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State of Washington

Bellingham Bay Regional Background Sediment Characterization

Bellingham, WA

Final Data Evaluation and Summary Report

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Bellingham Bay
Regional Background Sediment Characterization

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AOI	area of interest
ARI	Analytical Resources Inc.
Axys	Axys Analytical Ltd.
CAP	cleanup action plan
CD	consent decree
cPAH	carcinogenic polycyclic aromatic hydrocarbon
CSL	Cleanup Screening Level
CSO	combined sewer overflow
DGPS	differential global positioning system
DQO	data quality objectives
Ecology	Washington State Department of Ecology
EMPC	estimated maximum potential concentration
EPA	U.S. Environmental Protection Agency
KM	Kaplan-Meier
MDL	method detection limit
MLLW	mean lower low water
NAD83	1983 North American Datum
PCB	polychlorinated biphenyl
PeCDD	pentachlorodibenzodioxin
PQL	practical quantitation limit
PSEP	Puget Sound Estuary Program
PSRM	Puget Sound reference material
QA/QC	Quality Assurance/Quality Control
RI/FS	remedial investigation/feasibility study
RPD	relative percent difference
RSD	relative standard deviation
SAP	Sampling and Analysis Plan
SCO	sediment cleanup objective
SCUM II	Sediment Cleanup User's Manual II
SDL	sample specific detection limit
SIM	select ion monitoring
SMS	Sediment Management Standards
SVOC	semi-volatile organic chemical
TBT	tributyltin
TCDD	tetrachlorodibenzodioxin
TEC	toxic equivalent concentration
TEF	toxic equivalent factor
TEQ	toxic equivalent quotient
TOC	total organic carbon

UCL	upper confidence limit
UTL	upper tolerance limit
WAC	Washington Administrative Code
WHO	World Health Organization

1.0 Introduction

In early 2013, Ecology revised its Sediment Management Standards (SMS) to establish a new framework for identification and cleanup of contaminated sediment sites (Washington Administrative Code [WAC] 173-204). A key component of this framework was the concept of regional background sediment concentrations, which could potentially serve as the Cleanup Screening Level (CSL) for sediment sites. During the advisory group process for the rule revisions, it was recommended that Ecology be responsible for establishing regional background sediment concentrations for the state.

Bellingham Bay is the location of a multi-organization, comprehensive cleanup initiative known as the Bellingham Bay Demonstration Pilot. Under this initiative, Ecology is addressing 12 cleanup sites, including 8 sediment sites. Controlling pollution sources is also a component of the initiative. Regional background concentrations are needed to support these cleanup and source control activities.

The current study was prepared in accordance with the SMS and Sediment Cleanup User's Manual (SCUM II; Ecology 2013a & 2015). Sediment sampling, analytical procedures, and methods corresponded to the SMS, SCUM II, and WAC 173-340-830.

1.1. Regional Background Definition

For a number of bioaccumulative chemicals, risk-based values protective of human health and upper trophic levels fall below natural background concentrations, as defined in the SMS (WAC 173-204-505). Sediments are a sink for chemicals from potentially hundreds of sources, including a mix of permitted and unpermitted stormwater, atmospheric deposition, and historical releases from industrial activities. In urban embayments with developed shorelines, chemical concentrations in sediment are frequently higher than natural background concentrations.

The 2013 SMS rule revisions retained the two-tiered framework used to establish sediment cleanup levels, but now incorporates natural background (as the potential Sediment Cleanup Objective (SCO)) and a new term and concept, regional background as the potential CSL. The SMS rule includes a definition for regional background (WAC 173-204-505(16)) and parameters for establishing regional background (WAC 173-204-560(5)):

> ***"Regional Background"*** *means the concentration of a contaminant within a department defined geographic area that is primarily attributable to diffuse sources, such as atmospheric deposition or storm water, not attributable to a specific source or release.*

The SMS is intended to provide flexibility to establish regional background on a case-by-case basis and does not prescribe specifically how regional background should be established. The approach and methods contained in the Bellingham Bay Regional Background Sampling and Analysis Plans (SAP; Ecology 2014a) were developed by Ecology to establish regional background concentrations for the following analytes: lead, carcinogenic polycyclic hydrocarbons (cPAHs), dioxins/furans, and polychlorinated biphenyls (PCBs). This study serves as one example of how regional background concentrations can be established in a particular Ecology-defined geographic area.

Ecology's approach to establishing regional background has evolved over time through working on initial bays and after receiving comments from stakeholders and tribes, as described below.

1.2. Stakeholder Discussions

Ecology received a number of comments from stakeholders and tribes related to the regional background sampling conducted at Port Gardner and North Olympic Peninsula (Ecology 2013b, Ecology 2013c, and Ecology 2014b). Many stakeholders requested that for future regional background characterizations, they would like to work with Ecology before SAPs were drafted and submitted for public comment. In response, Ecology engaged stakeholders earlier in the process for the initial discussions regarding establishing regional background for Elliott Bay and/or the Lower Duwamish Waterway. A similar process was followed for Bellingham Bay, with Ecology holding a stakeholder review meeting in August 2014 to discuss the draft SAP (Ecology 2014a).

Based on these collective comments and discussions, Ecology determined that some modifications to the original sampling designs used to establish regional background were appropriate. The concepts described below were included in the Bellingham Bay Regional Background SAP and incorporated into the final Sediment Cleanup Users Manual II (SCUM II; Ecology 2013a & 2015).

The following modifications were incorporated into the Bellingham Bay regional background study design:

- **Rationale and Conceptual Bay Model.** This included a discussion of the selected analytes, existing information used to develop the sampling area of interest, and the rationale for the selected sampling methods. These choices were based on a conceptual bay model for Bellingham Bay and key features of Bellingham Bay. These included known sites and sources, existing chemistry data, existing modeling information, hydrodynamic information, bathymetry, etc.
- **Determining Areas of Primary Influence.** The area in which sediment samples were collected was consistent with the SMS definition of regional background (WAC 173-204-505(16)). This entailed sampling closer to the shoreline, sources, and sites, while

remaining outside areas of direct influence. Bay-specific information was used, where available, to determine areas directly associated with depositional zones of outfalls or other point sources and areas directly affected by sites.

- **Differentiating from Natural Background.** Existing data were examined to identify areas that were within the range of natural background concentrations (as defined in SCUM II; Ecology 2013a & 2015). These areas were excluded from sampling and calculation of regional background.
- **Differing Areas of Interest for Different Analytes.** Different analytes were found to be elevated above natural background in different areas of the bay. In Bellingham Bay, it was determined that cPAHs were elevated over a larger area than other chemicals. Therefore, a larger area of interest (AOI) was used for sampling regional background concentrations of cPAHs.

1.3. Bellingham Bay Area of Interest

Regional background concentrations for Bellingham Bay were determined based on data from samples collected within the AOI (Figure 1). The AOI was defined as a hydraulically connected marine environment that excluded areas directly influenced by known cleanup sites, potential sources (e.g., active or historical outfalls), dredged disposal sites, and areas more representative of natural background (as defined in WAC 173-204-505) such as the Nooksack River delta (Figure 1). Specifically, the AOI boundaries were determined as described below:

1. Cleanup sites along the shoreline were excluded based on clearly elevated levels of the bioaccumulative chemicals of concern. Bellingham Bay has been the focus of a number of sediment cleanup projects in the inner harbor and in other locations, along with a comprehensive waterfront redevelopment plan currently underway. Together, these processes have eliminated or reduced many contaminant sources (particularly industrial sources) to the bay, allowing natural recovery to begin. However, a number of sites have remaining contamination that may directly influence sediment concentrations in Bellingham Bay. The following cleanup sites were excluded from the AOI and a 75 m (~250 ft) exclusion buffer was added beyond the cleanup site boundaries (Figure 1). The cleanup sites are described below (from north to south):

   - **Oeser Company.** This is a wood treating company is located adjacent to Little Squalicum Park, which includes Little Squalicum Creek. Little Squalicum Creek discharges to the bay just north of Squalicum Creek. Historical wood treating practices resulted in the contamination of company property, as well as the park and creek. The site has been designated as a federal Superfund site. Contaminants at the site include pentachlorophenol, dioxins/furans, copper, zinc, and polycyclic aromatic hydrocarbons (PAHs). A Record of Decision was finalized in 2003 and site cleanup activities were undertaken in 2005 – 2009. In 2010, EPA determined that additional cleanup activities were required in Little Squalicum Park and these were conducted in 2010 – 2011.

- **Eldridge Municipal Landfill.** This is a former City of Bellingham municipal landfill located in Little Squalicum Park, next to Little Squalicum Creek. Contaminants at the site included PAHs, phthalates, pentachlorophenol, and metals (cadmium, copper, lead, mercury, and zinc). In 2011, over 4,000 tons of debris and soil were excavated and disposed of in Roosevelt Landfill. A remedial investigation/feasibility study (RI/FS) and a consent decree/cleanup action plan (CD/CAP) are in the process of being completed.
- **Weldcraft Steel & Marine.** This site is located in Outer Squalicum Harbor and has been used for boat repair, maintenance, and fabrication. Contaminants in sediments from past practices include metals, tributyltin (TBT), gasoline, and diesel. An interim cleanup action to remove contaminated sediment was completed in 2006. Contamination remains in upland areas of the site and an RI/FS has been completed.
- **Marine Services Northwest.** This site is located in Inner Squalicum Harbor. Contaminated sediments are located adjacent to a historical boat maintenance lift. Contaminants include metals, TBT, and PAHs. This is a quiescent and enclosed area. In 2001, a draft RI/FS was developed by the Port under the Voluntary Cleanup Program (VCP) prior to Ecology's decision to not allow sediment cleanups under VCP.
- **I&J Waterway.** This site consists of contaminated sediments in and adjacent to the federally authorized navigation lane. Historical industrial operations along the waterfront include a lumber mill, rock-crushing plant, and frozen food processing. A seafood processing plant is currently in operation. Contaminants identified in sediments include phthalates, phenols, PAHs, dioxins/furans, nickel, and mercury. An RI/FS is in the process of being completed.
- **Central Waterfront.** This site is located between I&J and Whatcom Waterways and consists of 55 acres of the waterfront with various historical industrial uses, including concrete manufacturing, lumber mill operations, boat repair, two bulk fuel terminal, rock processing, and a landfill. The site is adjacent to the former Georgia-Pacific treatment lagoon. Contaminants found in upland areas of this site include petroleum mixtures, PAHs, and a variety of metals. In 2013, an interim cleanup action was completed which included removal of over 1000 tons of petroleum-contaminated soil, removal of creosoted pilings, and beach restoration. The RI/FS for the rest of the site is expected to be completed in 2015.
- **Holly St. Landfill.** This historical City of Bellingham municipal waste landfill is bisected by Whatcom Creek as it enters Whatcom Waterway. Contaminants at the site include refuse along the shoreline, as well as copper and zinc releases to the waterway. Cleanup was completed in 2005.
- **Whatcom Waterway.** This sediment site is over 200 acres and includes the waterway itself, as well as the adjacent former Georgia-Pacific treatment lagoon. Contamination consists mainly of mercury and phenols from the former Georgia-Pacific pulp mill

operations. Untreated wastewater was discharged to the bay until 1979, when the Georgia-Pacific wastewater treatment lagoon and deepwater outfall (with a diffuser) was built. Prior to construction of the Post Point Wastewater Treatment Plant and outfall in 1974, primary treated wastewater was also discharged from the Whatcom Creek Waterway Wastewater Treatment Plant into the Whatcom Waterway. Contaminants in sediments include wood waste, phthalates, phenols, mercury, PAHs, various metals, and dioxins/furans. In 2001, an interim action resulted in the placement of dredged material over the approximately 6-acre Log Pond area of the site. The first phase of the final cleanup action is expected to begin in 2015 and will include dredging and capping in the inner portion of the waterway, additional capping in the Log Pond, and removal of structures and pilings.

