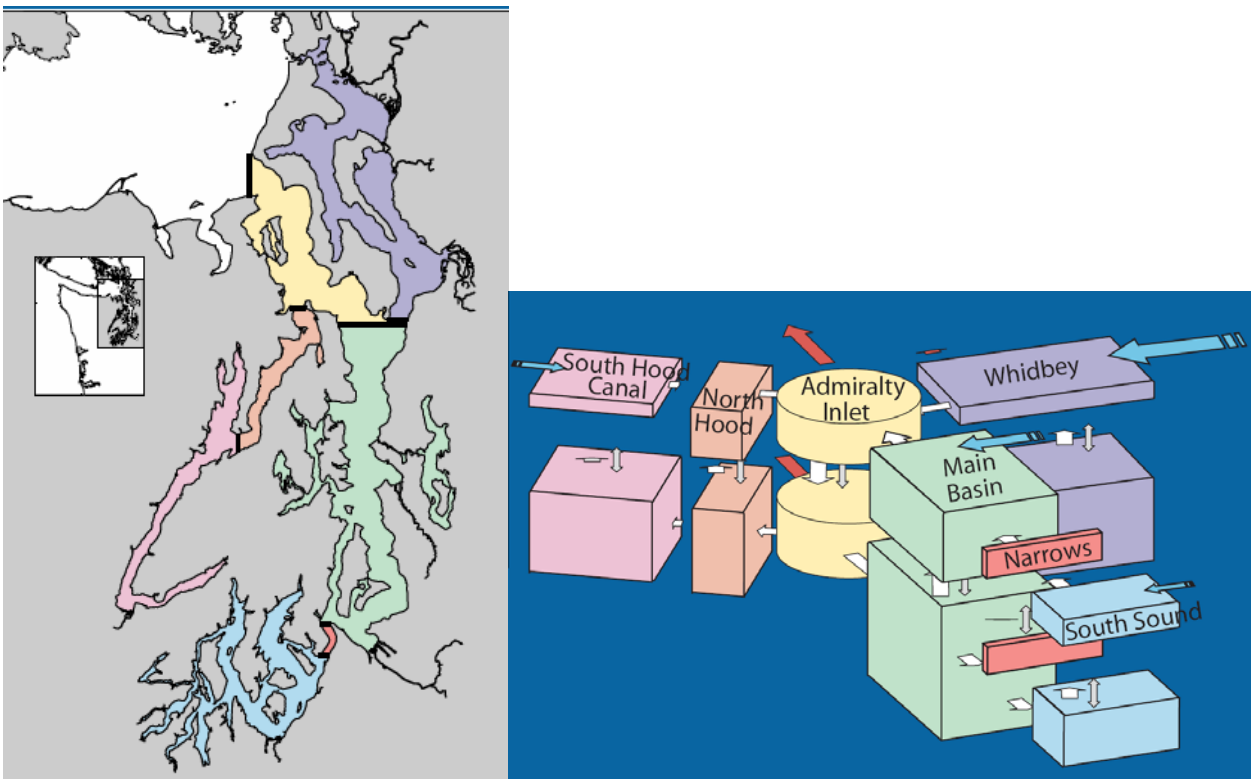

Figure 2. Cells of the Puget Sound Toxicant Transport and Fate Box Model (provided by Greg Pelletier, Washington State Department of Ecology, Olympia, WA).

Ancillary Data

Any ancillary laboratory data that might aid in interpreting the chemical concentrations or are considered vital model input variables were obtained along with the toxics data. These ancillary data included temperature, total organic carbon, dissolved organic carbon, total suspended solids, total dissolved solids, salinity, and specific conductivity.

An attempt was made to include the latitude and longitude of every sample, along with the requisite datum. If lat/long data were unavailable, information on sample locations was sometimes sufficiently detailed to assign an accurate position (e.g., "… *end of ferry dock*…" or "…*at green no. 5 navigation day mark*…"). Sampling information were also obtained, including sample depth, tide status, sample type (e.g., grab, composite), and sampling device.

Other information was noted such as the objectives of the sampling effort, as this can provide insight into the usability of the data. For instance, PAH data from an oil response may be useful information to spill investigators, but has limited use for the present effort.

Data Sources

The Department of Ecology made searches and specific requests for information of the following databases, data sources, or agency and individual resources:

- Ecology – Environmental Information Management (EIM) www.ecy.wa.gov/eim/
- EPA – STORET (both archive and current versions) www.epa.gov/storet/
- Georgia Basin/Puget Sound Research Conference Proceedings, 1998 – 2007 www.engr.washington.edu/epp/psgb/
- NOAA National Status and Trends Program http://specialprojects.nos.noaa.gov/
- U.S. Geological Survey, Water Science Center Office, Tacoma, WA http://wa.water.usgs.gov/
- Joint Effort to Monitor the Straits of Juan de Fuca (JEMS) http://prism.washington.edu/regionalissues
- King County Department of Natural Resources, Seattle, WA http://dnr.metrokc.gov/
- Environment Canada, Environmental Protection Branch, Vancouver, BC www.ec.gc.ca
- Fisheries and Oceans Canada, Institute of Ocean Sciences, Sidney, BC www-sci.pac.dfo-mpo.gc.ca/sci/facilities/ios_e.htm
- University of Washington, School of Oceanography, Seattle, WA www.ocean.washington.edu/2004/
- Online searches with Google Scholar
- Battelle Marine Sciences Laboratory, Sequim, WA http://marine.pnl.gov/
- Project ENVVEST for Sinclair and Dyes Inlets www.ecy.wa.gov/programs/wq/tmdl/sinclair-dyes_inlets
- Online searches of technical and professional journals, academic theses and dissertations, and scholarly articles with search tools such as: ACS Publications, GeoScienceWorld, InfoTrac, JSTOR, ScienceDirect, SpringerLink, and WorldCat.

In addition to the resources listed above, requests for data were made to dozens of researchers and agency staff too numerous to mention.

Database

The data were complied in an Excel® file format. The data compilation can be accessed on the *Control of Toxic Chemicals in Puget Sound* webpage, www.ecy.wa.gov/programs/wq/pstoxics. Search under *Puget Sound Toxics Water Column Data Summary.*

Results

The following sections contain a synopsis of the available data found on each chemical and chemical class of concern. Table 2 shows a summary of the search results. A table with the associated metadata is in the Appendix; as of this writing, the metadata compilation is incomplete.

Table 2. Number of Records Available for Marine Water Column Data.

Chemical	King County Dept. National Resources			Dangerfield et al. (1997)			Ecology EIM			Crecelius (1998)		
	PS	*SoG*	*SJF*	*PS*	*SoG*	*SJF*	*PS*	*SoG*	*SJF*	*PS*	*SoG*	*SJF*
Organics												
PCBs	412	-	-	-	4	-	-	-	-	-	-	-
PBDEs	-	-	-	-	4	-	-	-	-	-	-	-
PCDD/Fs	-	-	-	-	-	-	-	-	-	-	-	-
PAHs	632	-	-	-	-	-	32	-	-	-	-	-
DDT+metab.	362	-	-	-	-	-	-	-	-	-	-	-
Triclopyr	-	-	-	-	-	-	-	-	-	-	-	-
BEHP	625	-	-	-	-	-	13	-	-	-	-	-
Nonylphenol	75	-	-	-	-	-	-	-	-	-	-	-
Metals												
Arsenic	1,927	-	-	-	-	-	255	-	-	20	20	20
Cadmium	1,961	-	-	-	-	-	266	-	-	20	20	20
Copper	1,935	-	-	-	-	-	340	-	-	20	20	20
Lead	1,953	-	-	-	-	-	274	-	-	20	20	20
Mercury	1,058	-	-	-	-	-	103	-	-	20	20	20
Zinc	1,954	-	-	-	-	-	574	-	-	20	20	20

- no records
EIM = Environmental Information Management
PS = Puget Sound
SoG = Strait of Georgia
SoJF = Strait of Juan de Fuca

Organics

Few measurements have been made of PCBs, PBDEs, PCDDs, or PCDFs in the water marine column of Puget Sound or its boundary straits due to the low solubility of these compounds and high cost of analysis. Except for the most contaminated sites, concentrations of individual PCB and PBDE congeners in surface water are typically in the low picograms per liter (pg/L; parts per quadrillion) range, and even lower for PCDD/PCDFs. These chemicals are rarely detectable in bulk water samples without resorting to expensive high resolution EPA methods (e.g., high resolution gas chromatograph/mass spectrometry (HRGC/MS), $500 - $1,000 per analysis). Other means are available to concentrate these hydrophobic chemicals to detectable levels, such as solid phase extraction (SPE) columns and semi-permeable membrane devices (SPMDs). However these techniques are also expensive and require a high level of expertise. Therefore, it was not surprising to find few usable data for these chemicals.

For other organics, the number of measurements may be more frequent, but usability of the data for present purposes varied considerably.

The following sections discuss the available data and their suitability for flux calculations and the modeling effort.

PCBs

The King County Department of Natural Resources (KCDNR) has collected a number of marine water samples for PCB analyses. From 1999 through 2004, KCDNR analyzed PCBs in approximately 400 samples from 30 locations in the Main Basin and Whidbey Basin of Puget Sound. High method detection limits (MDLs; generally ~0.05 microgram per liter (µg/L)) limited the number of samples with detectable PCBs to nine from the intertidal reaches of the Duwamish River. The high MDLs preclude conclusions about the presence or absence of PCBs, and make it difficult to make good estimates of concentrations based on detection limits.

KCDNR conducted subsequent sampling for PCBs at five locations in 2005 using a congener-specific method (HRGC/MS) with much lower MDLs (~2 pg/L). These data are more useful and apparently of good quality, but the geographical range of sampling stations was limited to inner Elliott Bay and the mouth of the Duwamish River.

Probably the best PCB data currently available are from a Fisheries and Oceans Canada study in the Strait of Georgia, summarized by Dangerfield et al. (2007). Two locations in the southern strait – Boundary Pass and Rosario Strait – were sampled seasonally from depths above and below the halocline (~10 meters and ~100 meters) and analyzed for dissolved and particle-bound PCBs. These are desirable locations for calculating the flux of PCBs from the Strait of Georgia. One set of samples was also collected in the northern part of the strait (Johnstone Strait) during the fall.

In the southern part of the Strait of Georgia, dissolved PCBs made up approximately 80% of the total water column concentration above the halocline and 70% below. Total PCB concentrations at both depths were approximately 40-45 pg/L. More details on the study and relevant data may become available upon publication of the expanded data set (Peter Ross, Ocean and Fisheries Canada, written communications).

No recent PCB data were found for the Strait of Juan de Fuca.

PBDEs

Relevant PBDE data were limited to the Dangerfield et al. (2007) study. They found PBDE concentrations of 15-23 pg/L in the southern Strait of Georgia, with the higher concentrations and a higher dissolved component (approximately two-thirds) in the upper layers. Below the halocline, the 15 pg/L total PBDE concentration was evenly divided between the particulate and dissolved phases, due largely to the high concentration of decabromodiphenyl ether (DecaBDE) sorbed to particulate matter.

PCDDs/PCDFs

No data were found for PCDDs or PCDFs in marine waters of the Strait of Juan de Fuca, Strait of Georgia, or Puget Sound.

PAHs

KCDNR's previously mentioned sampling effort was more extensive with regard to PAHs, with 632 samples collected during 1996-2004. Each sample was analyzed for six low molecular weight PAHs (LPAH) and ten high molecular weight PAHs (HPAH).

Approximately one-half of the 68 stations sampled had detectable PAHs in at least one sample. Most of these stations, however, were intertidal, in inner Elliott Bay, or in the vicinity of Harbor Island. Open water stations such as Possession Sound, Colvos Passage, and Admiralty Inlet generally had no PAHs detectable.

Although there are many non-detects in the KCDNR PAH data, detection limits were low enough (0.005 – 0.38 µg/L) so that some fraction of the MDL (e.g., one half the MDL) could reasonably be used for model input or calibration. The broad spatial range of the sampling, including multiple depths at deeper locations, adds potential value to this data set.

None of the 32 PAH results available from the EIM database represented either ocean boundary or Puget Sound open water conditions. All of the PAH data are from cleanup sites in the near-shore areas of Puget Sound, with approximately two-thirds generated by the Focused Remedial Investigation at the Holly Street Landfill Redevelopment Project in Bellingham Bay.