- **Georgia-Pacific West.** This is the upland property where the main operations area of the former Georgia-Pacific mill was located on the south shoreline of Whatcom Waterway. Contaminants on the 74-acre site include PAHs, metals, dioxins/furans, various petroleum mixtures, and volatile organic compounds. The RI was completed in 2013 and interim actions to remove petroleum-contaminated and mercury-contaminated soil were conducted in 2011 and 2013. The site has two separate and distinct areas of contamination and has been divided accordingly. An FS and CD/CAP for the northern Pulp & Tissue Mill Remedial Action Unit was completed in 2014. An FS and CD/CAP amendment for the southern Chlor-Alkali Remedial Action Unit are expected to be completed in 2015.
- **R.G. Haley.** This site is located south of the Georgia-Pacific west site and north of the Cornwall Avenue Landfill site. Former wood treating operations, as well as lumber, coal, and wharf facilities have resulted in soil, groundwater, and sediment contamination. Contaminants include wood waste, diesel plumes, pentachlorophenol, dioxins/furans, and PAHs. An emergency action was taken in 2001to contain oil releases to Bellingham Bay, including building a sheet-pile wall, installing oil recovery wells, and some sediment removal. In 2013, a sand/clay layer was placed on a portion of the shoreline to address an oil seep. A draft RI/FS has been completed.
- **Cornwall Ave. Landfill.** This site is south and adjacent the R.G. Haley site and was originally used as a sawmill and for wood storage. It was later used as a City of Bellingham municipal waste landfill, followed by log storage after closure of the landfill. Erosion of the landfill into the bay has occurred over the years. Sediment contaminants include wood waste, metals, phthalates, polychlorinated biphenyls (PCBs), PAHs, phenols, diesel, and heavy oils. An interim action was conducted in 2011/2012 to cap much of the upland solid waste with stabilized dredged sediments and an impermeable liner. An RI/FS was completed in 2013 and a CD/CAP completed in 2014.
- **South State St. Manufactured Gas Plant.** This site is located along the southeast shoreline of Bellingham Bay at the north end of Boulevard Park. A former manufactured gas plant operated at this location until the late 1940s. Contaminants in sediments include

various petroleum products, PAHs, and volatile hydrocarbons. An RI has been conducted and the FS is underway.

- **Harris Avenue Shipyard.** This site is located at the southern end of the study area along the shoreline in Fairhaven. Sediments at the site have been contaminated by former shipbuilding and maintenance operations and contain metals, PCBs, phthalates, PAHs, and possibly dioxins/furans. An RI/FS is in the process of being completed.

2. In addition to the cleanup sites listed above, the following potential point and nonpoint sources of contamination were identified and excluded from the AOI (Figure 1):

   - **Post Point Wastewater Treatment Plant Outfall.** This outfall is at the southern boundary of the study area and discharges offshore at approximately 100 ft depth. The treatment plant has treated municipal sewage, stormwater, and industrial wastewater, and was upgraded to secondary treatment in 1993. Due to high organic loading, high ammonia and sulfides have been measured in sediments resulting in intermittent sediment bioassay failures. The depositional zone of this outfall is within the established exclusion zone of the AOI.
   - **Former Georgia-Pacific Deepwater Outfall.** This outfall extends 8,000 feet in a southwesterly direction from the former Georgia-Pacific treatment lagoon and includes a 2000-ft-long diffuser section discharging into 55 feet of water. Since the mill operations stopped in 2007, substantial natural recovery has occurred in this area. A 75 meter exclusion buffer was added around the diffuser.
   - **Urban Watersheds.** As noted above, several creeks carry stormwater discharges and historically received industrial discharges and can represent historical and/or current sources of contaminants to Bellingham Bay. Whatcom Creek discharges into Whatcom Waterway and would be included in that site. Little Squalicum Creek and Padden Creek could also have areas of elevated contaminants near their mouths, but recent data is not available to determine their status. The established exclusion buffers were sufficient to account for any direct influence from these potential sources.
   - **CSOs.** After the Post Point Treatment Plant was built in 1974, combined sewer overflow (CSO) events occurred at four locations, including at the Post Point Treatment Plant, at the C Street Interceptor (former Whatcom Waterway Treatment Plant outfall), at the lower Cornwall pump station, and at the Oak Street pump station. CSO reduction programs since then have minimized CSO events so that they only occur at the C Street Interceptor in Whatcom Waterway. The established sampling exclusion buffers were sufficient to account for any direct influence from these potential sources.
   - **Starr Rock.** In 1969, 130,000 cubic yards of sediment was dredged from Whatcom Waterway for maintenance and disposed of near Starr Rock, a natural rocky formation south of the Cornwall Avenue Landfill site. These sediments were likely contaminated with chemicals from wastewater discharged from the Georgia-Pacific pulp mill into Whatcom Waterway. Known contaminants include mercury, dioxins/furans, and various

semi-volatile organic chemicals (SVOCs). An additional 75 meter exclusion buffer was added around this potential source.

- **Early Sediment Disposal Sites.** The I&J Waterway was dredged in 1966 and the sediments were disposed of in an area about ¼ mile west of the terminus of the Georgia-Pacific deepwater outfall. The Squalicum Creek Waterway was also dredged in 1963 and these sediments were disposed of just east of the mouth of Little Squalicum Creek. Between 1979 and 1983, several dredging projects disposed of sediments in a disposal site northeast of the I&J site. Many of these sites may have contained contaminated sediments and several were likely impacted by mercury from the deepwater Georgia-Pacific outfall. However, all have been subject to decades of natural recovery as well. The established sampling exclusion buffers were sufficient to account for any direct influence from these potential sources.
- **DMMP Deepwater Disposal Site.** A deepwater non-dispersive disposal site has been established offshore of Post Point in the deeper areas of the bay. This disposal site has received mainly clean dredged material that is not necessarily representative of surrounding sediments. However, the last disposal event at this site was in 1998. This area was not included in the AOI.

3. Areas that represented natural background concentrations or that contained natural features that would hinder sampling were also excluded (Figure 1):

   - Areas where existing data were below natural background concentrations, as defined by the Bold Plus data set (SCUM II; Ecology 2013a & 2015), were excluded from the regional background AOIs. Boundaries were drawn approximately half-way between existing data points above and below the natural background 90/90 upper tolerance limit (UTL). A larger area of the bay was within natural background for dioxins/furans. Therefore, the regional background AOI for cPAHs, PCBs, and lead was larger than that for dioxins/furans (Figure 1).
   - Shallow areas < 6 ft mean lower low water (MLLW; ~2 m) in depth were excluded for logistical sampling reasons. These include all areas within the Nooksack River delta and south along the shoreline, some areas within the waterways, and very narrow areas along the southeast shoreline.

2.0 Sampling Methods and Analysis

The analytes selected for the calculation of regional background included lead, cPAHs, dioxin/furan congeners, and PCB congeners. Arsenic and cadmium were not included because they did not appear elevated in the bay outside of clearly contaminated areas within sites. Mercury was not included for two reasons: 1) current concentrations throughout the bay represent legacy contamination primarily from a single historic source, and 2) concentrations of mercury in the bay are rapidly recovering due to natural processes.

Lead was not evaluated as part of the conceptual bay model, but was discussed as a potential analyte at the August 2014 Bellingham Bay workshop (Section 1.2). Lead was added to the analyte list as a result of this discussion.

Two AOIs were established within Bellingham Bay based on distributions of existing data for cPAHs and dioxin/furan congeners. Concentrations of cPAHs were higher than natural background throughout a larger area than those of dioxin/furan congeners. As a result, the AOI for cPAHs was larger than that of dioxin/furan congeners (Figure 1). Due to a lack of existing bay-wide data, lead and PCB congeners were sampled in the larger cPAH AOI. *A priori* precision calculations based on existing data for cPAHs and dioxin/furan congeners from within the Bellingham Bay AOIs indicated that a minimum of eight dioxin samples and 22 cPAH samples would be expected to achieve the precision target for the data set (Ecology 2014a). Based on these estimates, no secondary samples were collected. The final sample counts for each AOI were as follows:

- 23 samples were collected from the larger AOI and analyzed for dioxin/furan congeners, cPAHs, PCB congeners, lead, total organic carbon (TOC), total solids, and grain size.
- 7 samples were collected from the dioxin/furan exclusion area and were analyzed for all of the above mentioned analytes except dioxin/furan congeners.

Sediment sampling was conducted from September 9 through September 11, 2014. The target sampling stations were selected within each AOI using a spatially balanced random sampling procedure such that no samples would be collected within 250 meters of each other.

2.1. Station Positioning and Navigation

The R/V *Kittiwake* was used for the surface sediment grabs. A differential global positioning system (DGPS) was used aboard the R/V *Kittiwake* for station positioning. The sampling station target coordinates were provided in advance and programmed into the R/V *Kittiwake's* navigation system. Upon sampling device deployment, the actual position was recorded once the device reached the seafloor and the winch cable was in a vertical position. Latitude and longitude station coordinates were recorded in degrees decimal minutes using the 1983 North American Datum (NAD83). Water depths were measured using the winch meter wheel and verified by the ship's fathometer. Table 1 provides the actual coordinates, water depths, and distance between the target and actual stations. Figure 2 shows the actual sample stations.

Two attempts were made at the target coordinates for station BB-19. A section of 2 x 4 lumber was caught in the grab on the first attempt. The second attempt came up empty. The target station was very near shore, and the bottom appeared to be a hard substrate (i.e. gravel and/or cobble). After consulting with Ecology, the station was moved 84 meters southwest (Table 1).

2.2. Surface Sediment Grabs

Surface sediment grabs were collected at 30 stations. All samples were collected using a stainless steel double van Veen grab sampler (0.2 m^2). Sampling followed the step wise procedure outlined in the SAP (Ecology 2014a). Notes related to sampling activities are presented in the sediment grab logbook in Appendix A. A brief summary of field sampling methods is provided below.

Established deployment and recovery procedures for the grab sampling gear, described by the Puget Sound Estuary Program (PSEP), were followed to ensure recovery of the best possible samples and minimize risks to personnel and equipment (PSEP 1997). Once a grab sample was retrieved, the overlying water was carefully siphoned off one side of the sampler. If the sample was judged to be acceptable according to PSEP specifications, the penetration depth was measured with a decontaminated stainless steel ruler, and sample quality, color, odor, and texture were described in the sample log. Scanned copies of the surface sediment grab logbook are presented in Appendix A.

The target depth for surface sediment collection was 12 cm. The penetration depth for seven samples was less than the target. However, penetration in all seven of these samples exceeded 10 cm.

Percent fines were determined at each station by rinsing 40 ml of sediment through a 63.5 µm sieve until the water was clear. Percent fines are equal to 40 minus the volume of remaining sediment divided by 40. The amount of sediment retained on the sieve was recorded in the surface sediment grab logbook (Appendix A).

2.3. Sample Storage, Delivery, and Chain of Custody

After filling the jars with homogenized aliquots of sediment, all samples were labeled and the lids were wrapped with electrical tape to seal the jars and prevent leakage. Each label was marked with a jar tag number for tracking purposes. Sample identification and jar tag numbers were recorded in the sample container logbook (Appendix B).

After labeling, all samples were stored in insulated coolers and preserved by cooling to a temperature of 4ºC.

Samples were delivered to Analytical Resources Incorporated (ARI; Tukwila, WA) and shipped to Axys Analytical (Sidney, BC). Sediment samples collected for archival were also submitted to ARI. All archive samples were frozen at -18°C. The Chain of Custody forms for all samples are presented in Appendix C.

2.3.1. Laboratory analysis

Samples were submitted to laboratories subcontracted by NewFields to conduct the chemical analysis. Axys analyzed the samples for dioxin/furan and PCB congeners. ARI analyzed samples for the sediment conventionals (TOC, total solids, and grain size), lead, and cPAHs. Table 2 presents a list of all samples collected as part of this sampling effort and includes the relevant analytical methods.

Additional samples collected for quality assurance/quality control (QA/QC) purposes are listed in Table 2. Field duplicates and triplicates were collected at stations BB-20 and BB-24. Rinsate blanks and equipment rinsate samples for metals and cPAHs were also collected. Further details relating to chemical analysis can be found in the SAP (Ecology 2014a).

Because of expected low concentrations, the data quality objectives (DQOs) used in this study were more stringent than those required under most sediment characterizations. As a result, the target practical quantitation limits (PQLs) for analysis were lower than most standard methods could provide. The PQLs for the analytes are listed in Table 3. This table includes the PQLs for the dioxin-like PCB congeners. The PQLs for the non-listed PCB congeners were all 0.4 ng/kg. The PQLs for the conventional parameters and the full list of PCB congeners can be found in the SAP (Ecology 2014a).

All non-detect sample results for cPAHs were reported to the method detection limit (MDL) and detected results less than the target PQL were "J" qualified. All non-detect results for metals were reported at the PQL. Metals data are not qualified below the PQL. Non-detect results for dioxin/furan and PCB congeners were reported at the sample-specific detection limit (SDL). All detected congener results less than the PQL were "J" qualified.

Laboratories do not provide PQL values for toxic equivalent quotient (TEQ) concentrations. Instead, these values were calculated for cPAHs, dioxin/furan congeners, and PCB congeners using the toxicity equivalency factors (TEF) from SCUM II (Ecology 2013a & 2015) for determining TEQ values and the individual compound or congener-specific PQLs in Table 3. The Ecology guidance for determining TEQs uses the dioxin/furan TEF values updated by the World Health Organization (WHO) in 2005 (Van den Berg et al. 2006). The resulting PQL for cPAHs was 0.76 μg TEQ/kg. The PQLs for dioxin/furan and PCB congeners were 2.3 and 0.052 ng TEQ/kg, respectively.

3.0 Data Validation

A QA2 (EPA Stage 3/4) chemistry data review was conducted by EcoChem, Inc. (Seattle, WA) who examined the complete analytical process from calculation of instrument and method detection limits, PQLs, final dilution volumes, sample size, and wet-to-dry ratios to quantification of calibration compounds and all analytes detected in blanks and environmental samples (PTI 1989a; PTI 1989b; USEPA 2009). The intent of the independent data validation was to ensure that the data are defensible and usable for regulatory purposes. This section provides a brief summary of the data validation reports. Two validation reports were completed. The first was for the majority of the chemistry samples, while the second was for two PCB congener samples that needed re-extraction and analysis by Axys. Both full validation reports are provided in Appendix E and available as electronic files upon request.

When necessary, EcoChem applied the following data qualifiers to the chemical results:

- U: The analyte was analyzed but not detected above the reported sample quantitation limit.
- UJ: The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.
- J: The analyte was positively identified. The associated numerical value is the approximate concentration of the analyte in the sample. "J" qualifiers were assigned by the laboratories for results less than the PQL and greater than the MDL, or by EcoChem for results that failed to meet study specific QA/QC criteria.
- DNR: Do not report. A more appropriate result is reported from another analysis or dilution.

The use of the DNR qualifier was limited to selecting the appropriate results for 2,3,7,8-TCDF, as results were reported for analysis on two separate columns. The remainder of the data was usable. Reason codes for applying the "U," "UJ," and "J" qualifiers and the definition for these codes are given in the validation reports (Appendix E).

Several qualifiers given by Axys were reclassified by EcoChem. Axys gave a "B" qualifier to all results where the analyte was detected in the method blank. EcoChem established an action level of five times the blank concentration. If a sample result was above that, the "B" qualifier was removed. If the result was below the action level, the result was qualified as not-detected "U."

The laboratory assigned "K" qualifiers to dioxin/furan and PCB congener data. This qualifier implied that a peak was detected, but did not meet identification criteria. These data were considered estimated maximum possible concentrations (EMPC). All EMPC results were given a "U" qualifier by EcoChem, but remained at the reported concentration which represented an elevated PQL for that congener.

Project specific QA/QC measures were employed during sample collection and analysis to ensure the precision, accuracy, and reproducibility of the results. This included field QA/QC samples such as equipment rinsates, rinsate blanks, and field duplicates and triplicates. Laboratory measures included the analysis of standard reference materials (SRM).

The equipment rinsate blank and decontamination water rinsate provided a quality control check on the potential for cross contamination by measuring the effectiveness of the sampling and processing decontamination procedures. Rinsate samples were collected and analyzed for lead and PAH. No PAH were detected in the rinsate samples. Lead was detected in each of the rinsates, but no sample results were within five times the blank concentrations.

Field duplicates and triplicates were collected at the same time as the original samples using identical sampling techniques. Duplicate/triplicates were used to determine the precision of the sample collection process and determine the representativeness of the sample. Table 2 lists the specific duplicates and triplicates collected for this study.

The relative percent difference (RPD) was used to evaluate duplicate samples, while the relative standard deviation (RSD) was used to evaluate triplicates. In general, if the RPD or RSD was greater than 50 percent, the affected results of the duplicate/triplicate sample were "J" qualified. If a result was already "U" qualified, the affected results were requalified "UJ." For the duplicate BB-24-S/D, the RPD for 22 PCB congeners and 3 homologs was greater than the control limits and the results were qualified. For duplicate BB-20-S/D, congeners PCB-80 and PCB-128 were qualified for an elevated RPD. Precision was acceptable for all other analytes.

Overall, the high precision of the field duplicates and triplicates indicated that the study results were representative of the sediment they were collected from, which is important for reducing variability in the data set.

The recently developed Puget Sound reference material (PSRM) was submitted for analysis for the analysis of dioxin and PCB congeners. The published acceptance criteria for this PSRM are ±50 percent of the mean.
(http://www.nws.usace.army.mil/Missions/CivilWorks/Dredging/SRM.aspx).

The results for 1,2,3,7,8,9-HxCDF were less than the lower control limit, while the results for PCB-120 were greater than the higher control limit. No results were qualified based on these outliers as the reference material is still undergoing evaluation and is not yet certified.

PCB congeners in samples BB-22 and BB-30 were analyzed in a separate batch due to issues with the initial extraction impacting the mono-chlorinated biphenyls. As a result, no laboratory quality control data was available for PCB-01, PCB-02, and PCB-03. Results for these congeners in both samples were "J" qualified. The validation for these samples was completed as part of a separate report (Appendix E).

4.0 Data Results

A summary of the results from the laboratory analysis is provided in this section. The results are presented in terms of general usability by listing the number of undetected and qualified results for each analyte (Figure 3). The results of the conventionals analyses (grain size distribution and TOC) are presented in Figure 4. The spatial distributions of the measured analytes throughout the AOI are presented in Figures 5 through 8. Complete data results are presented in Appendix F. Laboratory data packages are available electronically as Appendix D.

4.1. Calculation of Toxicity Equivalents

Calculation of the TEQ when many of the congener concentrations within a sample are reported below the detection limits can be problematic. A common approach is to substitute 0, ½, or 1 times the detection limit in place of a non-detected concentration. A more robust method for calculating total TEQs when non-detect values are present is the Kaplan-Meier (KM) approach, which is a statistical method for estimating a sum or mean when part of the population is censored (Helsel 2010, 2012). The methods for addressing non-detects, including KM, are discussed in greater detail in the SCUM II guidance, Chapter 6 (Ecology 2013a & 2015).

KM TEQs were calculated separately for the PCB congeners, dioxin/furan congeners, and cPAHs from each sample. The KM means reported for the TEQ data were calculated using R version 3.1.1 (R Core Team 2014) using the *cenfit* function from the NADA package (Lee 2013).The KM sum was calculated and the number and distribution of censored values was evaluated. The following rules were applied to the final KM TEQs:

- If the number of non-detect congeners within a sample exceeded 50 percent, the KM TEQ value was qualified as a less-than value (L qualified), followed by the number of censored congeners (see data tables in Appendix F). For example, if 12 of the 17 dioxin/furan congeners were undetected, the detection frequency was 29% and the KM TEQ would be calculated and qualified with L12.
- If the lowest detection limit for a non-detect was lower than all detected values, the positive bias in the KM estimate was adjusted downwards using Efron's bias correction (Klein and Moeschberger 2003). This method treats the lowest ranked value as detected even if it was reported as a non-detected data point.
- If the highest detection limit is greater than the highest detected value, the highest non-detect value provides no meaningful information and is ignored in the KM estimation of the mean. The highest toxic equivalent concentration (TEC) value is always treated as uncensored in the KM TEQ calculation, and the TEQ is qualified with an L if the original value was censored. All L-qualified TEQ values were treated as non-detects in the distributional assessments and when calculating summary statistics across samples.

Calculated KM TEQs are presented in the data tables in Appendix F along with the traditional 0, ½, and 1 detection limit substitutions. A brief comparison was made of the results from these four estimates of total TEQ.

The mean and 90th percentiles were calculated for each method. For cPAHs the mean and 90th percentiles differed by less than 0.1 μg TEQ/kg regardless of the method used, indicating non-detects had little influence on concentrations. The mean dioxin/furan TEQ concentrations were all within 0.06 ng TEQ/kg, while the 90th percentiles were consistent at 13.2 ng TEQ/kg.

Larger differences were noted for PCB TEQ concentrations. PCB TEQ means ranged from 0.09 ng TEQ/kg for the 0 DL substitution to 0.13 ng TEQ/kg for the 1 DL substitution. The 90th percentiles ranged from 0.21 to 0.25 ng TEQ/kg. The greatest difference between the methods was seen in the maximum concentrations for PCB TEQ. The maximum concentrations for the 0 and ½ DL substitutions were 0.28 and 0.29 ng TEQ/kg, respectively. The maximum concentrations for the 1 DL substitution and the KM estimate were 0.43 and 0.38 ng TEQ/kg, respectively. Sample BB-12 had the maximum PCB TEQ concentration which was driven by PCB-126. This congener has the highest TEF value of the dioxin-like PCBs, and was a non-detect at an elevated detection limit due to the presence of wood waste in this sample. The use of this elevated DL at the reported concentration is likely an overestimate of the true concentration. This sample was excluded in the calculation of the summary statistics in Section 4.3.3 and is discussed as an outlier in Section 5.3.

Given the small differences between the methods, the more statistically robust KM TEQ values are used in statistical summaries and analysis for the remainder of this report when discussing total TEQ concentrations.

4.2. Summary of Qualified Results

The DQOs for this study necessitated PQLs that were lower than those typically used in sediment investigations, as the intent of this regional background study is to obtain as few non-detects and as many unqualified results as possible. Too many non-detects could create a skewed distribution that would not meet the project requirements for precision (Section 5.2), while too many data qualified as estimated for a given analyte could result in an unreliable regional background concentration or one that is below the project-specific PQLs summarized in Table 3.

The number of qualified (both non-detect and estimated) results for each analyte are shown in Figure 3. Non-detect results are represented by dark blue and included all data given a qualifier flag of "U" or "UJ." Estimated values were given a qualifier flag of "J" and are represented by a medium blue color. A "J" qualifier indicates the result was considered an estimate either because the value was less than the PQL and greater than the MDL, or the EcoChem data validation indicated QA/QC issues. The light blue color indicates sample results that were not qualified. The total sample counts in Figure 3 include the field duplicates and have not been screened for outliers.

A total of 32 samples and 2 duplicates were analyzed for lead. None of these results were qualified.