In addition to the limited geographical range of the EIM data, usability is poor since only one sample had detectable PAHs: a bank seep to Thea Foss Waterway (Commencement Bay). The other EIM PAH data had either high detection limits (1 µg/L) or a limited number of analytes. Judging by the KCDNR data set, a detection limit of 1 ug/L is well above ambient water column concentrations of PAHs in Puget Sound.

DDT and Metabolites

Searches for data on DDT included its metabolites DDE and DDD.

Marine water column data on DDT compounds were found only in the KCDNR data set. None of the 362 samples from 39 stations had measurable amounts of DDT or metabolites at an MDL of 0.005 µg/L. An MDL of 0.005 ug/L is one-to-two orders of magnitude above concentrations routinely encountered in agricultural areas of Washington where DDT was used historically and thus unlikely to allow DDT compounds to be quantified in Puget Sound. The usability of these data is therefore poor.

Triclopyr

No data were found on triclopyr in marine waters of the Strait of Juan de Fuca, Strait of Georgia, or Puget Sound.

Bis(2-ethylhexyl)phthalate (BEHP)

Records for 638 analyses of BEHP in marine waters were found. Most of these (625) were from the same samples analyzed for PAHs by KCDNR. An additional 13 EIM results were from the Holly Street Landfill site in Bellingham Bay, previously mentioned.

BEHP is among the organic chemicals most commonly reported in environmental samples. However, contamination from sampling handling or laboratory procedures often confounds the results. Of the KCDNR samples with detectable BEHP (89%; MDL=0.14 µg/L), approximately 80% were blank qualified ("B" flag indicating the BEHP in the sample was less than ten times the BEHP detected in the method blank). Blank qualified data are generally considered unusable due to the potential to be biased high.

Although many of the KCDNR data for BEHP are unusable, there are still many good data from this set. For instance, most of the samples with BEHP concentrations > 1 µg/L (17% of samples) required no qualification. Perhaps as useful is the environmentally relevant MDL of 0.14 µg/L. Approximately 11% of samples had non-detectable BEHP concentrations at this MDL.

BEHP results from the Holly Street site are of limited use. Most samples had BEHP concentrations at or near the detection limit of 1 µg/L.

Nonylphenol

During 2003-2004, KCDNR analyzed nonylphenol (reported as total 4-nonylphenol) in 75 samples collected at six locations in the Main Basin and Whidbey Basin of Puget Sound. There was significant blank contamination in all but one sample each from two of the four sampling events. Nonylphenol was detected in only one sample during the other two sampling events. Here again, environmentally relevant detection limits (MDLs of 0.047 - 0.094 µg/L) could be useful for model input or calibration.

Metals

Metals have been analyzed at numerous locations in north Puget Sound waters during the past ten years. Compared to organic chemicals, there is an abundance of useful metals data due to relative ease of detection and low cost of analysis.

KCDNR has extensive data on total and dissolved metals from their marine monitoring stations in the Main Basin, extending as far north as Admiralty Inlet and Possession Sound (Whidbey Basin). Both surface (1-30 meters) and deep (50-210 meters) layers were sampled, depending on location. The data appear to be of good quality and useful for characterizing concentrations in the Main Basin and Whidbey Basin.

Some of the best data on marine water column metals come from a 1997 study by Battelle, commissioned by the Western States Petroleum Association (Crecelius, 1998). Specific objectives of this study were to characterize background concentrations of metals in three areas of Puget Sound: Cherry Point, March Point, and Commencement Bay. Water samples were

collected at a depth of one meter below the surface. The Cherry Point location is at the south end of the Strait of Georgia. The March Point site is near Anacortes and could be considered representative the Strait of Juan de Fuca, as a first approximation. Perhaps equally important is that "… sampling stations [ten per area] were selected to minimize the influence from local point sources, such as outfalls, rivers, and marinas." The most representative and recent data currently available on metals in Puget Sound boundary waters can be found in this report.

Many metals records were found in EIM. However, these data are largely limited to near-shore cleanup-site investigations, and some are of questionable quality or lack essential supporting information.

As of this writing, metadata have not yet been prepared for the EIM metals results. However, cursory scans of the data show no recent results for the Strait of Juan de Fuca. The only metals samples analyzed in the vicinity of Strait of Georgia are from the Holly Street Landfill site in Bellingham Bay.

Some older data exist on arsenic, cadmium, copper, lead, zinc, and mercury concentrations in the Strait of Juan de Fuca (Carpenter et al., 1978; Bloom & Crecelius, 1983; Romberg et al., 1984; Paulson et al., 1988, 1991a, b). Although these studies do not meet the 1995 cutoff set for the present search, the samples were analyzed using appropriate low-level techniques. The data are of good quality and include deep water samples. These results could be used for initial estimates of ocean fluxes to Puget Sound, until newer data are obtained.

Arsenic

The Battelle study of background metals concentrations (Crecelius, 1998) found both dissolved and total median arsenic concentrations of ~1 µg/L at March Point, significantly higher than at Cherry Point (~0.45 µg/L). Crecelius (1998) provided a brief review of previous studies and concluded that, in general, arsenic concentrations found in his study are similar to arsenic levels reported elsewhere and are not enriched due to anthropogenic activities. However, median Puget Sound arsenic concentrations measured by KCDNR were at the high end of the March Point levels (i.e., ~1.1 µg/L), signaling that a more thorough review of arsenic data may be required to sort out the influencing factors.

EIM data searches found 255 records for arsenic. Approximately one-half of the records are for dissolved arsenic. Most samples for total, total recoverable, and dissolved arsenic had detectable concentrations in the 0.5 – 2.0 µg/L range. Like the Battelle study, dissolved and total arsenic concentrations are nearly identical, with median concentrations of ~1 µg/L.

Cadmium

Total cadmium levels in the Strait of Georgia appear to be ~0.04 – 0.07 µg/L, with dissolved concentrations slightly lower, based on median concentrations reported by Crecelius (1998). Like arsenic, March Point cadmium concentrations were significantly higher than at Cherry Point, so some caution should be used in selecting representative concentrations for oceanic boundary conditions. Based on a review of existing data, Crecelius (1998) concluded that cadmium is not enriched by local anthropogenic activities.

In her review of Georgia Basin surface waters, Garrett (2004) found that mean cadmium concentrations of coastal waters have been below the historical detection limits of 0.1 – 0.5 µg/L, suggesting the values reported by Crecelius do not necessarily represent a lower range of what may be present in other waters. Consistent with other reports, dissolved cadmium values from both KCDNR and EIM have median values ~0.06 µg/L, with slightly higher concentrations in the total fraction.

Copper

Copper concentrations are influenced by anthropogenic activities and can be elevated near urban and industrial areas, or near marinas and harbors where copper may leach or slough from vessel bottom paints. Therefore, particular attention needs to be given to marine water column data that are to be used as representing copper concentrations at the oceanic boundaries or in Puget Sound.

Crecelius (1998) reported median total copper concentrations at March Point and Cherry Point of 0.5 and 0.7 µg/L, respectively, approximately 10% higher than the associated dissolved concentrations. These values are much lower than what may be considered an approximate global seawater average of 2 µg/L (Garrett, 2004). Results from the 340 EIM records for copper appear to support a lower-than-global regional copper concentrations in Puget Sound, with a median concentration of approximately 0.8 µg/L.

The KCDNR data show lower median copper concentrations in Puget Sound, similar to those reported for the Battelle study. The median concentration for total copper was 0.55 µg/L, with the dissolved copper median approximately 30% lower than the total.

Lead

Like copper, lead concentrations can vary significantly due to anthropogenic inputs. Crecelius (1998) found median total lead concentrations at March Point 160% higher than at Cherry Point, again indicating that caution should be used in assigning these concentrations as background for the Straits. Differences were largely due to much higher particulate lead concentrations at March Point.

Measurements of total lead by Boyle et al. (2005) in near-surface waters of the central North Pacific Ocean during 1999 are approximately 0.008 µg/L, about one-half the concentration at Cherry Point (0.015 µg/L) and one-fifth the concentration at March Point (0.038 µg/L). The authors of the Pacific Ocean study concluded that, while lead levels have decreased by about half since the mid-1970s due to the phase-out of leaded gasoline, the major current source of lead in the Pacific is probably global atmospheric emissions, particularly from Asia.

KCDNR analyzed hundreds of samples for lead from 1996 – 2002. Most results for dissolved lead were either rejected due to blank contamination or non-detects (MDL=0.005-0.007 µg/L). Of the detected values, median concentrations for total lead (~0.045 µg/L) and dissolved lead (~0.008 µg/L) were similar to the March Point concentrations.

EIM data searches found 274 records for lead. Most results are for dissolved lead, and most samples for total, total recoverable, and dissolved lead had detectable concentrations. Median concentrations for total and dissolved lead were approximately 0.08 µg/L and 0.03 µg/L, respectively. These appear to be high values with respect to background concentrations, and may reflect sampling locations close to lead sources or with historical lead contamination.

Mercury

In the 1997 Battelle study (Crecelius, 1998), both mercury concentrations were similar at March Point and Cherry Point. Median total and dissolved concentrations at these sites were ~0.5 ng/L and ~0.25 ng/L, respectively, higher than total mercury concentrations typically found in the North Pacific Ocean during the past 20 years (0.1 – 0.2 ng/L; Laurier et al., 2004). Some researchers cite even higher levels (~5 ng/L) for oceanic waters, but acknowledge limitations with older data that may have suffered from sample contamination or poor analytical techniques (Garrett, 2004).

KCDNR marine data from 1997-2001 show median mercury concentrations similar to Battelle's findings for March Point and Cherry Point. Total and dissolved mercury concentrations were approximately 0.6 and 0.3 ng/L, respectively. Users of the KCDNR data should be aware that mercury was analyzed by cold vapor atomic fluorescence (CVAF) during this time period, providing useful data. However, the KCDNR analysis in 1996 and 2003 was done using cold vapor atomic absorbance (CVAA), and mercury was often not detected as a result.

EIM data searches found 103 records for mercury. Most results are for total recoverable mercury; no samples analyzed for dissolved or total mercury were detected at 0.5 µg/L. The median concentration for total recoverable mercury was approximately 0.003 µg/L.

Zinc

Zinc is probably enriched in marine waters by anthropogenic sources, and this appears to be reflected in the available data. Background concentrations of zinc appear to be at overall low concentrations, with median total concentrations of 0.33 µg/L and 0.83 µg/L at March Point and Cherry Point, respectively. The differences between these two sites may not be attributable to generalized anthropogenic inputs, since the opposite pattern is seen for lead and mercury. The relatively higher zinc levels at Cherry Point may be a reflection of a high concentration of particle-bound zinc, possibly related to the Fraser River plume.

Puget Sound zinc concentrations appear to be more similar to Cherry Point than March Point. KCDNR reported total zinc of 0.87 µg/L as an overall median concentration from all of their Puget Sound stations. However, the overall dissolved zinc median in Puget Sound (0.73 µg/L) suggests concentrations in the water column may be elevated above background.

EIM data searches found 574 records for zinc, mostly as dissolved. The overall median concentration was approximately 2 µg/L. No difference was apparent between the median concentration of dissolved and total zinc. Higher zinc concentrations in EIM data are probably reflective of anthropogenic inputs.

Summary and Conclusions

This report identifies the data available since 1995 on selected toxic chemicals in the water column of Puget Sound and boundary straits. The data are needed to estimate the flux of toxic chemicals from the ocean boundaries to Puget Sound and for input to the Puget Sound Toxicant Transport and Fate Box Model.

Approximately 15,000 records have been compiled to date, with more than 90% of the records comprised of metals data. For some chemicals, the data are adequate to estimate concentrations at the oceanic boundaries in the Strait of Juan de Fuca and Strait of Georgia, as well as for cells of the Puget Sound box model. For others, data suitable for concentration estimates are limited in geographical scope or are non-existent.

This report identifies data gaps that should be addressed by sampling during subsequent phases of the Puget Sound toxic loading analysis. Table 3 summarizes the usability of the available data for the chemicals of concern. The chemicals are ranked according to those which have: (1) existing data adequate to estimate fluxes or Puget Sound box model concentrations, (2) data that are only suitable for rough estimates and where additional data are desirable, and (3) insufficient data to make any estimates.