Dibenz(a,h)anthracene was the only PAH with non-detect results. Twenty six out of 32 results were non-detects, with an additional three "J" qualified results. The remaining cPAH compounds were detected in all samples. However, results from twelve samples were "J" qualified for each cPAH compound. The total cPAH TEQ concentration was above the calculated PQL of 0.76 µg TEQ/kg in all samples (Figure 3).

There were also relatively few non-detects for the dioxin/furan congeners. 2,3,7,8-TCDD and 1,2,3,7,8-PeCDD have the greatest impact on total TEQ (TEF of 1). These two congeners alone comprised nearly 25 percent of the total TEQ on average, but were not detected in one sample each. The hexa-, hepta-, and octachlorinated dioxin congeners were detected with the greatest frequency. Two samples had a total TEQ less than the PQL of 2.3 ng TEQ/kg (Figure 3).

Of the dioxin-like PCBs, PCB-169 was not detected in any of the samples and PCB-81 was not detected in 15 samples. The remaining congeners were detected in at least 75 percent of the samples. PCB-126 has the greatest impact on total TEQ with a TEF of 0.1 and was a non-detect in six samples. The total PCB TEQ was less than the PQL of 0.052 ng TEQ/kg in seven samples (Figure 3).

Overall, the data quality for calculation of regional background is high, as most of the analytes were detected and without qualifiers in more than two-thirds of the samples analyzed.

4.3. Summary and Spatial Distribution of Results

This section provides an initial evaluation of the sample results prior to the more in-depth statistical evaluation of Section 5.0. The spatial distributions of each analyte are presented in Figures 4 through 8. Summary statistics including the minimum, median, average, and maximum concentrations for each analyte are presented in Table 4 for the Bellingham Bay data set. Table 4 also includes the Pearson correlation coefficient (*r*-value) and its significance level (*p*-value) for correlations of each analyte to TOC.

Field duplicates and triplicates were averaged prior to mapping the spatial distributions and calculating the summary statistics in Table 4. Only detected concentrations were averaged for a given station. If all concentrations were non-detects, the maximum detection limit was used. The TEQ values presented in this section were calculated using the KM method described in Section 4.1.

Potential outliers were excluded from the calculation of the summary statistics. The excluded samples are listed in the following text and in the footnotes of Table 4. A more detailed evaluation of these samples as outliers is provided in Section 5.3.

4.3.1. Conventional parameters

Conventional parameters analyzed for this study included grain size, TOC, and total solids. Figure 4 presents combined results for the grain size distribution and percent TOC for all stations. In this figure, percent fines are represented by the color gradient and percent TOC is represented by the size of the circle.

There was little variation in percent fines throughout the AOI. With the exception of BB-12, all samples were between 84 and 99.6 percent (Figure 4). While measured fines in BB-12 were reported at 55.2 percent, this is likely an underestimate. This sample contained a large amount of fine, woody debris that skewed the final determination of fines low.

The large amount of wood waste in sample BB-12 was apparent from its high concentration of TOC and was indicative of a direct anthropogenic influence. TOC in this sample was 20.8 percent, more than five times higher than the next highest concentration in Bellingham Bay, and more than four times higher than the maximum observed in the Bold survey. Excluding BB-12, TOC in Bellingham Bay ranged from 1.0 to 4.0 percent. Most of the analytes were correlated to TOC. No correlation analyses were conducted against percent fines due to the limited range of fines in Bellingham Bay.

4.3.2. Metals

All 30 samples were analyzed for lead (Figure 5). The lowest concentrations were found in the northwest corner of the AOI, where the highest natural recovery was observed. The highest concentration of 53 mg/kg was present at station BB-28. This concentration was a statistical outlier, and because the station was located near a historical source (Section 5.3), it was excluded from the summary statistics as an outlier. BB-12 was also excluded due to elevated TOC and its implication of direct anthropogenic influence. In the remaining 28 samples, lead concentrations ranged from 8.4 to 16 mg/kg (Table 4). The correlation of lead to TOC had an $r = 0.818$ and was statistically significant ($p < 0.0001$).

4.3.3. Organics

Sample BB-12 is shown in Figures 6, 7, and 8, but was excluded from the calculation of summary statistics for all analytes (Table 4) due to the presence of wood waste and high TOC (Section 5.3). PCB congener and cPAH TEQs were removed for station BB-28 due to elevated concentrations of these analytes that potentially originated from the historical source; the dioxin/furan concentration at this station was retained as it was not likely impacted by the historical source (Section 5.3).

The cPAH TEQ concentration was highest at station BB-28 (2,050 µg/kg, Figure 6). Excluding this sample, the next highest concentration was 94 µg/kg. The median cPAH TEQ concentration was 20 µg/kg. cPAH TEQs were significantly correlated to TOC with $r = 0.749$ ($p < 0.0001$, Table 4).

The spatial distribution of dioxin/furan TEQ concentrations is shown in Figure 7. Concentrations less than 4.0 ng TEQ/kg were assumed to be representative of natural background. The dioxin/furan AOI was smaller than that of the other analytes due to low dioxin/furan concentrations in the existing data in the northwest corner of the AOI. Samples BB-14 and BB-27 near the boundary with the natural background area both had concentrations near 2.0 ng TEQ/kg (Figure 7). These stations appear to be representative of natural background and were excluded from the regional background data set. In the remaining 20 samples, dioxin/furan TEQ concentrations ranged from 4.2 to 14 ng TEQ/kg, with a median of 9.9 ng TEQ/kg. Dioxin/furan TEQ concentrations were not significantly correlated to TOC ($p > 0.05$, Table 4).

The PCB congener TEQ is based on the toxicity of dioxin/furan congeners. However, the TEFs for PCBs are lower than those of dioxin/furan congeners, resulting in lower TEQs. The PCB congener TEQ was highest at station BB-12 and was due to a particularly influential non-detected congener (Section 4.1). Station BB-28, located near a historical source, had the next highest PCB TEQ concentration (0.28 ng TEQ/kg). Both stations BB-12 and BB-28 (Figure 8) were excluded from the summary of results for PCB congener TEQ concentrations (Section 5.3). PCB TEQ results for the remaining 28 samples ranged from 0.028 to 0.21 ng TEQ/kg with a median of 0.08 ng TEQ/kg. PCB TEQ concentrations had a statistically significant correlation to TOC ($p = 0.005$, Table 4).

4.3.4. Chemical distribution summary

Overall, the physical and chemical distributions shown on Figures 4 through 8 indicate the following patterns and similarities:

- Consistent concentrations of percent fines at all stations, with the exception of station BB-12.
- Wood waste and elevated TOC at station BB-12.
- Direct influence on concentrations of lead, cPAHs, and PCBs from a historical source at station BB-28.
- Low concentrations in the northwest corner of the AOI due to the influence of the Nooksack River.
- Strong or moderate correlations of most chemicals with TOC.

When stations BB-12 and BB-28 are excluded, these chemical distributions suggest that:

- The AOI did not contain areas directly affected by sites or sources.
- Variations in the data were primarily correlated with natural characteristics of the sediments and processes within the bay.

These features confirm that the overall data set is appropriate for calculation of regional background concentrations. A more formal outlier analysis is presented in Section 5.3.

5.0 Data Analysis

This section describes the approach used to evaluate the data for Bellingham Bay with the objective of determining regional background concentrations for those analytes that were elevated above natural background.

5.1. Natural Background for Bellingham Bay

The natural background data set suitable for use in Puget Sound is defined in SCUM II (Ecology 2013a & 2015). Comparison to this natural background data set was important for establishing the western and southern boundaries of the AOIs in Bellingham Bay, determining which analytes were elevated above natural background, and evaluating potential outliers.

Ecology has determined that data from the OSV Bold survey (DMMP 2009) plus select data sets from reference areas (Bold Plus) are appropriate for use as natural background for sites throughout Puget Sound. Bold Plus consists of the 70 samples collected as part of the OSV Bold survey and analyzed for a full suite of analytes plus additional samples from reference areas. The Bold Plus data set was used for comparison with the Bellingham Bay data set (Section 5.3) to identify which analytes were present at concentrations above natural background. Information on the full suite of Bold Plus data can be found in SCUM II, Chapter 10 (Ecology 2013a & 2015).

5.2. Data Sufficiency

The first step in ensuring that the data set was sufficient to calculate regional background values was to evaluate the precision of the mean, expressed as the width of the 95 percent upper confidence limit (UCL) of the mean and divided by the mean. For normally distributed data precision is calculated as:

$$\text{Precision} = \frac{t_{0.05(1),df} S/\sqrt{n}}{\bar{X}}$$

where:

$\bar{X}$ = the arithmetic mean of the n baseline samples

$t_{0.05(1),df}$ = the 1- tailed critical value from the t-distribution, for df degrees of freedom and α of 0.05.

df = the degrees of freedom associated with the sample standard deviation (S). This is n-1, where n is the number of observations used to estimate the variance.

S = standard deviation of the sample = $\sqrt{\frac{\sum_{i=1}^{n}(X_i-\bar{X})^2}{(n-1)}}$

Precision of the mean expressed in this way is a common frame of reference for quantifying uncertainty in the population estimates that are necessary for the calculation of the background threshold value. For non-normal data, precision is calculated using the most appropriate estimate of the 95 UCL on the mean (e.g., the gamma formula and critical values for data that follow the gamma distribution, or a non-parametric bootstrap method for data that do not follow a discernible distribution).

A precision value of 25 percent was selected as a rough guideline for regional background data sets. After excluding samples based on the outlier analysis (Section 5.3), the precision for lead, dioxin/furan TEQ, and PCB congener TEQ were all less than 25 percent (Table 5). The precision for cPAH was higher at 30 percent, but deemed sufficient for calculation of regional background (Table 5).

5.3. Outlier Analysis

Ecology has formulated a weight of evidence approach to identify and evaluate potential outliers and determine whether they should be excluded from the calculation of regional background. The recommended steps for this approach are as follows:

- A statistical analysis was conducted to identify potential outliers. This analysis included a variety of techniques such as Q-Q plots, box plots, and univariate outlier tests appropriate to the distribution. This analysis is summarized in Appendix G.
- The bay-specific distribution was compared to the Bold Plus natural background distribution, both visually for the entire distribution and with respect to the calculated 90/90 UTLs for the bay-specific and natural background distributions.
- If the bay-specific distribution for an analyte was within the natural background distribution, the analyte and any potential outliers associated with it were not evaluated further. Alternatively, if the bay-specific distribution for an analyte appeared to exceed natural background, any potential outliers within that distribution were evaluated further.
- If a station was elevated for any analyte and determined to be directly influenced by a current or historical source, the analyte(s) from that station believed to be associated with the source was excluded from the calculation of regional background.
- If a station was elevated for any analyte, but not directly impacted by a current or historical source, other factors that may explain the elevated value(s) were considered. Factors may include gradients or patterns in the data set for that analyte (or lack thereof), correlations with natural geologic factors (grain size or TOC), sediment transport processes, etc. Correlations to TOC are explored in Appendix G.
- If deemed necessary, the 90/90 UTL of the data set was calculated with and without any elevated values and/or statistically identified outliers. If the resulting 90/90 UTL calculated values were within the range of analytical variability and were not substantially different from one another, Ecology may have decided to retain the elevated

concentrations in the calculation of regional background. The decisions from the previous steps deemed this unnecessary for the Bellingham Bay data set.

- If available, Ecology may also choose to analyze additional supplemental samples if it would be expected to further clarify the upper tail of the bay-specific distribution. This was deemed unnecessary for the Bellingham Bay data set.

A summary of the results for each analyte is presented in Tables 4 and 5 and in Figure 9. A full description of the potential outlier investigations is presented in Appendix G. The key findings are as follows:

- Sample BB-28 was identified as a statistical outlier for lead and cPAHs, and also had somewhat elevated levels of PCB TEQs. Further review of potential sites and sources identified a former refueling station in the vicinity of BB-28 that was a likely source for all three analytes. Therefore, data for these analytes at this station were excluded from the calculation of regional background.
- Sample BB-12 was identified as a statistical outlier due to elevated TOC. The TOC was linked to wood waste that was observed in this sample during the field investigation, suggesting a direct anthropogenic influence. The wood waste in the sample also caused elevated detection limits for some analytes, particularly PCB-126, which skewed the TEQ calculation (Section 4.1). This elevated detection limit resulted in PCB TEQ being identified as a statistical outlier at this station. Because of the anthropogenic influence and the analytical interference caused by the wood waste, data for all analytes at this station were excluded from the calculation of regional background.
- No additional statistical outliers were found. However, dioxin/furan TEQ concentrations at stations BB-14 and BB-27 had recovered to levels below natural background. Given that these stations were located adjacent to the dioxin/furan AOI boundary (Figure 7), these stations were considered to be part of that natural background area and were excluded from the calculation of regional background.

5.4. Calculation of Bellingham Bay 90/90 UTLs and Regional Background Values

Table 6 presents the 90/90 UTL values for Bellingham Bay alongside the Bold Plus 90/90 UTL natural background concentrations. All 90/90 UTL values were calculated in ProUCL 5.0 (USEPA 2013).

The Bellingham Bay 90/90 UTLs for lead and PCB TEQ were consistent with those of natural background. The Bellingham Bay 90/90 UTL for lead was 16 mg/kg, compared to 21 mg/kg for the Bold Plus natural background. The Bellingham Bay 90/90 UTL for PCB TEQ was 0.21 ng TEQ/kg, equal to that for natural background.

The Bellingham Bay 90/90 UTL for dioxin/furan TEQ was 15 ng TEQ/kg, nearly four times greater than the natural background of 4 ng TEQ/kg. The Bellingham Bay cPAH 90/90 UTL of 86 µg TEQ/kg was more than five times greater than the natural background of 16 µg TEQ/kg.

The following conclusions regarding regional background can be drawn from these results:

- The Bellingham Bay and natural background 90/90 UTLs for lead and PCB TEQ were within the range of analytical variability and considered the same. Therefore, regional background values cannot be calculated for these analytes and will default to natural background.
- The Bellingham Bay 90/90 UTL for dioxin/furan TEQ is above natural background by nearly a factor of 4. A regional background concentration of 15 ng TEQ/kg has been calculated.
- The Bellingham Bay 90/90 UTL for cPAH TEQ is above natural background by nearly a factor of 5. A regional background concentration of 86 µg TEQ/kg has been calculated.

6.0 References

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Tables

Table 1. Sampling station depths, actual coordinates, distance from target, and percent fines for the Bellingham Bay Regional Background data set.

Station ID	Mudline Depth (m MLLW)	Northing (SPN NAD83)	Easting (SPN NAD83)	Latitude (NAD83)	Longitude (NAD83)	Distance from Target (m)
BB-01	-9.7	641884.8	1234001.8	48.747430	-122.517903	0.6
BB-02	-5.2	644345.9	1234823.4	48.754223	-122.514722	0.2
BB-03	-6	641881.6	1237271.8	48.747617	-122.504353	4
BB-04	-7.1	642707.1	1235645.5	48.749782	-122.511167	0.6
BB-05	-9.1	642708.4	1233998.9	48.749687	-122.517990	1.6
BB-06	-4.5	643526.6	1237283.8	48.752125	-122.504452	0.3
BB-07	-4.1	644343.1	1235647.8	48.754265	-122.511305	1.5
BB-08	-16.1	634503.1	1234822.8	48.727252	-122.513833	0.3
BB-09	-12.5	636964.0	1236466.6	48.734093	-122.507247	0.8
BB-10	-14.4	635325.1	1235644.7	48.729553	-122.510503	0.4
BB-11	-11.4	639430.3	1234822.2	48.740753	-122.514282	1.6
BB-12	-3.3	642706.4	1238922.3	48.749975	-122.497588	0.8
BB-13	-19.5	636145.9	1233181.7	48.731655	-122.520780	0.7
BB-14	-10.8	641066.1	1234000.0	48.745187	-122.517837	1.1
BB-15	-22.2	634502.6	1233179.9	48.727152	-122.520638	1.2
BB-16	-9.7	639421.9	1236461.7	48.740828	-122.507488	1.2
BB-17	-13.5	637785.3	1235646.4	48.736295	-122.510718	0.8
BB-18	-9.7	632857.0	1235642.8	48.722790	-122.510288	2.1
BB-19	-9	636033.9	1237031.7	48.731578	-122.504822	84
BB-20	-7.8	640241.8	1237273.6	48.743123	-122.504198	3.5
BB-21	-16.7	637788.7	1233183.5	48.736157	-122.520922	1.3
BB-22	-10.1	633683.6	1235642.7	48.725055	-122.510363	0.4
BB-23	-6.9	639423.8	1238924.5	48.740980	-122.497285	0.4
BB-24	-16.2	636145.8	1234825.7	48.731753	-122.513970	0.8
BB-25	-6	641068.4	1238927.0	48.745487	-122.497422	1.1
BB-26	-9.9	639426.5	1238099.5	48.740938	-122.500703	1.6
BB-27	-9	641065.5	1235645.5	48.745283	-122.511018	0.5
BB-28	-5.3	634504.4	1236467.0	48.727353	-122.507023	0.9
BB-29	-9.8	638603.6	1237284.3	48.738635	-122.504007	0.4
BB-30	-14.4	637786.9	1234821.3	48.736250	-122.514137	1

Notes:
MLLW – mean lower low water
SPN NAD – state plane north North American datum

Table 2. Collected sediment samples, target analytes, and analytical methods.

Sampling Location	Grain Size	TOC	Total Solids	Lead	cPAH	Dioxin/Furan Congeners	PCB Congeners	Archive
Method	**PSEP**	**PSEP**	**PSEP**	**EPA 200.8**	**LL SIM 8270**	**EPA 1613B**	**EPA 1668A**	
BB-01-S	X	X	X	X	X	-	X	A
BB-02-S	X	X	X	X	X	-	X	A
BB-03-S	X	X	X	X	X	-	X	A
BB-04-S	X	X	X	X	X	-	X	A
BB-05-S	X	X	X	X	X	-	X	A
BB-06-S	X	X	X	X	X	-	X	A
BB-07-S	X	X	X	X	X	-	X	A
BB-08-S	X	X	X	X	X	X	X	A
BB-09-S	X	X	X	X	X	X	X	A
BB-10-S	X	X	X	X	X	X	X	A
BB-11-S	X	X	X	X	X	X	X	A
BB-12-S	X	X	X	X	X	X	X	A
BB-13-S	X	X	X	X	X	X	X	A
BB-14-S	X	X	X	X	X	X	X	A
BB-15-S	X	X	X	X	X	X	X	A
BB-16-S	X	X	X	X	X	X	X	A
BB-17-S	X	X	X	X	X	X	X	A
BB-18-S	X	X	X	X	X	X	X	A
BB-19-S	X	X	X	X	X	X	X	A
BB-20-S	X	X	X	X	X	X	X	A
BB-20-D	X	X	X	X	X	X	X	-
BB-20-T	X	X	X	-	-	-	-	-
BB-21-S	X	X	X	X	X	X	X	A
BB-22-S	X	X	X	X	X	X	X	A
BB-23-S	X	X	X	X	X	X	X	A
BB-24-S	X	X	X	X	X	X	X	A
BB-24-D	X	X	X	X	X	X	X	-
BB-24-T	X	X	X	-	-	-	-	-
BB-25-S	X	X	X	X	X	X	X	A
BB-26-S	X	X	X	X	X	X	X	A
BB-27-S	X	X	X	X	X	X	X	A
BB-28-S	X	X	X	X	X	X	X	A
BB-29-S	X	X	X	X	X	X	X	A
BB-30-S	X	X	X	X	X	X	X	A

Notes:
A – archive cPAH – carcinogenic polycyclic aromatic hydrocarbons PCB – polychlorinated biphenyl D – duplicate T – triplicate
TOC – total organic carbon EPA – Environmental Protection Agency PSEP – Puget Sound Estuary Program

Table 3. Target analytes, methods, and practical quantitation limits.

Analyte	Preparation Method	Analytical Method	PQL
Metals (mg/kg DW)			
Lead	EPA 3050B/3051	EPA 200.8	0.1
Carcinogenic PAHs (µg/kg DW)			
Benzo(a)pyrene	EPA 3546	EPA 8270 SIM LL	0.5
Benz(a)anthracene	EPA 3546	EPA 8270 SIM LL	0.5
Benzo(b)fluoranthene	EPA 3546	EPA 8270 SIM LL	0.5
Benzo(k)fluoranthene	EPA 3546	EPA 8270 SIM LL	0.5
Chrysene	EPA 3546	EPA 8270 SIM LL	0.5
Indeno(1,2,3-cd)pyrene	EPA 3546	EPA 8270 SIM LL	0.5
Dibenz(a,h)anthracene	EPA 3546	EPA 8270 SIM LL	0.5
cPAH TEQ[a]	--	--	0.76
PCB Congeners (ng/kg DW)			
PCB 77	EPA 1668A	EPA 1668	0.4
PCB 81	EPA 1668A	EPA 1668	0.4
PCB 105	EPA 1668A	EPA 1668	0.4
PCB 114	EPA 1668A	EPA 1668	0.4
PCB 118	EPA 1668A	EPA 1668	0.4
PCB 123	EPA 1668A	EPA 1668	0.4
PCB 126	EPA 1668A	EPA 1668	0.4
PCB 156	EPA 1668A	EPA 1668	0.8
PCB 157	EPA 1668A	EPA 1668	
PCB 167	EPA 1668A	EPA 1668	0.4
PCB 169	EPA 1668A	EPA 1668	0.4
PCB 189	EPA 1668A	EPA 1668	0.4
PCB Congener TEQ[a]	--	--	0.052
Dioxin/Furan Congeners (ng/kg DW)			
2,3,7,8-TCDD	EPA 1613B/3540C	EPA 1613B	0.2
1,2,3,7,8-PeCDD	EPA 1613B/3540C	EPA 1613B	1
1,2,3,4,7,8-HxCDD	EPA 1613B/3540C	EPA 1613B	1
1,2,3,6,7,8-HxCDD	EPA 1613B/3540C	EPA 1613B	1
1,2,3,7,8,9-HxCDD	EPA 1613B/3540C	EPA 1613B	1
1,2,3,4,6,7,8-HpCDD	EPA 1613B/3540C	EPA 1613B	1
OCDD	EPA 1613B/3540C	EPA 1613B	2
2,3,7,8-TCDF	EPA 1613B/3540C	EPA 1613B	0.2
1,2,3,7,8-PeCDF	EPA 1613B/3540C	EPA 1613B	1
2,3,4,7,8-PeCDF	EPA 1613B/3540C	EPA 1613B	1
1,2,3,4,7,8-HxCDF	EPA 1613B/3540C	EPA 1613B	1
1,2,3,6,7,8-HxCDF	EPA 1613B/3540C	EPA 1613B	1
1,2,3,7,8,9-HxCDF	EPA 1613B/3540C	EPA 1613B	1

Analyte	Preparation Method	Analytical Method	PQL
2,3,4,6,7,8-HxCDF	EPA 1613B/3540C	EPA 1613B	1
1,2,3,4,6,7,8-HpCDF	EPA 1613B/3540C	EPA 1613B	1
1,2,3,4,7,8,9-HpCDF	EPA 1613B/3540C	EPA 1613B	1
OCDF	EPA 1613B/3540C	EPA 1613B	2
Dioxin/Furan TEQ[a]	--	--	2.3

Notes:
DW – dry weight   TEQ – toxicity equivalent quotient   PQL – practical quantitation limit
PAH – polycyclic aromatic hydrocarbon   PCB – polychlorinated biphenyl
SIM – selected ion monitoring
Rose highlighting indicates the project specific PQL
a. TEQ values were calculated by multiplying the PQL by the appropriate TEF.