Of the chemicals and chemical groups for which data were sought, only the metals data are adequate for flux calculations and for providing representative concentrations for some cells in the Puget Sound box model. There are gaps in the metals data for the Strait of Juan de Fuca, South Puget Sound, and Hood Canal.

None of the available organics data can provide reliable estimates for fluxes at the Puget Sound/Strait of Juan de Fuca boundary. However, currently available synoptic data on PCBs and PBDEs collected from the Strait of Georgia provide rough estimates of fluxes in the waters that bound Puget Sound. Bis(2-ethylhexyl)phthalate data, although potentially biased due to blank contamination, provide a basis on which to estimate a concentration range for the Puget Sound water column. The PAH and nonylphenol data are incomplete due to low frequency of detection, but may be adequate for rough estimates based on detection limits. The PCDD, PCDF, DDT compounds, and triclopyr data are inadequate.

Table 3. Data Usability for Estimating Oceanic Boundary Fluxes and for Input to the Puget Sound Box Model.

Chemical	Useful for Calculating Fluxes at Oceanic Boundary?	Comment	Useful for Puget Sound Box Model?	Comment
Organics				
PCBs	Est. Only (2)	Strait of Georgia data	No	Limited spatial range; non-detect, high MDL
PBDEs	Est. Only (2)	Strait of Georgia data	No	No data
PCDD/Fs	No	No data	No	No data
PAHs	No	No data	Estimates Only (4)	Estimate concentration from MDL
DDT+ metabolites	No	No data	No	Not detected, high detection limit
Triclopyr	No	No data	No	No data
BEHP	No	No data	Estimates Only (1)	Blank qualified (B) data
Nonylphenol	No	No data	Estimates Only (1)	Estimate upper concentration range from MDL
Metals				
Arsenic	Yes (1,4)	No recent Juan de Fuca data	Yes (1,3,4)	Limited to Main Basin and Admiralty Inlet
Cadmium	Yes (1,4)	No recent Juan de Fuca data	Yes (1,3,4)	Limited to Main Basin and Admiralty Inlet
Copper	Yes (1,4)	No recent Juan de Fuca data	Yes (1,3,4)	Limited to Main Basin and Admiralty Inlet
Lead	Yes (1,4)	No recent Juan de Fuca data	Yes (1,3,4)	Limited to Main Basin and Admiralty Inlet
Mercury	Yes (1,4)	No recent Juan de Fuca data	Yes (1,3,4)	Limited to Main Basin and Admiralty Inlet
Zinc	Yes (1,4)	No recent Juan de Fuca data	Yes (1,3,4)	Limited to Main Basin and Admiralty Inlet

Rating:
- Yes — Existing data adequate for estimates
- Est. — Existing data may be used for rough estimates; additional data is desirable
- No — Data not sufficient for estimates

References:
1. KCDNR
2. Dangerfield et al. (2007)
3. Ecology-EIM
4. Crecelius (1998)

Recommendations

Based on a review of the available information, it is recommended that sampling be conducted for all of the organic chemicals of concern. Data should be obtained in the Strait of Juan de Fuca and Strait of Georgia boundary waters, as well as at Puget Sound locations suited to represent the cells of the Puget Sound box model. There are gaps in the metals data for the Strait of Juan de Fuca, South Puget Sound, and Hood Canal that should also be addressed through sampling.

If limited resources mandate restricting laboratory analyses, it is recommended that parameters be dropped in the following order, based on the amount, quality, and usability of the currently available data:

1. Bis(2-ethylhexyl)phthalate from Puget Sound samples.
2. PAHs from Puget Sound samples.
3. Nonylphenol from Puget Sound samples.
4. PCBs from Strait of Georgia boundary samples.
5. PBDEs from Strait of Georgia boundary samples.

Existing data should be electronically formatted for model input. This may require developing rules for handling non-detects or data which are biased by geographical location or site type. As noted previously, the PCB and PBDE data cited from the Dangerfield et al. (2007) study in the Strait of Georgia are not yet available.

A Quality Assurance Project Plan should be prepared prior to collecting new water column data (Lombard and Kirchmer, 2004). The plan should provide a rationale for selecting target chemicals, sampling locations, frequency, and timing. The plan should specify field and laboratory procedures appropriate to obtaining data for use in flux calculations and box model analyses.

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Appendix. Metadata for Existing and Available Records on Selected Toxic Chemicals in the Water Column of the Strait of Juan de Fuca, Strait of Georgia, and Puget Sound.

Table A-1. Metadata for Existing and Available Records on Selected Toxic Chemicals in the Water Column of the Strait of Juan de Fuca, Strait of Georgia, and Puget Sound.

Data Source	Year	Chemical or Chemical Group	Location	Station Type	Number of Samples	Number of Sampling Events	Comments
Dangerfield et al.	2005?	Total PCB (congeners)	Strait of Georgia (3 locations)	shallow	3 (south strait)	three seasons	available data are synoptic - PCBs were detected
Dangerfield et al.	2005?	Total PCB (congeners)	Strait of Georgia (3 locations)	deep	3 (south strait)	three seasons	available data are synoptic - PCBs were detected
Dangerfield et al.	2005?	Total PBDEs (congeners)	Strait of Georgia (3 locations)	shallow	3 (south strait)	three seasons	available data are synoptic - PBDEs were detected
Dangerfield et al.	2005?	Total PBDEs (congeners)	Strait of Georgia (3 locations)	deep	3 (south strait)	three seasons	available data are synoptic - PBDEs were detected
King County DNR	2005	Total PCBs (congeners)	Inner Elliott Bay	--	4	4	available data are synoptic - PCBs were detected
King County DNR	2005	Total PCBs (congeners)	Duwamish River Harbor Island	shallow	4	4	available data are synoptic - PCBs were detected
King County DNR	2005	Total PCBs (congeners)	Duwamish River Harbor Island	deep	5	4	available data are synoptic - PCBs were detected
King County DNR	2005	Total PCBs (congeners)	Duwamish River 16th Ave S Bridge	shallow	6	4	available data are synoptic - PCBs were detected
King County DNR	2005	Total PCB (congeners)	Duwamish River 16th Ave S Bridge	deep	4	4	available data are synoptic - PCBs were detected
King County DNR	2000	Total PCBs (Aroclor-equiv.)	Boeing Creek Mouth	intertidal	4	4	no PCBs detected at DL = 0.05 ug/L
King County DNR	2000	Total PCBs (Aroclor-equiv.)	Brackett's Landing Underwater Park	intertidal	4	4	no PCBs detected at DL = 0.05 ug/L
King County DNR	2000-2001	Total PCBs (Aroclor-equiv.)	Carkeek Park	intertidal	8	7	no PCBs detected at DL = 0.05 ug/L
King County DNR	2000	Total PCBs (Aroclor-equiv.)	Edmonds/Ocean Avenue	intertidal	5	4	no PCBs detected at DL = 0.05 ug/L
King County DNR	2000-2001	Total PCBs (Aroclor-equiv.)	Edwards Point/South of Oil Dock	intertidal	8	7	no PCBs detected at DL = 0.05 ug/L
King County DNR	2000	Total PCBs (Aroclor-equiv.)	Golden Gardens	intertidal	4	4	no PCBs detected at DL = 0.05 ug/L
King County DNR	2000-2001	Total PCBs (Aroclor-equiv.)	Meadowdale Beach Park	intertidal	7	7	no PCBs detected at DL = 0.05 ug/L
King County DNR	2000	Total PCBs (Aroclor-equiv.)	North Beach/Blue Ridge Park	intertidal	4	4	no PCBs detected at DL = 0.05 ug/L
King County DNR	2000	Total PCBs (Aroclor-equiv.)	Picnic Point Park	intertidal	4	4	no PCBs detected at DL = 0.05 ug/L
King County DNR	2000	Total PCBs (Aroclor-equiv.)	Point Wells/South Side	intertidal	4	4	no PCBs detected at DL = 0.05 ug/L
King County DNR	2000	Total PCBs (Aroclor-equiv.)	Shilshole/Ray's Boathouse	intertidal	4	4	no PCBs detected at DL = 0.05 ug/L
King County DNR	1999-2000	Total PCBs (Aroclor-equiv.)	Admiralty Inlet	offshore-shallow	10	9	no PCBs detected at DL = 0.05 ug/L
King County DNR	1999-2000	Total PCBs (Aroclor-equiv.)	Admiralty Inlet	offshore-mid	9	9	no PCBs detected at DL = 0.05 ug/L
King County DNR	1999-2000	Total PCBs (Aroclor-equiv.)	Admiralty Inlet	offshore-deep	10	9	no PCBs detected at DL = 0.05 ug/L
King County DNR	2003-2004	Total PCBs (Aroclor-equiv.)	Central Elliott Bay	offshore-shallow	6	4	no PCBs detected at DL = 0.05 ug/L
King County DNR	2003-2004	Total PCBs (Aroclor-equiv.)	Central Elliott Bay	offshore-mid	4	4	no PCBs detected at DL = 0.05 ug/L
King County DNR	2003-2004	Total PCBs (Aroclor-equiv.)	Central Elliott Bay	offshore-deep	5	4	no PCBs detected at DL = 0.05 ug/L
King County DNR	2003-2004	Total PCBs (Aroclor-equiv.)	Central Waterfront	offshore	4	4	no PCBs detected at DL = 0.05 ug/L
King County DNR	1999-2000	Total PCBs (Aroclor-equiv.)	Colvos Passage	offshore-shallow	10	9	no PCBs detected at DL = 0.05 ug/L
King County DNR	1999-2000	Total PCBs (Aroclor-equiv.)	Colvos Passage	offshore-mid	10	9	no PCBs detected at DL = 0.05 ug/L
King County DNR	1999-2000	Total PCBs (Aroclor-equiv.)	Colvos Passage	offshore-deep	10	9	no PCBs detected at DL = 0.05 ug/L