Table 4. Summary statistics and correlation to total organic carbon (TOC) for target analytes.

Location ID	Lead	cPAH TEQ[a]	Dx/F TEQ[a]	PCB TEQ[a]
Units	mg/kg	µg TEQ/kg	ng TEQ/kg	ng TEQ/kg
Sample Size	28[b]	28[c]	20[d]	28[e]
Minimum	8.4	7.4	4.2	0.028
Average	12	30	9.3	0.098
Median	11	21	9.9	0.086
Maximum	16	94	14	0.25
r-value	0.818	0.749	0.288	0.517
p-value	<0.0001	<0.0001	0.218	0.005

Notes:

cPAH – carcinogenic polycyclic aromatic hydrocarbon Dx/F – dioxin/furan congener PCB – polychlorinated biphenyl

a. Toxicity equivalency quotient – calculated as described in Section 4.1.

b. Excludes BB-12 due to elevated TOC and BB-28 due to an elevated lead concentration of 53 mg/kg (Section 5.3).

c. Excludes BB-12 due to elevated TOC and BB-28 due to an elevated cPAH concentration of 2,050 µg/kg (Section 5.3).

d. Excludes BB-12 due to elevated TOC and BB-14 and BB-27 due to concentrations consistent with natural background (Section 5.3).

e. Excludes BB-12 due to elevated TOC and BB-28 due to an elevated PCB TEQ concentration of 0.3 ng TEQ/kg (Section 5.3).

Table 5. Statistical summary of the Bellingham Bay data set.

Parameter	Units	N	% Detect	CV	Precision[a]	Distribution[b,c]	Samples Excluded[d]
Lead	mg/kg	28	100%	0.19	6%	Nonparametric	BB-12, BB-28
cPAH	µg TEQ/kg	28	100%	0.80	30%	Nonparametric	BB-12, BB-28
Dioxins/Furans	ng TEQ/kg	20	100%	0.34	13%	Normal	BB-12, BB-14, BB-27
PCB congener	ng TEQ/kg	28	96%	0.60	23%	Gamma	BB-12, BB-28

Notes:
cPAH – carcinogenic polycyclic aromatic hydrocarbon PCB – polychlorinated biphenyl N – sample size CV – coefficient of variance
a. The precision column shows the half-width of the 95% UCL on the mean relative to the mean (e.g., for a normal distribution, t × (std.dev./sqrt(n))/mean); the target was precision ≤ 25%.
b. Outlier tests included Rosner's (for normal distributions, *n* ≥ 25), or Tukey's rule of 2 × IQR from the median (non-parametric). No samples were identified as outliers after excluding samples identified in the last column.
c. Best fit distribution as determined by the goodness-of-fit tests in ProUCL and the highest correlation coefficient for the probability plots (detected concentrations only).
d. Samples were removed from the data set prior to the statistical evaluations summarized here (see Section 5.3 for further details regarding exclusion of these samples).

Table 6. Calculated 90/90 upper tolerance limits (UTLs) for the Bellingham Bay and Bold Plus natural background data sets.

Analyte	Units	Bellingham Bay		Bold Plus
		N	90/90 UTL[a]	90/90 UTL[a]
Lead	mg/kg	28	16	21
cPAH TEQ	µg TEQ/kg	28	86	16
PCB TEQ	ng TEQ/kg	28	0.21	0.20
Dioxin/Furan TEQ	ng TEQ/kg	20	15	3.6

Notes:
cPAH – carcinogenic polycyclic aromatic hydrocarbon PCB – polychlorinated biphenyl TEQ – toxicity equivalency quotient N – sample size
a. All values rounded to two significant figures.

Figures

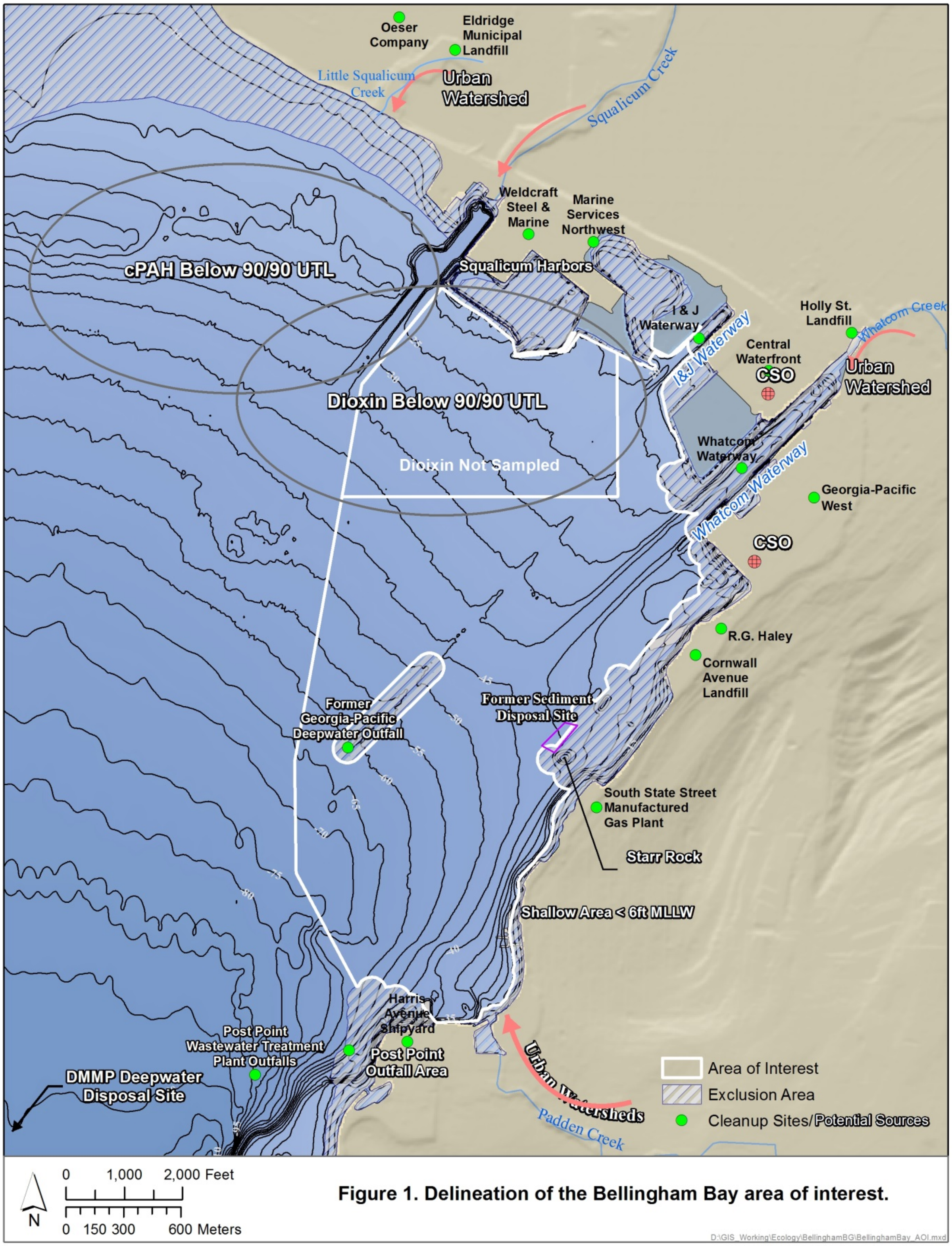

Figure 1. Delineation of the Bellingham Bay area of interest.

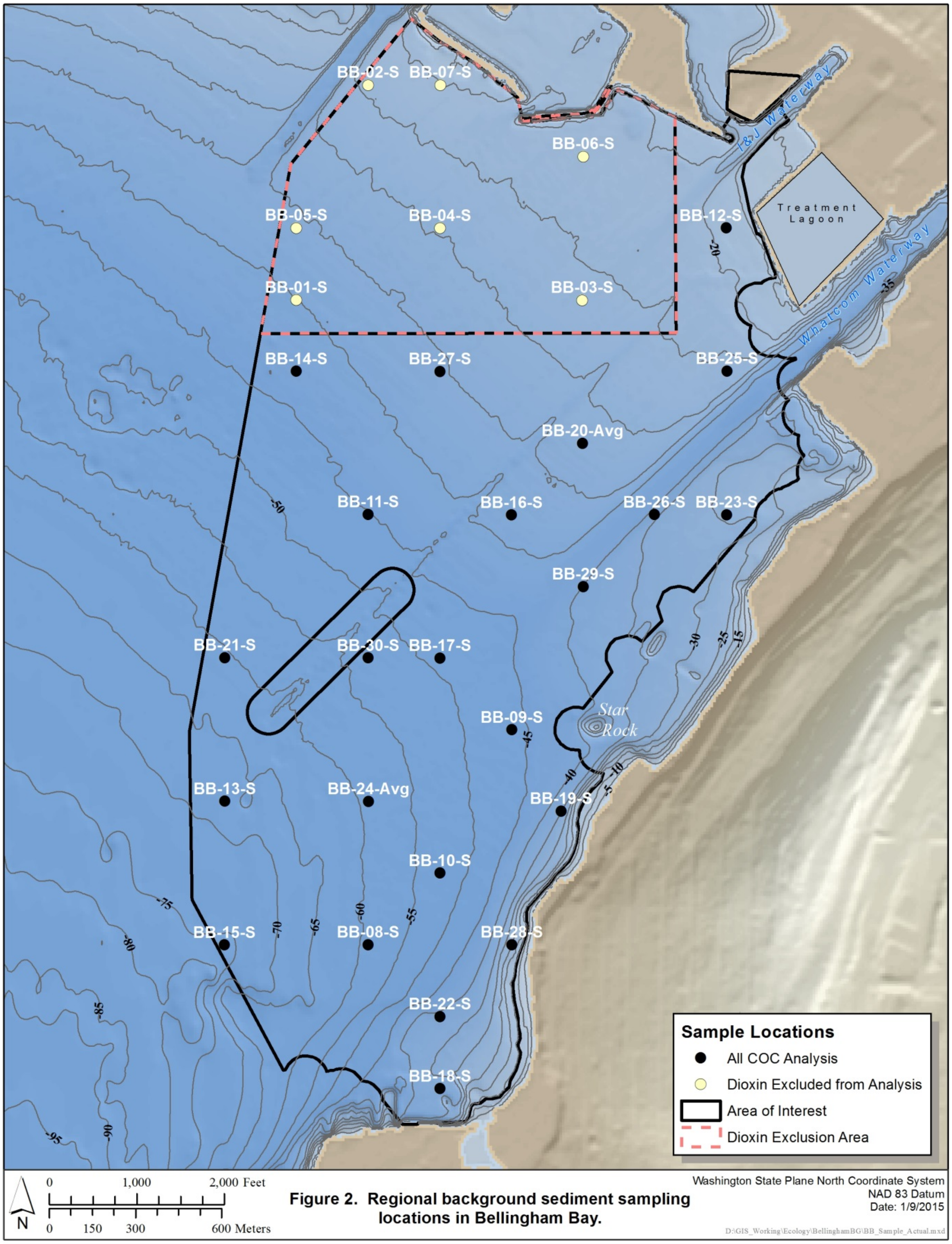

Figure 2. Regional background sediment sampling locations in Bellingham Bay.