Data Source	Year	Chemical or Chemical Group	Location	Station Type	Number of Samples	Number of Sampling Events	Comments
King County DNR	2003	Total PCBs (Aroclor-equiv.)	DUW150N	offshore	4	4	detected Aroclor 1254 on two occasions
King County DNR	2003	Total PCBs (Aroclor-equiv.)	DUW150S	offshore	4	4	detected Aroclor 1254 on three occasions and 1260 twice
King County DNR	2003	Total PCBs (Aroclor-equiv.)	DUW300N	offshore	4	4	detected Aroclor 1254 on three occasions
King County DNR	2003	Total PCBs (Aroclor-equiv.)	DUW300S	offshore	4	4	detected Aroclors 1254 and 1260 on one occasion
King County DNR	2003	Total PCBs (Aroclor-equiv.)	DUWREF	offshore	8	8	no PCBs detected at DL = 0.05 ug/L
King County DNR	1999-2000	Total PCBs (Aroclor-equiv.)	Fauntleroy/Vashon	offshore-shallow	9	9	no PCBs detected at DL = 0.05 ug/L
King County DNR	1999-2000	Total PCBs (Aroclor-equiv.)	Fauntleroy/Vashon	offshore-mid	10	9	no PCBs detected at DL = 0.05 ug/L
King County DNR	1999-2000	Total PCBs (Aroclor-equiv.)	Fauntleroy/Vashon	offshore-deep	10	9	no PCBs detected at DL = 0.05 ug/L
King County DNR	1999-2000, 2003-2004	Total PCBs (Aroclor-equiv.)	Jefferson Head	offshore-shallow	16	13	no PCBs detected at DL = 0.05 ug/L
King County DNR	1999-2000, 2003-2004	Total PCBs (Aroclor-equiv.)	Jefferson Head	offshore-mid	13	13	no PCBs detected at DL = 0.05 ug/L
King County DNR	1999-2000, 2003-2004	Total PCBs (Aroclor-equiv.)	Jefferson Head	offshore-deep	13	13	no PCBs detected at DL = 0.05 ug/L
King County DNR	1999-2000, 2003-2004	Total PCBs (Aroclor-equiv.)	Point Wells	offshore-shallow	17	14	no PCBs detected at DL = 0.05 ug/L
King County DNR	1999-2000, 2003-2004	Total PCBs (Aroclor-equiv.)	Point Wells	offshore-mid	13	13	no PCBs detected at DL = 0.05 ug/L
King County DNR	1999-2000, 2003-2004	Total PCBs (Aroclor-equiv.)	Point Wells	offshore-deep	13	13	no PCBs detected at DL = 0.05 ug/L
King County DNR	1999-2000	Total PCBs (Aroclor-equiv.)	Possession Sound	offshore-shallow	11	9	no PCBs detected at DL = 0.05 ug/L
King County DNR	1999-2000	Total PCBs (Aroclor-equiv.)	Possession Sound	offshore-mid	9	9	no PCBs detected at DL = 0.05 ug/L
King County DNR	1999-2000	Total PCBs (Aroclor-equiv.)	Possession Sound	offshore-deep	10	9	no PCBs detected at DL = 0.05 ug/L
King County DNR	1999-2000	Total PCBs (Aroclor-equiv.)	Renton Treatment Plant Outfall	offshore-shallow	10	9	no PCBs detected at DL = 0.05 ug/L
King County DNR	1999-2000	Total PCBs (Aroclor-equiv.)	Renton Treatment Plant Outfall	offshore-mid	9	9	no PCBs detected at DL = 0.05 ug/L
King County DNR	1999-2000	Total PCBs (Aroclor-equiv.)	Renton Treatment Plant Outfall	offshore-deep	10	9	no PCBs detected at DL = 0.05 ug/L
King County DNR	2003-2004	Total PCBs (Aroclor-equiv.)	South End (Upstream) Harbor Island	offshore-shallow	8	4	no PCBs detected at DL = 0.05 ug/L
King County DNR	2003-2004	Total PCBs (Aroclor-equiv.)	South End (Upstream) Harbor Island	offshore-deep	4	4	no PCBs detected at DL = 0.05 ug/L
King County DNR	1999-2000, 2003-2004	Total PCBs (Aroclor-equiv.)	West Point Treatment Plant Outfall	offshore-shallow	16	13	no PCBs detected at DL = 0.05 ug/L
King County DNR	1999-2000, 2003-2004	Total PCBs (Aroclor-equiv.)	West Point Treatment Plant Outfall	offshore-mid	15	12	no PCBs detected at DL = 0.05 ug/L
King County DNR	1999-2000, 2003-2004	Total PCBs (Aroclor-equiv.)	West Point Treatment Plant Outfall	offshore-deep	15	13	no PCBs detected at DL = 0.05 ug/L
King County DNR	2000	PAHs	Boeing Creek Mouth	intertidal	4	4	mostly non-detect at 0.005 - 0.026 ug/l
King County DNR	2000	PAHs	Brackett's Landing Underwater Park	intertidal	4	4	detected in ~20% of samples
King County DNR	2000-2001	PAHs	Carkeek Park	intertidal	13	12	detected in ~7% of samples
King County DNR	2000	PAHs	Edmonds/Ocean Avenue	intertidal	6	4	detected in ~16% of samples
King County DNR	2000-2001	PAHs	Edwards Point/South of Oil Dock	intertidal	13	12	detected in ~14% of samples
King County DNR	2000	PAHs	Golden Gardens	intertidal	4	4	detected in ~28% of samples

Data Source	Year	Chemical or Chemical Group	Location	Station Type	Number of Samples	Number of Sampling Events	Comments
King County DNR	2000-2001	PAHs	Meadowdale Beach Park	intertidal	12	12	detected in ~7% of samples
King County DNR	2000	PAHs	North Beach/Blue Ridge Park	intertidal	4	4	detected in ~9% of samples
King County DNR	2000	PAHs	Picnic Point Park	intertidal	4	4	detected in ~7% of samples
King County DNR	2000	PAHs	Point Wells/South Side	intertidal	4	4	detected in ~12% of samples
King County DNR	2000	PAHs	Shilshole/Ray's Boathouse	intertidal	4	4	detected in ~25% of samples
King County DNR	1999-2000	PAHs	Admiralty Inlet	offshore-shallow	13	12	mostly non-detect at 0.005 - 0.38 ug/L
King County DNR	1999-2000	PAHs	Admiralty Inlet	offshore-mid	13	12	mostly non-detect at 0.005 - 0.38 ug/L
King County DNR	1999-2000	PAHs	Admiralty Inlet	offshore-deep	13	12	mostly non-detect at 0.005 - 0.38 ug/L
King County DNR	2003-2004	PAHs	Central Elliott Bay	offshore-shallow	6	4	approx 17% of analyte-samples detected
King County DNR	2003-2004	PAHs	Central Elliott Bay	offshore-mid	4	4	mostly non-detect at 0.009 - 0.095 ug/L
King County DNR	2003-2004	PAHs	Central Elliott Bay	offshore-deep	5	4	none detected at 0.009 - 0.095 ug/L
King County DNR	2003-2004	PAHs	Central Waterfront	offshore	4	4	detected in ~33% of samples
King County DNR	1996-1997	PAHs	Connecticut CSO (East Waterway)	offshore-shallow	7	7	none detected at 0.094 - 0.39 ug/L
King County DNR	1996-1997	PAHs	Connecticut CSO (East Waterway)	offshore-deep	7	7	none detected at 0.094 - 0.39 ug/L
King County DNR	1999-2000	PAHs	Colvos Passage	offshore-shallow	13	12	mostly non-detect at 0.005 - 0.38 ug/L
King County DNR	1999-2000	PAHs	Colvos Passage	offshore-mid	13	12	mostly non-detect at 0.005 - 0.38 ug/L
King County DNR	1999-2000	PAHs	Colvos Passage	offshore-deep	13	12	mostly non-detect at 0.005 - 0.38 ug/L
King County DNR	1996-1997	PAHs	Denny Way Cap	offshore-shallow	7	7	none detected at 0.094 - 0.4 ug/L
King County DNR	1996-1997	PAHs	Denny Way Cap	offshore-deep	7	7	none detected at 0.094 - 0.4 ug/L
King County DNR	1996-1997	PAHs	Denny Way CSO Outfall	offshore	7	7	none detected at 0.094 - 0.4 ug/L
King County DNR	2003	PAHs	DUW150N	offshore	4	4	mostly non-detect at 0.071 - 0.54 ug/L
King County DNR	2003	PAHs	DUW150S	offshore	4	4	none detected at 0.071 - 0.54 ug/L
King County DNR	2003	PAHs	DUW300N	offshore	4	4	none detected at 0.071 - 0.54 ug/L
King County DNR	2003	PAHs	DUW300S	offshore	4	4	none detected at 0.071 - 0.54 ug/L
King County DNR	2003	PAHs	DUWREF	offshore	8	8	none detected at 0.071 - 0.54 ug/L
King County DNR	1996-1997	PAHs	Duwamish Head	offshore-shallow	7	7	none detected at 0.094 - 0.39 ug/L
King County DNR	1996-1997	PAHs	Duwamish Head	offshore-deep	6	6	none detected at 0.094 - 0.39 ug/L
King County DNR	1996-1997	BEHP	Duwamish River - Brandon CSO (Center)	offshore	7	7	none detected at 0.094 - 0.39 ug/L
King County DNR	1996-1997	BEHP	Duwamish River - Brandon CSO (East)	offshore	7	7	none detected at 0.094 - 0.39 ug/L
King County DNR	1996-1997	BEHP	Duwamish River - Brandon CSO (West)	offshore	6	6	none detected at 0.094 - 0.39 ug/L
King County DNR	1996-1997	PAHs	East Waterway (Center)	offshore	7	7	none detected at 0.094 - 0.39 ug/L /l
King County DNR	1996-1997	PAHs	East Waterway (East)	offshore	7	7	none detected at 0.094 - 0.39 ug/L

Data Source	Year	Chemical or Chemical Group	Location	Station Type	Number of Samples	Number of Sampling Events	Comments
King County DNR	1996-1997	PAHs	East Waterway (West)	offshore	7	7	none detected at 0.094 - 0.39 ug/L
King County DNR	1999-2000	PAHs	Fauntleroy/Vashon	offshore-shallow	12	12	mostly non-detect at 0.005 - 0.38 ug/L
King County DNR	1999-2000	PAHs	Fauntleroy/Vashon	offshore-mid	13	12	mostly non-detect at 0.005 - 0.38 ug/L
King County DNR	1999-2000	PAHs	Fauntleroy/Vashon	offshore-deep	14	12	mostly non-detect at 0.005 - 0.38 ug/L
King County DNR	1996-1997	PAHs	Harbor Island	offshore-shallow	7	7	none detected at 0.094 - 0.39 ug/L
King County DNR	1996-1997	PAHs	Harbor Island	offshore-deep	7	7	none detected at 0.094 - 0.39 ug/L
King County DNR	1999-2000, 2003-2004	PAHs	Jefferson Head	offshore-shallow	20	16	mostly non-detect at 0.005 - 0.38 ug/L
King County DNR	1999-2000, 2003-2004	PAHs	Jefferson Head	offshore-mid	15	15	mostly non-detect at 0.005 - 0.38 ug/L
King County DNR	1999-2000, 2003-2004	PAHs	Jefferson Head	offshore-deep	17	16	mostly non-detect at 0.005 - 0.38 ug/L
King County DNR	1999-2000, 2003-2004	PAHs	Point Wells	offshore-shallow	20	16	mostly non-detect at 0.005 - 0.38 ug/L
King County DNR	1999-2000, 2003-2004	PAHs	Point Wells	offshore-mid	15	15	mostly non-detect at 0.005 - 0.38 ug/L
King County DNR	1999-2000, 2003-2004	PAHs	Point Wells	offshore-deep	16	16	mostly non-detect at 0.005 - 0.38 ug/L
King County DNR	1999-2000	PAHs	Possession Sound	offshore-shallow	14	12	mostly non-detect at 0.005 - 0.38 ug/L
King County DNR	1999-2000	PAHs	Possession Sound	offshore-mid	12	12	none detected at 0.005 - 0.38 ug/L
King County DNR	1999-2000	PAHs	Possession Sound	offshore-deep	13	12	mostly non-detect at 0.005 - 0.38 ug/L
King County DNR	1999-2000	PAHs	Renton Treatment Plant Outfall	offshore-shallow	14	12	mostly non-detect at 0.005 - 0.38 ug/L
King County DNR	1999-2000	PAHs	Renton Treatment Plant Outfall	offshore-mid	12	12	none detected at 0.005 - 0.38 ug/L
King County DNR	1999-2000	PAHs	Renton Treatment Plant Outfall	offshore-deep	12	12	none detected at 0.005 - 0.38 ug/L
King County DNR	2003-2004	PAHs	South End (Upstream) Harbor Island	offshore-shallow	8	4	detected in ~25% of samples
King County DNR	2003-2004	PAHs	South End (Upstream) Harbor Island	offshore-deep	4	4	detected in ~14% of samples
King County DNR	1996-1997	PAHs	SW Michigan CSO (Center)	offshore	7	7	none detected at 0.094 - 0.39 ug/L
King County DNR	1996-1997	PAHs	SW Michigan CSO (East)	offshore	7	7	none detected at 0.094 - 0.39 ug/L
King County DNR	1996-1997	PAHs	SW Michigan CSO (West)	offshore	7	7	none detected at 0.094 - 0.39 ug/L
King County DNR	1999-2000, 2003-2004	PAHs	West Point Treatment Plant Outfall	offshore-shallow	19	16	mostly non-detect at 0.005 - 0.38 ug/L
King County DNR	1999-2000, 2003-2004	PAHs	West Point Treatment Plant Outfall	offshore-mid	18	15	none detected at 0.005 - 0.38 ug/L
King County DNR	1999-2000, 2003-2004	PAHs	West Point Treatment Plant Outfall	offshore-deep	18	17	mostly non-detect at 0.005 - 0.38 ug/L
King County DNR	1996-1997	PAHs	West Waterway	offshore-shallow	7	7	none detected at 0.094 - 0.4 ug/L
King County DNR	1996-1997	PAHs	West Waterway	offshore-deep	7	7	none detected at 0.094 - 0.4 ug/L
King County DNR	1996-1997	PAHs	West Waterway (Center)	offshore	7	7	none detected at 0.094 - 0.4 ug/L
King County DNR	1996-1997	PAHs	West Waterway (East)	offshore	5	5	none detected at 0.094 - 0.4 ug/L /l
King County DNR	1996-1997	PAHs	West Waterway (West)	offshore	7	7	none detected at 0.094 - 0.4 ug/L