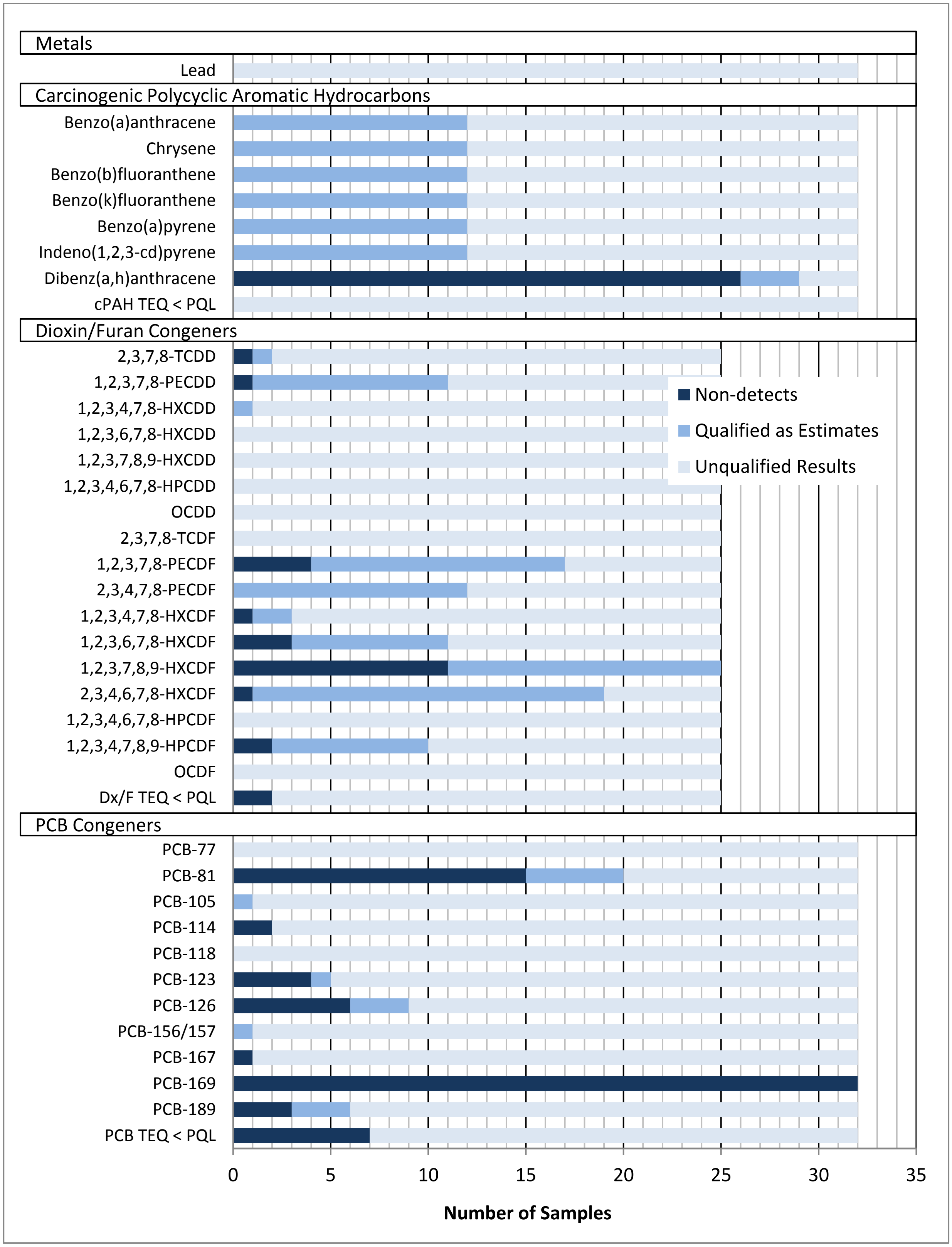

Figure 3. Summary of undetected and qualified results.

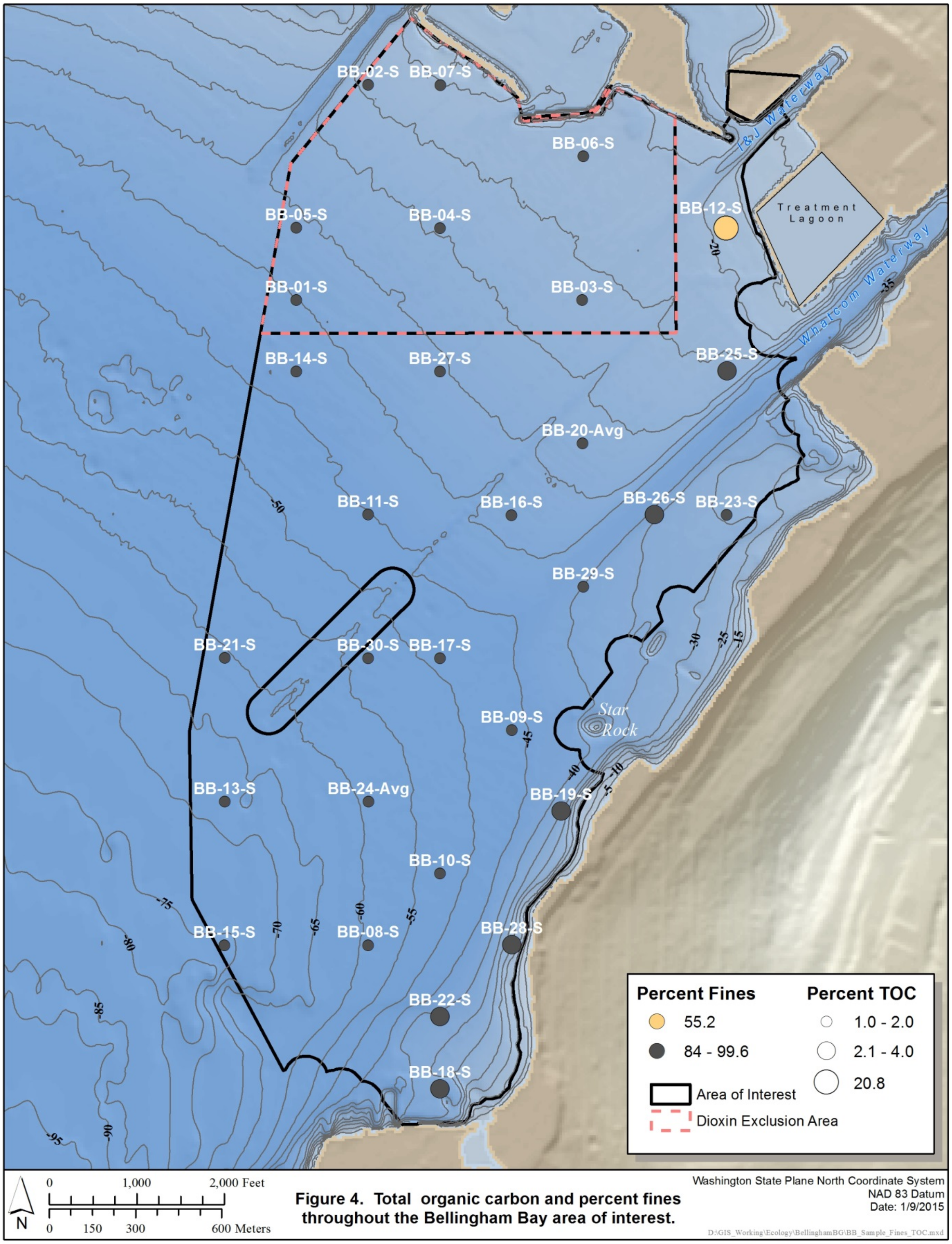

Figure 4. Total organic carbon and percent fines throughout the Bellingham Bay area of interest.

Washington State Plane North Coordinate System
NAD 83 Datum
Date: 1/9/2015

D:\GIS_Working\Ecology\BellinghamBG\BB_Sample_Fines_TOC.mxd

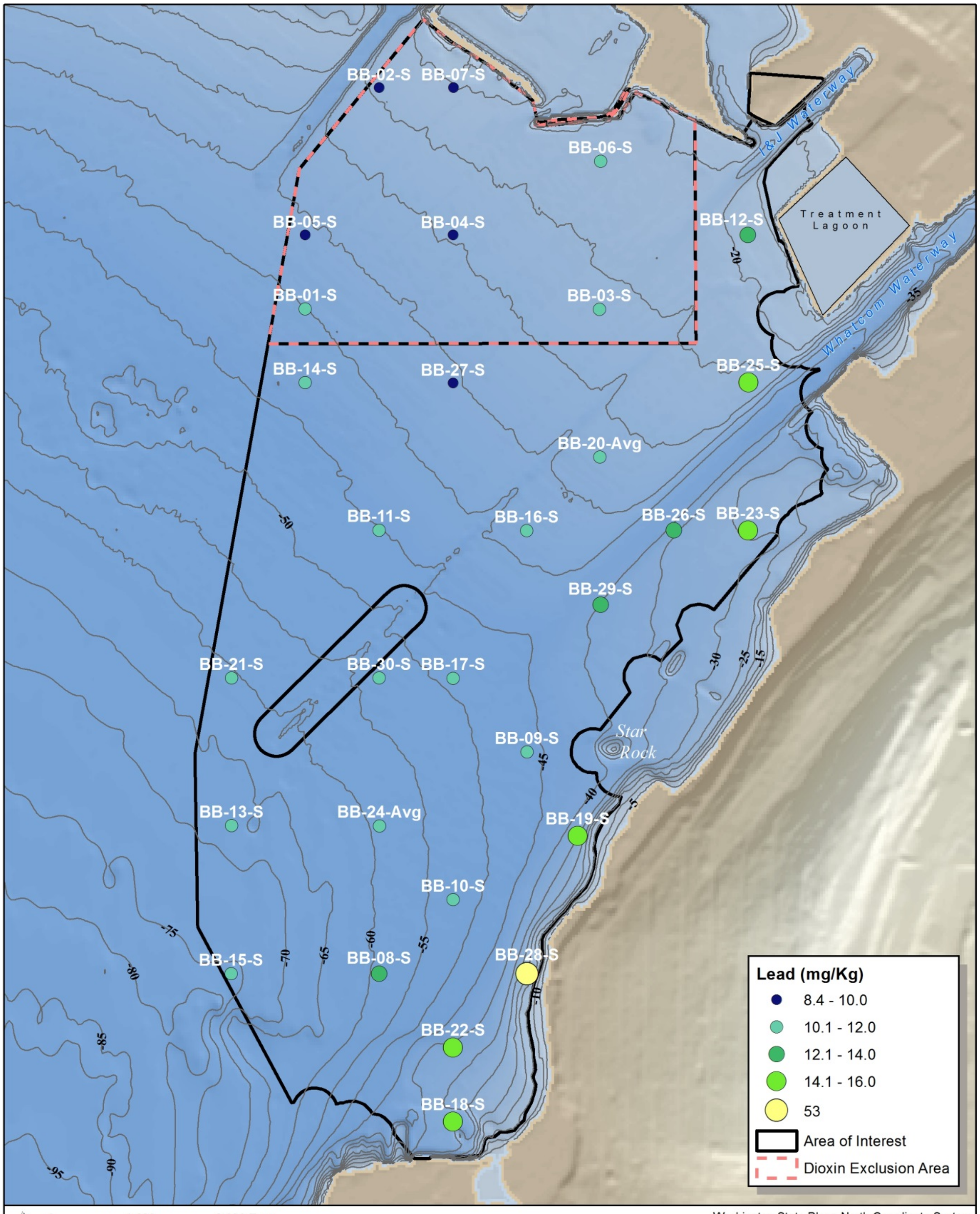

Figure 5. Lead concentrations throughout the Bellingham Bay area of interest.