Data Source	Year	Chemical or Chemical Group	Location	Station Type	Number of Samples	Number of Sampling Events	Comments
EIM - Consultant	2000	PAHs	Holly Street Landfill Redevelopment Project, Focused Remedial Investig'n		1	1	none detected at 1 ug/L
EIM - Consultant	2000	PAHs	Holly Street Landfill Redevelopment Project, Focused Remedial Investig'n		2	1	none detected at 1 ug/L
EIM - Consultant	2000	PAHs	Holly Street Landfill Redevelopment Project, Focused Remedial Investig'n		1	1	none detected at 1 ug/L
EIM - Consultant	2000	PAHs	Holly Street Landfill Redevelopment Project, Focused Remedial Investig'n		2	1	none detected at 1 ug/L
EIM - Consultant	2000	PAHs	Holly Street Landfill Redevelopment Project, Focused Remedial Investig'n		1	1	none detected at 1 ug/L
EIM - Consultant	2000	PAHs	Holly Street Landfill Redevelopment Project, Focused Remedial Investig'n		1	1	none detected at 1 ug/L
EIM - Consultant	2000	PAHs	Holly Street Landfill Redevelopment Project, Focused Remedial Investig'n		1	1	none detected at 1 ug/L
EIM - Consultant	2000	PAHs	Holly Street Landfill Redevelopment Project, Focused Remedial Investig'n		1	1	none detected at 1 ug/L
EIM - Consultant	2000	PAHs	Holly Street Landfill Redevelopment Project, Focused Remedial Investig'n		1	1	none detected at 1 ug/L
EIM - Consultant	2000	PAHs	Holly Street Landfill Redevelopment Project, Focused Remedial Investig'n		1	1	none detected at 1 ug/L
EIM - Consultant	2000	PAHs	Holly Street Landfill Redevelopment Project, Focused Remedial Investig'n		1	1	none detected at 1 ug/L
EIM - US Navy?	1996	PAHs	US Navy WHIDBEY LAKE HANCOCK -- FS NO.137		2	1	only Acenaphthene and Acenaphthylene analyzed, neither detected at 0.1 ug/L
EIM - US Navy?	1996	PAHs	US Navy WHIDBEY LAKE HANCOCK -- FS NO.137		5	1	only Acenaphthene and Acenaphthylene analyzed, neither detected at 0.1 ug/L
EIM - US Navy?	1996	PAHs	US Navy WHIDBEY LAKE HANCOCK -- FS NO.137		2	1	only Acenaphthene and Acenaphthylene analyzed, neither detected at 0.1 ug/L
EIM - US Navy?	1996	PAHs	US Navy WHIDBEY LAKE HANCOCK -- FS NO.137		3	1	only Acenaphthene and Acenaphthylene analyzed, neither detected at 0.1 ug/L
EIM - US Navy?	1996	PAHs	US Navy WHIDBEY LAKE HANCOCK -- FS NO.137		2	1	only Acenaphthene and Acenaphthylene analyzed, neither detected at 0.1 ug/L
EIM - US Navy?	1996	PAHs	US Navy WHIDBEY LAKE HANCOCK -- FS NO.137		2	1	only Acenaphthene and Acenaphthylene analyzed, neither detected at 0.1 ug/L
EIM - US Navy?	1996	PAHs	US Navy WHIDBEY LAKE HANCOCK -- FS NO.137		2	1	only Acenaphthene and Acenaphthylene analyzed, neither detected at 0.1 ug/L
EIM	1998	PAHs	Olympic Chemical		1	1	detected in ~ 62% of samples
King County DNR	2000	DDT	Boeing Creek Mouth	intertidal	4	4	none detected at 0.005 ug/L
King County DNR	2000	DDT	Brackett's Landing Underwater Park	intertidal	4	4	none detected at 0.005 ug/L
King County DNR	2000-2001	DDT	Carkeek Park	intertidal	8	7	none detected at 0.005 ug/L
King County DNR	2000	DDT	Edmonds/Ocean Avenue	intertidal	6	4	none detected at 0.005 ug/L
King County DNR	2000-2001	DDT	Edwards Point/South of Oil Dock	intertidal	8	7	none detected at 0.005 ug/L
King County DNR	2000	DDT	Golden Gardens	intertidal	4	4	none detected at 0.005 ug/L
King County DNR	2000-2001	DDT	Meadowdale Beach Park	intertidal	7	7	none detected at 0.005 ug/L
King County DNR	2000	DDT	North Beach/Blue Ridge Park	intertidal	4	4	none detected at 0.005 ug/L
King County DNR	2000	DDT	Picnic Point Park	intertidal	4	4	none detected at 0.005 ug/L
King County DNR	2000	DDT	Point Wells/South Side	intertidal	4	4	none detected at 0.005 ug/L

Data Source	Year	Chemical or Chemical Group	Location	Station Type	Number of Samples	Number of Sampling Events	Comments
King County DNR	2000	DDT	Shilshole/Ray's Boathouse	intertidal	4	4	none detected at 0.005 ug/L
King County DNR	1999-2000	DDT	Admiralty Inlet	offshore-shallow	10	9	none detected at 0.005 ug/L
King County DNR	1999-2000	DDT	Admiralty Inlet	offshore-mid	9	9	none detected at 0.005 ug/L
King County DNR	1999-2000	DDT	Admiralty Inlet	offshore-deep	10	9	none detected at 0.005 ug/L
King County DNR	2003-2004	DDT	Central Elliott Bay	offshore-shallow	6	4	none detected at 0.005 ug/L
King County DNR	2003-2004	DDT	Central Elliott Bay	offshore-mid	4	4	none detected at 0.005 ug/L
King County DNR	2003-2004	DDT	Central Elliott Bay	offshore-deep	5	4	none detected at 0.005 ug/L
King County DNR	1999-2000	DDT	Colvos Passage	offshore-shallow	10	9	none detected at 0.005 ug/L
King County DNR	1999-2000	DDT	Colvos Passage	offshore-mid	10	9	none detected at 0.005 ug/L
King County DNR	1999-2000	DDT	Colvos Passage	offshore-deep	10	9	none detected at 0.005 ug/L
King County DNR	1999-2000	DDT	Fauntleroy/Vashon	offshore-shallow	9	9	none detected at 0.005 ug/L
King County DNR	1999-2000	DDT	Fauntleroy/Vashon	offshore-mid	10	9	none detected at 0.005 ug/L
King County DNR	1999-2000	DDT	Fauntleroy/Vashon	offshore-deep	10	9	none detected at 0.005 ug/L
King County DNR	1999-2000, 2003-2004	DDT	Jefferson Head	offshore-shallow	16	13	none detected at 0.005 ug/L
King County DNR	1999-2000, 2003-2004	DDT	Jefferson Head	offshore-mid	13	13	none detected at 0.005 ug/L
King County DNR	1999-2000, 2003-2004	DDT	Jefferson Head	offshore-deep	13	13	none detected at 0.005 ug/L
King County DNR	1999-2000, 2003-2004	DDT	Point Wells	offshore-shallow	17	13	none detected at 0.005 ug/L
King County DNR	1999-2000, 2003-2004	DDT	Point Wells	offshore-mid	13	13	none detected at 0.005 ug/L
King County DNR	1999-2000, 2003-2004	DDT	Point Wells	offshore-deep	13	13	none detected at 0.005 ug/L
King County DNR	1999-2000	DDT	Possession Sound	offshore-shallow	11	9	none detected at 0.005 ug/L
King County DNR	1999-2000	DDT	Possession Sound	offshore-mid	9	9	none detected at 0.005 ug/L
King County DNR	1999-2000	DDT	Possession Sound	offshore-deep	10	9	none detected at 0.005 ug/L
King County DNR	1999-2000	DDT	Renton Treatment Plant Outfall	offshore-shallow	10	9	none detected at 0.005 ug/L
King County DNR	1999-2000	DDT	Renton Treatment Plant Outfall	offshore-mid	9	9	none detected at 0.005 ug/L
King County DNR	1999-2000	DDT	Renton Treatment Plant Outfall	offshore-deep	10	9	none detected at 0.005 ug/L
King County DNR	2003-2004	DDT	South End (Upstream) Harbor Island	offshore-shallow	8	4	none detected at 0.005 ug/L
King County DNR	2003-2004	DDT	South End (Upstream) Harbor Island	offshore-deep	4	4	none detected at 0.005 ug/L
King County DNR	1999-2000, 2003-2004	DDT	West Point Treatment Plant Outfall	offshore-shallow	16	13	none detected at 0.005 ug/L
King County DNR	1999-2000, 2003-2004	DDT	West Point Treatment Plant Outfall	offshore-mid	15	13	none detected at 0.005 ug/L
King County DNR	1999-2000, 2003-2004	DDT	West Point Treatment Plant Outfall	offshore-deep	15	13	none detected at 0.005 ug/L
King County DNR	2000	BEHP	Boeing Creek Mouth	intertidal	3	3	approx. 17 % > 1 ug/L, most with no "B"; approx. 72% detected at <1 ug/L, most (87%) with "B"; 11% non-detect at DL = 0.14 ug/L

Data Source	Year	Chemical or Chemical Group	Location	Station Type	Number of Samples	Number of Sampling Events	Comments
King County DNR	2000	BEHP	Brackett's Landing Underwater Park	intertidal	3	3	approx. 17 % > 1 ug/L, most with no "B"; approx. 72% detected at <1 ug/L, most (87%) with "B"; 11% non-detect at DL = 0.14 ug/L
King County DNR	2000-2001	BEHP	Carkeek Park	intertidal	12	11	approx. 17 % > 1 ug/L, most with no "B"; approx. 72% detected at <1 ug/L, most (87%) with "B"; 11% non-detect at DL = 0.14 ug/L
King County DNR	2000	BEHP	Edmonds/Ocean Avenue	intertidal	4	3	approx. 17 % > 1 ug/L, most with no "B"; approx. 72% detected at <1 ug/L, most (87%) with "B"; 11% non-detect at DL = 0.14 ug/L
King County DNR	2000-2001	BEHP	Edwards Point/South of Oil Dock	intertidal	12	11	approx. 17 % > 1 ug/L, most with no "B"; approx. 72% detected at <1 ug/L, most (87%) with "B"; 11% non-detect at DL = 0.14 ug/L
King County DNR	2000	BEHP	Golden Gardens	intertidal	3	3	approx. 17 % > 1 ug/L, most with no "B"; approx. 72% detected at <1 ug/L, most (87%) with "B"; 11% non-detect at DL = 0.14 ug/L
King County DNR	2000-2001	BEHP	Meadowdale Beach Park	intertidal	11	11	approx. 17 % > 1 ug/L, most with no "B"; approx. 72% detected at <1 ug/L, most (87%) with "B"; 11% non-detect at DL = 0.14 ug/L
King County DNR	2000	BEHP	North Beach/Blue Ridge Park	intertidal	3	3	approx. 17 % > 1 ug/L, most with no "B"; approx. 72% detected at <1 ug/L, most (87%) with "B"; 11% non-detect at DL = 0.14 ug/L
King County DNR	2000	BEHP	Picnic Point Park	intertidal	3	3	approx. 17 % > 1 ug/L, most with no "B"; approx. 72% detected at <1 ug/L, most (87%) with "B"; 11% non-detect at DL = 0.14 ug/L
King County DNR	2000	BEHP	Point Wells/South Side	intertidal	3	3	approx. 17 % > 1 ug/L, most with no "B"; approx. 72% detected at <1 ug/L, most (87%) with "B"; 11% non-detect at DL = 0.14 ug/L
King County DNR	2000	BEHP	Shilshole/Ray's Boathouse	intertidal	3	3	approx. 17 % > 1 ug/L, most with no "B"; approx. 72% detected at <1 ug/L, most (87%) with "B"; 11% non-detect at DL = 0.14 ug/L
King County DNR	1999-2000	BEHP	Admiralty Inlet	offshore-shallow	13	12	approx. 17 % > 1 ug/L, most with no "B"; approx. 72% detected at <1 ug/L, most (87%) with "B"; 11% non-detect at DL = 0.14 ug/L
King County DNR	1999-2000	BEHP	Admiralty Inlet	offshore-mid	13	12	approx. 17 % > 1 ug/L, most with no "B"; approx. 72% detected at <1 ug/L, most (87%) with "B"; 11% non-detect at DL = 0.14 ug/L
King County DNR	1999-2000	BEHP	Admiralty Inlet	offshore-deep	13	12	approx. 17 % > 1 ug/L, most with no "B"; approx. 72% detected at <1 ug/L, most (87%) with "B"; 11% non-detect at DL = 0.14 ug/L
King County DNR	2003-2004	BEHP	Central Elliott Bay	offshore-shallow	6	4	approx. 17 % > 1 ug/L, most with no "B"; approx. 72% detected at <1 ug/L, most (87%) with "B"; 11% non-detect at DL = 0.14 ug/L
King County DNR	2003-2004	BEHP	Central Elliott Bay	offshore-mid	4	4	approx. 17 % > 1 ug/L, most with no "B"; approx. 72% detected at <1 ug/L, most (87%) with "B"; 11% non-detect at DL = 0.14 ug/L
King County DNR	2003-2004	BEHP	Central Elliott Bay	offshore-deep	5	4	approx. 17 % > 1 ug/L, most with no "B"; approx. 72% detected at <1 ug/L, most (87%) with "B"; 11% non-detect at DL = 0.14 ug/L
King County DNR	2003-2004	BEHP	Central Waterfront	offshore	4	4	approx. 17 % > 1 ug/L, most with no "B"; approx. 72% detected at <1 ug/L, most (87%) with "B"; 11% non-detect at DL = 0.14 ug/L
King County DNR	1996-1997	BEHP	Connecticut CSO (East Waterway)	offshore-shallow	7	7	approx. 17 % > 1 ug/L, most with no "B"; approx. 72% detected at <1 ug/L, most (87%) with "B"; 11% non-detect at DL = 0.14 ug/L
King County DNR	1996-1997	BEHP	Connecticut CSO (East Waterway)	offshore-deep	7	7	approx. 17 % > 1 ug/L, most with no "B"; approx. 72% detected at <1 ug/L, most (87%) with "B"; 11% non-detect at DL = 0.14 ug/L
King County DNR	1999-2000	BEHP	Colvos Passage	offshore-shallow	13	12	approx. 17 % > 1 ug/L, most with no "B"; approx. 72% detected at <1 ug/L, most (87%) with "B"; 11% non-detect at DL = 0.14 ug/L
King County DNR	1999-2000	BEHP	Colvos Passage	offshore-mid	13	12	approx. 17 % > 1 ug/L, most with no "B"; approx. 72% detected at <1 ug/L, most (87%) with "B"; 11% non-detect at DL = 0.14 ug/L
King County DNR	1999-2000	BEHP	Colvos Passage	offshore-deep	13	12	approx. 17 % > 1 ug/L, most with no "B"; approx. 72% detected at <1 ug/L, most (87%) with "B"; 11% non-detect at DL = 0.14 ug/L
King County DNR	1996-1997	BEHP	Denny Way Cap	offshore-shallow	7	7	approx. 17 % > 1 ug/L, most with no "B"; approx. 72% detected at <1 ug/L, most (87%) with "B"; 11% non-detect at DL = 0.14 ug/L
King County DNR	1996-1997	BEHP	Denny Way Cap	offshore-deep	7	7	approx. 17 % > 1 ug/L, most with no "B"; approx. 72% detected at <1 ug/L, most (87%) with "B"; 11% non-detect at DL = 0.14 ug/L
King County DNR	1996-1997	BEHP	Denny Way CSO Outfall	offshore	7	7	approx. 17 % > 1 ug/L, most with no "B"; approx. 72% detected at <1 ug/L, most (87%) with "B"; 11% non-detect at DL = 0.14 ug/L
King County DNR	2003	BEHP	DUW150N	offshore	4	4	approx. 17 % > 1 ug/L, most with no "B"; approx. 72% detected at <1 ug/L, most (87%) with "B"; 11% non-detect at DL = 0.14 ug/L
King County DNR	2003	BEHP	DUW150S	offshore	4	4	approx. 17 % > 1 ug/L, most with no "B"; approx. 72% detected at

Data Source	Year	Chemical or Chemical Group	Location	Station Type	Number of Samples	Number of Sampling Events	Comments
							<1 ug/L, most (87%) with "B"; 11% non-detect at DL = 0.14 ug/L
King County DNR	2003	BEHP	DUW300N	offshore	4	4	approx. 17 % > 1 ug/L, most with no "B"; approx. 72% detected at <1 ug/L, most (87%) with "B"; 11% non-detect at DL = 0.14 ug/L l
King County DNR	2003	BEHP	DUW300S	offshore	4	4	approx. 17 % > 1 ug/L, most with no "B"; approx. 72% detected at <1 ug/L, most (87%) with "B"; 11% non-detect at DL = 0.14 ug/L
King County DNR	2003	BEHP	DUWREF	offshore	8	8	approx. 17 % > 1 ug/L, most with no "B"; approx. 72% detected at <1 ug/L, most (87%) with "B"; 11% non-detect at DL = 0.14 ug/L
King County DNR	1996-1997	BEHP	Duwamish Head	offshore-shallow	7	7	approx. 17 % > 1 ug/L, most with no "B"; approx. 72% detected at <1 ug/L, most (87%) with "B"; 11% non-detect at DL = 0.14 ug/L
King County DNR	1996-1997	BEHP	Duwamish Head	offshore-deep	6	6	approx. 17 % > 1 ug/L, most with no "B"; approx. 72% detected at <1 ug/L, most (87%) with "B"; 11% non-detect at DL = 0.14 ug/L
King County DNR	1996-1997	BEHP	Duwamish River - Brandon CSO (Center)	offshore	7	7	approx. 17 % > 1 ug/L, most with no "B"; approx. 72% detected at <1 ug/L, most (87%) with "B"; 11% non-detect at DL = 0.14 ug/L
King County DNR	1996-1997	BEHP	Duwamish River - Brandon CSO (East)	offshore	7	7	approx. 17 % > 1 ug/L, most with no "B"; approx. 72% detected at <1 ug/L, most (87%) with "B"; 11% non-detect at DL = 0.14 ug/L
King County DNR	1996-1997	BEHP	Duwamish River - Brandon CSO (West)	offshore	6	6	approx. 17 % > 1 ug/L, most with no "B"; approx. 72% detected at <1 ug/L, most (87%) with "B"; 11% non-detect at DL = 0.14 ug/L
King County DNR	1996-1997	BEHP	East Waterway (Center)	offshore	7	7	approx. 17 % > 1 ug/L, most with no "B"; approx. 72% detected at <1 ug/L, most (87%) with "B"; 11% non-detect at DL = 0.14 ug/L
King County DNR	1996-1997	BEHP	East Waterway (East)	offshore	7	7	approx. 17 % > 1 ug/L, most with no "B"; approx. 72% detected at <1 ug/L, most (87%) with "B"; 11% non-detect at DL = 0.14 ug/L
King County DNR	1996-1997	BEHP	East Waterway (West)	offshore	7	7	approx. 17 % > 1 ug/L, most with no "B"; approx. 72% detected at <1 ug/L, most (87%) with "B"; 11% non-detect at DL = 0.14 ug/L
King County DNR	1999-2000	BEHP	Fauntleroy/Vashon	offshore-shallow	12	12	approx. 17 % > 1 ug/L, most with no "B"; approx. 72% detected at <1 ug/L, most (87%) with "B"; 11% non-detect at DL = 0.14 ug/L
King County DNR	1999-2000	BEHP	Fauntleroy/Vashon	offshore-mid	13	12	approx. 17 % > 1 ug/L, most with no "B"; approx. 72% detected at <1 ug/L, most (87%) with "B"; 11% non-detect at DL = 0.14 ug/L
King County DNR	1999-2000	BEHP	Fauntleroy/Vashon	offshore-deep	14	12	approx. 17 % > 1 ug/L, most with no "B"; approx. 72% detected at <1 ug/L, most (87%) with "B"; 11% non-detect at DL = 0.14 ug/L
King County DNR	1996-1997	BEHP	Harbor Island	offshore-shallow	7	7	approx. 17 % > 1 ug/L, most with no "B"; approx. 72% detected at <1 ug/L, most (87%) with "B"; 11% non-detect at DL = 0.14 ug/L
King County DNR	1996-1997	BEHP	Harbor Island	offshore-deep	7	7	approx. 17 % > 1 ug/L, most with no "B"; approx. 72% detected at <1 ug/L, most (87%) with "B"; 11% non-detect at DL = 0.14 ug/L
King County DNR	1999-2000, 2003-2004	BEHP	Jefferson Head	offshore-shallow	20	16	approx. 17 % > 1 ug/L, most with no "B"; approx. 72% detected at <1 ug/L, most (87%) with "B"; 11% non-detect at DL = 0.14 ug/L
King County DNR	1999-2000, 2003-2004	BEHP	Jefferson Head	offshore-mid	15	15	approx. 17 % > 1 ug/L, most with no "B"; approx. 72% detected at <1 ug/L, most (87%) with "B"; 11% non-detect at DL = 0.14 ug/L
King County DNR	1999-2000, 2003-2004	BEHP	Jefferson Head	offshore-deep	17	16	approx. 17 % > 1 ug/L, most with no "B"; approx. 72% detected at <1 ug/L, most (87%) with "B"; 11% non-detect at DL = 0.14 ug/L
King County DNR	1999-2000, 2003-2004	BEHP	Point Wells	offshore-shallow	20	16	approx. 17 % > 1 ug/L, most with no "B"; approx. 72% detected at <1 ug/L, most (87%) with "B"; 11% non-detect at DL = 0.14 ug/L
King County DNR	1999-2000, 2003-2004	BEHP	Point Wells	offshore-mid	16	16	approx. 17 % > 1 ug/L, most with no "B"; approx. 72% detected at <1 ug/L, most (87%) with "B"; 11% non-detect at DL = 0.14 ug/L
King County DNR	1999-2000, 2003-2004	BEHP	Point Wells	offshore-deep	16	16	approx. 17 % > 1 ug/L, most with no "B"; approx. 72% detected at <1 ug/L, most (87%) with "B"; 11% non-detect at DL = 0.14 ug/L
King County DNR	1999-2000	BEHP	Possession Sound	offshore-shallow	14	12	approx. 17 % > 1 ug/L, most with no "B"; approx. 72% detected at <1 ug/L, most (87%) with "B"; 11% non-detect at DL = 0.14 ug/L
King County DNR	1999-2000	BEHP	Possession Sound	offshore-mid	12	12	approx. 17 % > 1 ug/L, most with no "B"; approx. 72% detected at <1 ug/L, most (87%) with "B"; 11% non-detect at DL = 0.14 ug/L
King County DNR	1999-2000	BEHP	Possession Sound	offshore-deep	13	12	approx. 17 % > 1 ug/L, most with no "B"; approx. 72% detected at <1 ug/L, most (87%) with "B"; 11% non-detect at DL = 0.14 ug/L
King County DNR	1999-2000	BEHP	Renton Treatment Plant Outfall	offshore-shallow	14	12	approx. 17 % > 1 ug/L, most with no "B"; approx. 72% detected at <1 ug/L, most (87%) with "B"; 11% non-detect at DL = 0.14 ug/L

Data Source	Year	Chemical or Chemical Group	Location	Station Type	Number of Samples	Number of Sampling Events	Comments
King County DNR	1999-2000	BEHP	Renton Treatment Plant Outfall	offshore-mid	12	12	approx. 17 % > 1 ug/L, most with no "B"; approx. 72% detected at <1 ug/L, most (87%) with "B"; 11% non-detect at DL = 0.14 ug/L
King County DNR	1999-2000	BEHP	Renton Treatment Plant Outfall	offshore-deep	12	12	approx. 17 % > 1 ug/L, most with no "B"; approx. 72% detected at <1 ug/L, most (87%) with "B"; 11% non-detect at DL = 0.14 ug/L
King County DNR	2003-2004	BEHP	South End (Upstream) Harbor Island	offshore-shallow	8	4	approx. 17 % > 1 ug/L, most with no "B"; approx. 72% detected at <1 ug/L, most (87%) with "B"; 11% non-detect at DL = 0.14 ug/L
King County DNR	2003-2004	BEHP	South End (Upstream) Harbor Island	offshore-deep	4	4	approx. 17 % > 1 ug/L, most with no "B"; approx. 72% detected at <1 ug/L, most (87%) with "B"; 11% non-detect at DL = 0.14 ug/L
King County DNR	1996-1997	BEHP	SW Michigan CSO (Center)	offshore	7	7	approx. 17 % > 1 ug/L, most with no "B"; approx. 72% detected at <1 ug/L, most (87%) with "B"; 11% non-detect at DL = 0.14 ug/L
King County DNR	1996-1997	BEHP	SW Michigan CSO (East)	offshore	7	7	approx. 17 % > 1 ug/L, most with no "B"; approx. 72% detected at <1 ug/L, most (87%) with "B"; 11% non-detect at DL = 0.14 ug/L
King County DNR	1996-1997	BEHP	SW Michigan CSO (West)	offshore	7	7	approx. 17 % > 1 ug/L, most with no "B"; approx. 72% detected at <1 ug/L, most (87%) with "B"; 11% non-detect at DL = 0.14 ug/L
King County DNR	1999-2000, 2003-2004	BEHP	West Point Treatment Plant Outfall	offshore-shallow	19	16	approx. 17 % > 1 ug/L, most with no "B"; approx. 72% detected at <1 ug/L, most (87%) with "B"; 11% non-detect at DL = 0.14 ug/L
King County DNR	1999-2000, 2003-2004	BEHP	West Point Treatment Plant Outfall	offshore-mid	18	15	approx. 17 % > 1 ug/L, most with no "B"; approx. 72% detected at <1 ug/L, most (87%) with "B"; 11% non-detect at DL = 0.14 ug/L
King County DNR	1999-2000, 2003-2004	BEHP	West Point Treatment Plant Outfall	offshore-deep	18	16	approx. 17 % > 1 ug/L, most with no "B"; approx. 72% detected at <1 ug/L, most (87%) with "B"; 11% non-detect at DL = 0.14 ug/L
King County DNR	1996-1997	BEHP	West Waterway	offshore-shallow	7	7	approx. 17 % > 1 ug/L, most with no "B"; approx. 72% detected at <1 ug/L, most (87%) with "B"; 11% non-detect at DL = 0.14 ug/L
King County DNR	1996-1997	BEHP	West Waterway	offshore-deep	7	7	approx. 17 % > 1 ug/L, most with no "B"; approx. 72% detected at <1 ug/L, most (87%) with "B"; 11% non-detect at DL = 0.14 ug/L
King County DNR	1996-1997	BEHP	West Waterway (Center)	offshore	7	7	approx. 17 % > 1 ug/L, most with no "B"; approx. 72% detected at <1 ug/L, most (87%) with "B"; 11% non-detect at DL = 0.14 ug/L
King County DNR	1996-1997	BEHP	West Waterway (East)	offshore	5	5	approx. 17 % > 1 ug/L, most with no "B"; approx. 72% detected at <1 ug/L, most (87%) with "B"; 11% non-detect at DL = 0.14 ug/L
King County DNR	1996-1997	BEHP	West Waterway (West)	offshore	7	7	approx. 17 % > 1 ug/L, most with no "B"; approx. 72% detected at <1 ug/L, most (87%) with "B"; 11% non-detect at DL = 0.14 ug/L
EIM - Consultant	2000	BEHP	Holly Street Landfill Redevelopment Project, Focused Remedial Investig'n		1	1	no BEHP detected at 1.3 ug/L
EIM - Consultant	2000	BEHP	Holly Street Landfill Redevelopment Project, Focused Remedial Investig'n		2	1	detected in one of three samples at 1.2 ug/L
EIM - Consultant	2000	BEHP	Holly Street Landfill Redevelopment Project, Focused Remedial Investig'n		1	1	detected in one of three samples at 2.2 ug/L
EIM - Consultant	2000	BEHP	Holly Street Landfill Redevelopment Project, Focused Remedial Investig'n		2	1	no BEHP detected at 1.3 ug/L
EIM - Consultant	2000	BEHP	Holly Street Landfill Redevelopment Project, Focused Remedial Investig'n		1	1	no BEHP detected at 1.3 ug/L
EIM - Consultant	2000	BEHP	Holly Street Landfill Redevelopment Project, Focused Remedial Investig'n		1	1	detected at 23 ug/L
EIM - Consultant	2000	BEHP	Holly Street Landfill Redevelopment Project, Focused Remedial Investig'n		1	1	none detected at 1 ug/L
EIM - Consultant	2000	BEHP	Holly Street Landfill Redevelopment Project, Focused Remedial Investig'n		1	1	none detected at 1 ug/L
EIM - Consultant	2000	BEHP	Holly Street Landfill Redevelopment Project, Focused Remedial Investig'n		1	1	detected in one of two samples at 2.5 ug/L
EIM - Consultant	2000	BEHP	Holly Street Landfill Redevelopment Project, Focused Remedial Investig'n		1	1	detected in one of two samples at 1.2 ug/L
EIM - Consultant	2000	BEHP	Holly Street Landfill Redevelopment Project, Focused Remedial Investig'n		1	1	no BEHP detected at 1 ug/L
King County DNR	2003-2004	Nonylphenol	Central Elliott Bay	offshore-shallow	6	4	all samples non-detect (DL=0.047-0.094 ug/L) or "B"

Data Source	Year	Chemical or Chemical Group	Location	Station Type	Number of Samples	Number of Sampling Events	Comments
King County DNR	2003-2004	Nonylphenol	Central Elliott Bay	offshore-mid	4	4	all samples non-detect (DL=0.047-0.094 ug/L) or "B"
King County DNR	2003-2004	Nonylphenol	Central Elliott Bay	offshore-deep	5	4	all samples except one non-detect (DL=0.047-0.094 ug/L) or "B"
King County DNR	2003-2004	Nonylphenol	South End (Upstream) Harbor Island	offshore-shallow	8	4	all samples non-detect (DL=0.047-0.094 ug/L) or "B"
King County DNR	2003-2004	Nonylphenol	South End (Upstream) Harbor Island	offshore-deep	4	4	all samples non-detect (DL=0.047-0.094 ug/L) or "B"
King County DNR	2003-2004	Nonylphenol	Central Waterfront	offshore	4	4	all samples non-detect (DL=0.047-0.094 ug/L) or "B"
King County DNR	2003-2004	Nonylphenol	Jefferson Head	offshore-shallow	6	4	all samples non-detect (DL=0.047-0.094 ug/L) or "B"
King County DNR	2003-2004	Nonylphenol	Jefferson Head	offshore-mid	4	4	all samples non-detect (DL=0.047-0.094 ug/L) or "B"
King County DNR	2003-2004	Nonylphenol	Jefferson Head	offshore-deep	4	4	all samples non-detect (DL=0.047-0.094 ug/L) or "B"
King County DNR	2003-2004	Nonylphenol	Point Wells	offshore-shallow	6	4	all samples non-detect (DL=0.047-0.094 ug/L) or "B"
King County DNR	2003-2004	Nonylphenol	Point Wells	offshore-mid	4	4	all samples non-detect (DL=0.047-0.094 ug/L) or "B"
King County DNR	2003-2004	Nonylphenol	Point Wells	offshore-deep	4	4	all samples non-detect (DL=0.047-0.094 ug/L) or "B"
King County DNR	2003-2004	Nonylphenol	West Point Treatment Plant Outfall	offshore-shallow	6	4	all samples except one non-detect (DL=0.047-0.094 ug/L) or "B"
King County DNR	2003-2004	Nonylphenol	West Point Treatment Plant Outfall	offshore-mid	6	4	all samples non-detect (DL=0.047-0.094 ug/L) or "B"
King County DNR	2003-2004	Nonylphenol	West Point Treatment Plant Outfall	offshore-deep	4	4	all samples non-detect (DL=0.047-0.094 ug/L) or "B"
King County DNR	1999-2000	Cd, dissolved	Admiralty Inlet	offshore-deep	15	15	ICP-MS; conc=0.056-0.074 ug/L, approx median=0.068 ug/L
King County DNR	1999-2000	Cd, dissolved	Admiralty Inlet	offshore-mid	15	15	ICP-MS; conc=0.058-0.074 ug/L, approx median=0.066 ug/L
King County DNR	1999-2000	Cd, dissolved	Admiralty Inlet	offshore-shallow	25	15	ICP-MS; conc=0.035-0.071 ug/L, approx median=0.057 ug/L
King County DNR	1999-2000	Cd, total	Admiralty Inlet	offshore-mid	15	15	ICP-MS; conc=0.062-0.075 ug/L, approx median=0.067 ug/L
King County DNR	1999-2000	Cd, total	Admiralty Inlet	offshore-shallow	15	15	ICP-MS; conc=0.059-0.075 ug/L, approx median=0.067 ug/L
King County DNR	1999-2000	Cd, total	Admiralty Inlet	offshore-deep	25	15	ICP-MS; conc=0.051-0.076 ug/L, approx median=0.062 ug/L
King County DNR	1999-2000	Pb, dissolved	Admiralty Inlet	offshore-shallow	15	15	ICP-MS; conc=<0.005-0.0064 ug/L, approx median= <0.005 ug/L
King County DNR	1999-2000	Pb, dissolved	Admiralty Inlet	offshore-mid	25	15	ICP-MS; conc=<0.005-0.0073 ug/L, approx median= <0.005 ug/L
King County DNR	1999-2000	Pb, dissolved	Admiralty Inlet	offshore-shallow	15	15	ICP-MS; conc=<0.005-0.0088 ug/L, approx median= <0.005 ug/L
King County DNR	1999-2000	Pb, total	Admiralty Inlet	offshore-mid	15	15	ICP-MS; conc=0.014-0.055 ug/L, approx median=0.027 ug/L
King County DNR	1999-2000	Pb, total	Admiralty Inlet	offshore-shallow	15	15	ICP-MS; conc=0.012-0.072 ug/L, approx median=0.018 ug/L
King County DNR	1999-2000	Pb, total	Admiralty Inlet	offshore-shallow	25	15	ICP-MS; conc=0.0084-0.030 ug/L, approx median= 0.013 ug/L
King County DNR	1999-2000	Hg, dissolved	Admiralty Inlet	offshore-mid	13	13	CVAF; conc=<0.1-0.42 ng/L, approx median=0.18 ng/L
King County DNR	1999-2000	Hg, dissolved	Admiralty Inlet	offshore-shallow	13	13	CVAF; conc=<0.1-0.35 ng/L, approx median=0.18 ng/L
King County DNR	1999-2000	Hg, dissolved	Admiralty Inlet	offshore-shallow	21	13	CVAF; conc=0.11-0.32 ng/L, approx median=0.18 ng/L
King County DNR	1999-2000	Hg, total	Admiralty Inlet	offshore-mid	13	13	CVAF; conc=0.23-0.64 ng/L, approx median=0.31 ng/L
King County DNR	1999-2000	Hg, total	Admiralty Inlet	offshore-shallow	13	13	CVAF; conc=0.15-0.46 ng/L, approx median=0.3 ng/L
King County DNR	1999-2000	Hg, total	Admiralty Inlet	offshore-shallow	21	13	CVAF; conc=0.14-0.69 ng/L, approx median=0.27 ng/L

Data Source	Year	Chemical or Chemical Group	Location	Station Type	Number of Samples	Number of Sampling Events	Comments
King County DNR	1999-2002	Cd, dissolved	Alki Point Treatment Plant	intertidal	4	4	ICP-MS; conc=0.051-0.062 ug/L
King County DNR	1999	Cd, total	Alki Point Treatment Plant	intertidal	1	1	ICP-MS; conc=0.079 ug/L
King County DNR	1999-2002	Pb, dissolved	Alki Point Treatment Plant	intertidal	4	4	ICP-MS; conc=<0.007-0.013 ug/L
King County DNR	1999	Pb, total	Alki Point Treatment Plant	intertidal	1	1	ICP-MS; conc=0.38 ug/L
King County DNR	2000-2001	Cd, dissolved	Boeing Creek Mouth	intertidal	9	8	ICP-MS; conc=0.040-0.070 ug/L, approx median=0.063 ug/L
King County DNR	2000-2001	Cd, total	Boeing Creek Mouth	intertidal	9	8	ICP-MS; conc=0.058-0.072 ug/L, approx median=0.068 ug/L
King County DNR	2000-2001	Pb, dissolved	Boeing Creek Mouth	intertidal	9	8	ICP-MS; 8 of 9 non-detect at DL=0.007 ug/L
King County DNR	2000-2001	Pb, total	Boeing Creek Mouth	intertidal	9	8	ICP-MS; conc=0.055-1.04 ug/L, approx median=0.11 ug/L
King County DNR	2000-2001	Hg, dissolved	Boeing Creek Mouth	intertidal	9	8	CVAF; conc=0.1-0.49 ng/L, approx median=0.22 ng/L
King County DNR	2000-2001	Hg, total	Boeing Creek Mouth	intertidal	9	8	CVAF; conc=0.41-5.1 ng/L, approx median=0.56 ng/L
King County DNR	2000-2001	Cd, dissolved	Brackett's Landing Underwater Park	intertidal	8	8	ICP-MS; conc=0.049-0.070 ug/L, approx median=0.063 ug/L
King County DNR	2000-2001	Cd, total	Brackett's Landing Underwater Park	intertidal	8	8	ICP-MS; conc=0.057-0.083 ug/L, approx median=0.064 ug/L
King County DNR	2000-2001	Pb, dissolved	Brackett's Landing Underwater Park	intertidal	8	8	ICP-MS; conc=<0.007-0.044 ug/l, approx median=0.02 ug/l
King County DNR	2000-2001	Pb, total	Brackett's Landing Underwater Park	intertidal	8	8	ICP-MS; conc=0.078-1.03 ug/l, approx median=0.2 ug/l
King County DNR	2000-2001	Hg, dissolved	Brackett's Landing Underwater Park	intertidal	8	8	CVAF; conc=0.16-0.37 ng/L, approx median=0.22 ng/L
King County DNR	2000-2001	Hg, total	Brackett's Landing Underwater Park	intertidal	8	8	CVAF; conc=0.41-1.45 ng/L, approx median=0.7 ng/L
King County DNR	2000-2001	Cd, dissolved	Carkeek Park	intertidal	18	16	ICP-MS; conc=0.053-0.073 ug/L, approx median=0.065 ug/L
King County DNR	2000-2001	Cd, total	Carkeek Park	intertidal	18	16	ICP-MS; conc=0.046-0.079 ug/L, approx median=0.067 ug/L
King County DNR	2000-2001	Pb, dissolved	Carkeek Park	intertidal	18	16	ICP-MS; 14 of 18 non-detect at DL=0.007 ug/L
King County DNR	2000-2001	Pb, total	Carkeek Park	intertidal	18	16	ICP-MS; conc=0.027-0.58 ug/L, approx median=0.083 ug/L
King County DNR	2000-2001	Hg, dissolved	Carkeek Park	intertidal	18	16	CVAF; conc=<0.1-0.74 ng/L, approx median=0.22 ng/L
King County DNR	2000-2001	Hg, total	Carkeek Park	intertidal	18	16	CVAF; conc=0.27-4.05 ng/L, approx median=0.8 ng/L
King County DNR	1999-2000	Cd, dissolved	Colvos Passage	offshore-deep	15	15	ICP-MS; conc=0.055-0.069 ug/L, approx median=0.065 ug/L
King County DNR	1999-2000	Cd, dissolved	Colvos Passage	offshore-mid	15	15	ICP-MS; conc=0.056-0.069 ug/L, approx median=0.064 ug/L
King County DNR	1999-2000	Cd, dissolved	Colvos Passage	offshore-shallow	27	15	ICP-MS; conc=0.046-0.068 ug/L, approx median=0.06 ug/L
King County DNR	1999-2000	Cd, total	Colvos Passage	offshore-mid	15	15	ICP-MS; conc=0.058-0.072 ug/L, approx median=0.065 ug/L
King County DNR	1999-2000	Cd, total	Colvos Passage	offshore-shallow	15	15	ICP-MS; conc=0.058-0.073 ug/L, approx median=0.067 ug/L
King County DNR	1999-2000	Cd, total	Colvos Passage	offshore	27	15	ICP-MS; conc=0.053-0.075 ug/L, approx median=0.065 ug/L
King County DNR	1999-2000	Pb, dissolved	Colvos Passage	offshore	27	15	ICP-MS; 16 of 27 non-detect at DL=0.005-0.007 ug/L
King County DNR	1999-2000	Pb, dissolved	Colvos Passage	offshore	15	15	ICP-MS; 10 of 15 non-detect at DL=0.005-0.007 ug/L
King County DNR	1999-2000	Pb, dissolved	Colvos Passage	offshore	15	15	ICP-MS; 9 of 15 non-detect at DL=0.005-0.007 ug/L
King County DNR	1999-2000	Pb, total	Colvos Passage	offshore-deep	27	15	ICP-MS; conc=0.008-0.054 ug/L, approx median=0.02 ug/L
King County DNR	1999-2000	Pb, total	Colvos Passage	offshore-mid	15	15	ICP-MS; conc=0.018-0.10 ug/L, approx median=0.032 ug/L

Data Source	Year	Chemical or Chemical Group	Location	Station Type	Number of Samples	Number of Sampling Events	Comments
King County DNR	1999-2000	Pb, total	Colvos Passage	offshore	15	15	ICP-MS; conc=0.012-0.045 ug/L, approx median=0.026 ug/L
King County DNR	1999-2000	Hg, dissolved	Colvos Passage	offshore-deep	20	13	CVAF; conc=<0.1-0.36 ng/L, approx median=0.2 ng/L
King County DNR	1999-2000	Hg, dissolved	Colvos Passage	offshore-mid	13	13	CVAF; conc=<0.1-0.35 ng/L, approx median=0.2 ng/L
King County DNR	1999-2000	Hg, dissolved	Colvos Passage	offshore	13	13	CVAF; conc=<0.1-0.26 ng/l, approx median=0.16 ng/l
King County DNR	1999-2000	Hg, total	Colvos Passage	offshore-deep	21	13	CVAF; conc=0.17-0.63 ng/l, approx median=0.28 ng/l
King County DNR	1999-2000	Hg, total	Colvos Passage	offshore-mid	13	13	CVAF; conc=0.19-0.59 ng/L, approx median=0.4 ng/L
King County DNR	1999-2000	Hg, total	Colvos Passage	offshore	13	13	CVAF; conc=0.23-0.65 ng/L, approx median=0.3 ng/L
King County DNR	1996-1997	Cd, dissolved	Connecticut CSO (East Waterway)	offshore-shallow	12	12	ICP-MS; conc=0.048-0.071 ug/L, approx median=0.06 ug/L
King County DNR	1996-1997	Cd, dissolved	Connecticut CSO (East Waterway)	offshore-deep	6	6	ICP-MS; conc=0.066-0.082 ug/l, approx median=0.069 ug/l
King County DNR	1996-1997	Cd, total	Connecticut CSO (East Waterway)	offshore-shallow	29	29	ICP-MS; conc=0.047-0.082 ug/L, approx median=0.063 ug/L
King County DNR	1996-1997	Cd, total	Connecticut CSO (East Waterway)	offshore-deep	23	23	ICP-MS; conc=0.057-0.076 ug/L, approx median=0.066 ug/L
King County DNR	1996-1997	Pb, dissolved	Connecticut CSO (East Waterway)	offshore	12	12	blank contamination
King County DNR	1996-1997	Pb, dissolved	Connecticut CSO (East Waterway)	offshore	6	6	blank contamination
King County DNR	1996-1997	Pb, total	Connecticut CSO (East Waterway)	offshore-shallow	23	23	median conc= approx. 0.083 ug/L; several samples had blank contamination
King County DNR	1996-1997	Pb, total	Connecticut CSO (East Waterway)	offshore	29	29	ICP-MS; conc=0.042-0.57 ug/L, approx median=0.15 ug/L
King County DNR	1996	Hg, total	Connecticut CSO (East Waterway)	offshore-deep	1	1	CVAA; non-detect at MDL=0.2 ug/L
King County DNR	1996	Hg, total	Connecticut CSO (East Waterway)	offshore	1	1	CVAA; non-detect at MDL=0.2 ug/L
King County DNR	1996-1997	Cd, dissolved	Denny Way Cap	offshore-deep	11	11	ICP-MS; conc=0.051-0.074 ug/L, approx median=0.063 ug/L
King County DNR	1996-1997	Cd, dissolved	Denny Way Cap	offshore-shallow	6	6	ICP-MS; conc=0.062-0.071 ug/L, approx median=0.067 ug/L
King County DNR	1996-1997	Cd, total	Denny Way Cap	offshore-shallow	26	26	ICP-MS; conc=0.042-0.078 ug/L, approx median=0.058 ug/L
King County DNR	1996-1997	Cd, total	Denny Way Cap	offshore-deep	22	22	ICP-MS; conc=0.061-0.076 ug/L, approx median=0.068 ug/L
King County DNR	1996-1997	Pb, dissolved	Denny Way Cap	offshore-deep	6	6	blank contamination
King County DNR	1996-1997	Pb, dissolved	Denny Way Cap	offshore-shallow	11	11	blank contamination
King County DNR	1996-1997	Pb, total	Denny Way Cap	offshore-deep	22	22	median conc approx. 0.1 ug/L; some blank contamination
King County DNR	1996-1997	Pb, total	Denny Way Cap	offshore-shallow	27	27	ICP-MS; conc=0.036-0.48 ug/L, approx median=0.16 ug/L
King County DNR	1996	Hg, total	Denny Way Cap	offshore-shallow	1	1	CVAA; non-detect at MDL=0.2 ug/L
King County DNR	1996	Hg, total	Denny Way Cap	offshore-deep	1	1	CVAA; non-detect at MDL=0.2 ug/L
King County DNR	1996-1997	Cd, dissolved	Denny Way CSO Outfall	offshore-shallow	6	6	ICP-MS; conc=0.046-0.074 ug/L, approx median=0.056 ug/L
King County DNR	1996-1997	Cd, total	Denny Way CSO Outfall	offshore-shallow	22	22	ICP-MS; conc=0.038-0.075 ug/L, approx median=0.056 ug/L
King County DNR	1996-1997	Pb, dissolved	Denny Way CSO Outfall	offshore-shallow	6	6	blank contamination
King County DNR	1996-1997	Pb, total	Denny Way CSO Outfall	offshore-shallow	22	22	ICP-MS; conc=0.068-0.75 ug/L, approx median=0.2 ug/L
King County DNR	1996	Hg, total	Denny Way CSO Outfall	offshore-shallow	1	1	CVAA; non-detect at MDL=0.2 ng/L
King County DNR	2003	Hg, dissolved	DUW150N	offshore	2	1	CVAA; <5-5.8 ng/L

Data Source	Year	Chemical or Chemical Group	Location	Station Type	Number of Samples	Number of Sampling Events	Comments
King County DNR	2003	Hg, total	DUW150N	offshore	2	1	CVAA; <5-6.5 ng/L
King County DNR	2003	Hg, dissolved	DUW150S	offshore	4	4	CVAA; <5-5.2 ng/L
King County DNR	2003	Hg, total	DUW150S	offshore	4	4	CVAA; 5.2-103 ng/L, very high levels of mercury
King County DNR	2003	Hg, dissolved	DUW300N	offshore	2	1	CVAA; 7-8 ng/L
King County DNR	2003	Hg, total	DUW300N	offshore	2	1	CVAA; 9-27 ng/L
King County DNR	2003	Hg, dissolved	DUW300S	offshore	4	4	CVAA; non-detect at DL=5 ng/L
King County DNR	2003	Hg, total	DUW300S	offshore	4	4	CVAA; <5-6 ng/L

CSO Combined sewer outfall
CVAA Cold vapor atomic absorbance
CVAF Cold vapor atomic fluorescence
DL Detection limit
ICP-MS Inductively coupled plasma mass spectrometry

Cd cadmium
Hg mercury
Pb lead