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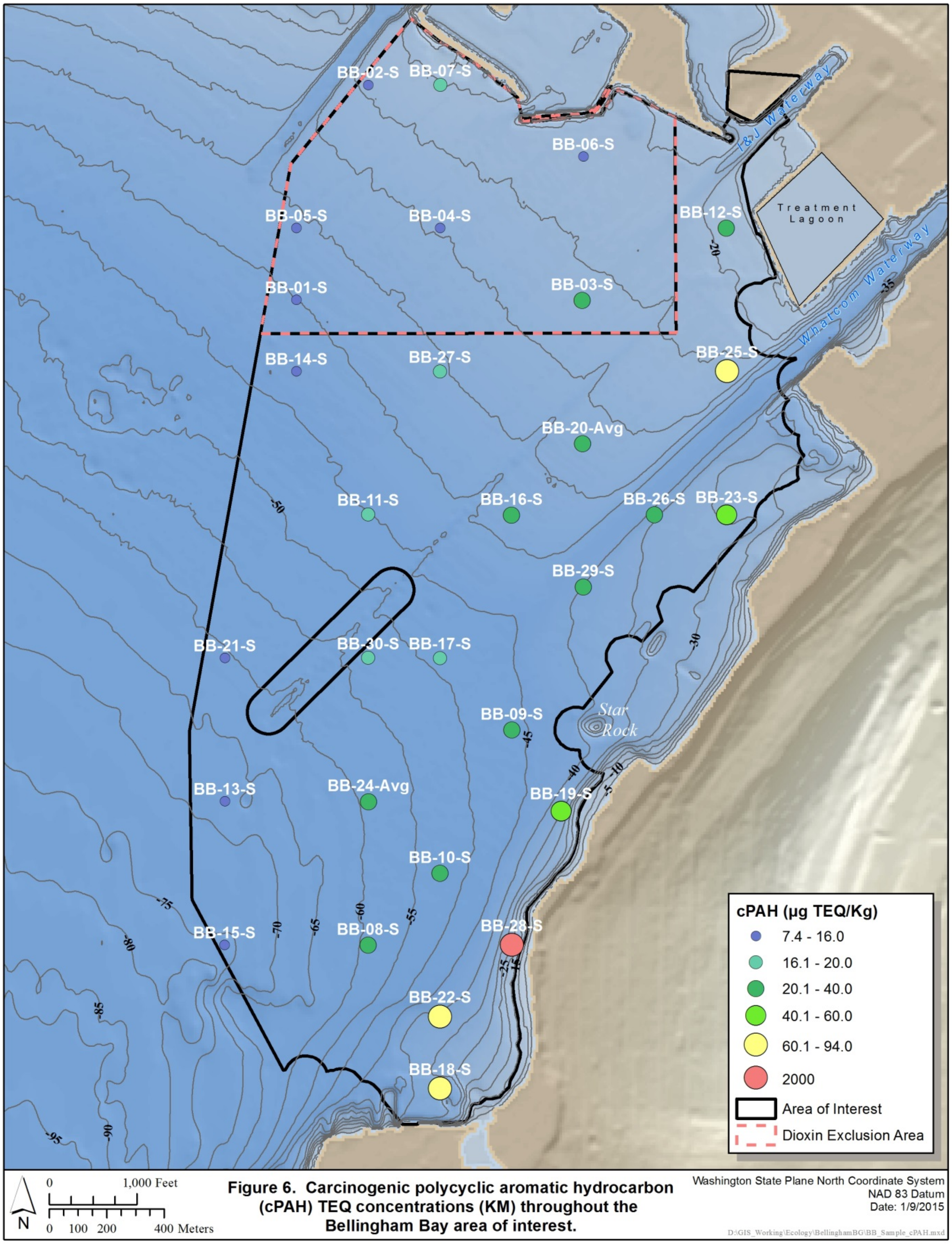

Figure 6. Carcinogenic polycyclic aromatic hydrocarbon (cPAH) TEQ concentrations (KM) throughout the Bellingham Bay area of interest.

Washington State Plane North Coordinate System
NAD 83 Datum
Date: 1/9/2015

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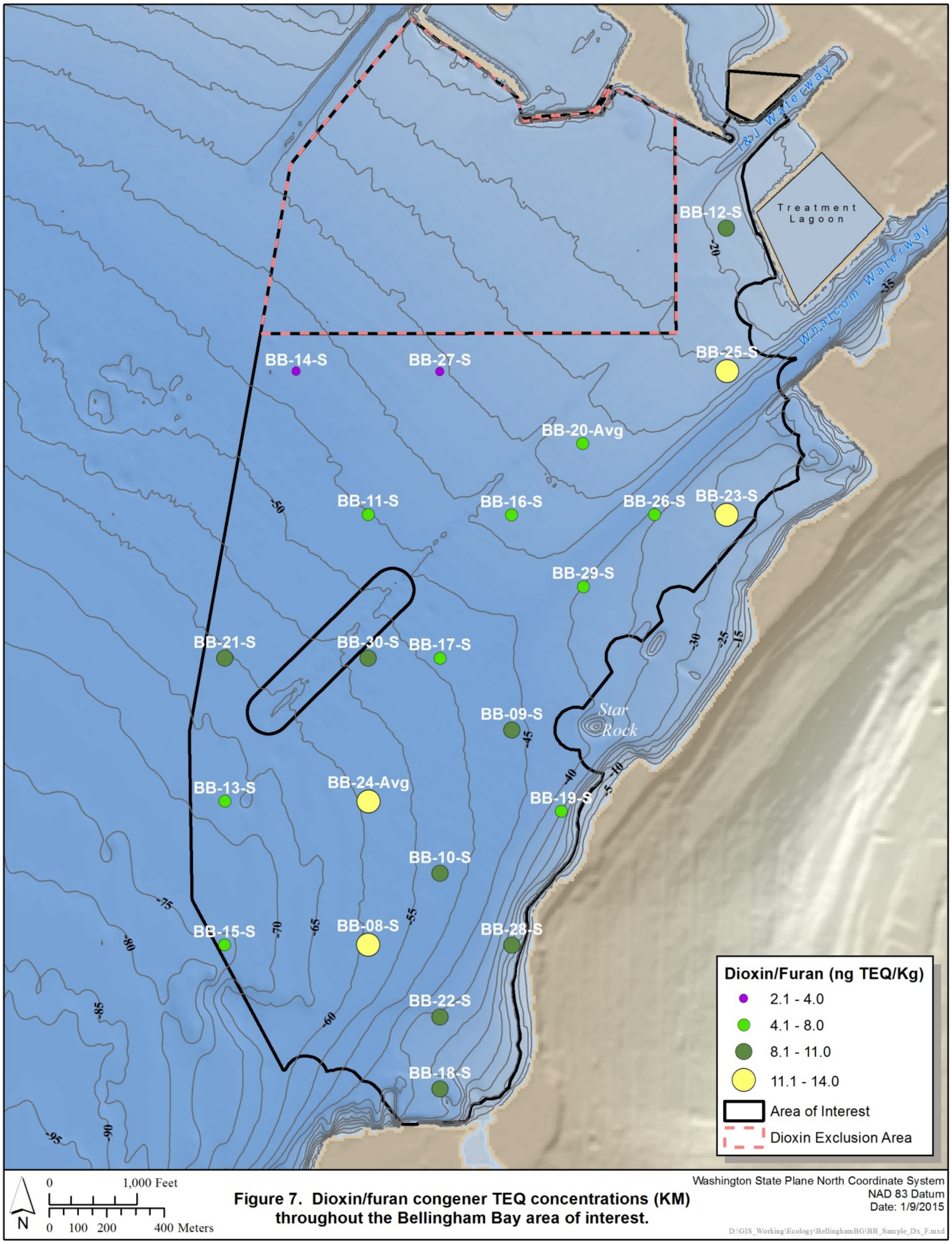
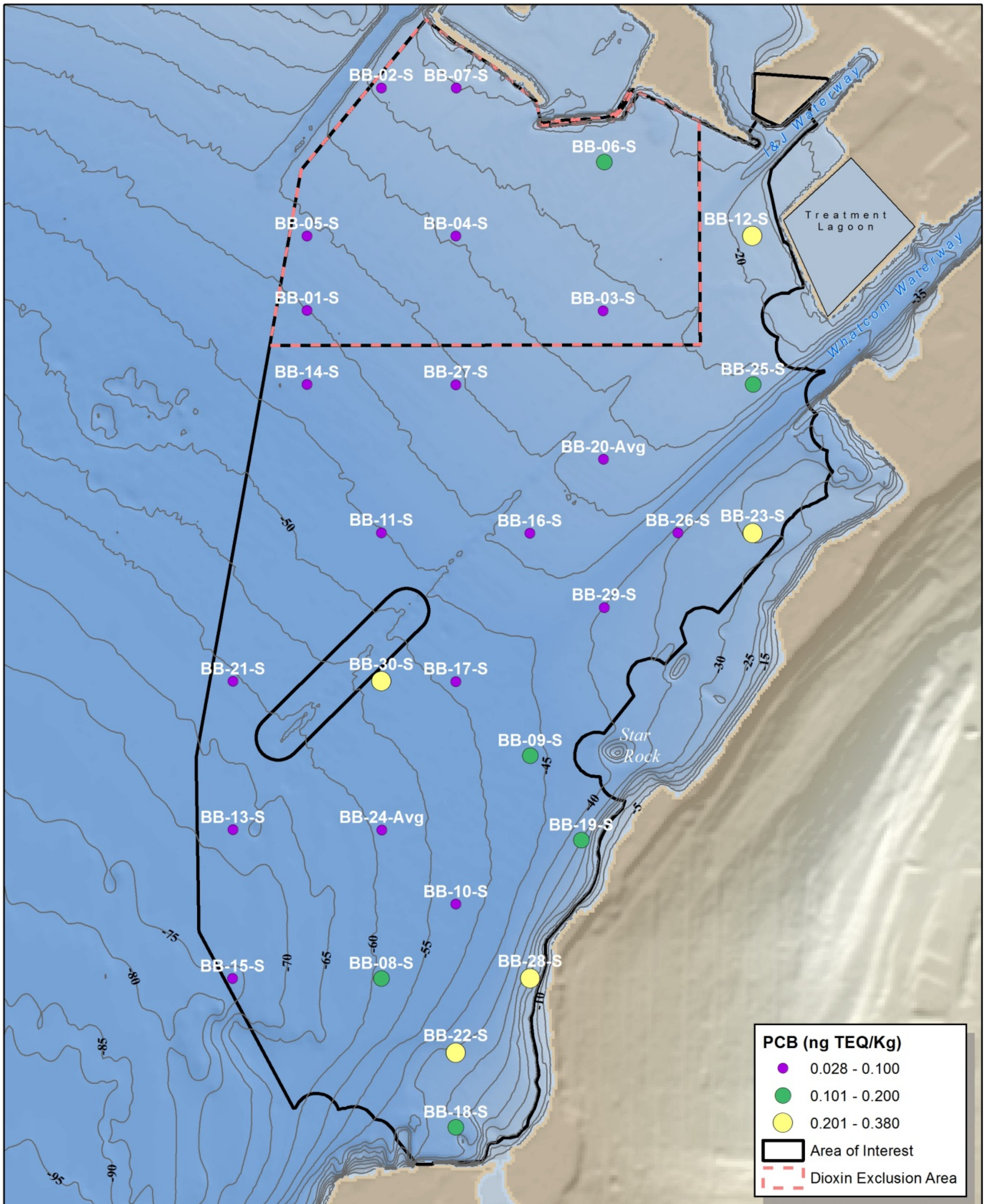


Figure 7. Dioxin/furan congener TEQ concentrations (KM) throughout the Bellingham Bay area of interest.



0 1,000 Feet
0 100 200 400 Meters
N

Figure 8. Polychlorinated biphenyl (PCB) congener TEQ concentrations (KM) throughout the Bellingham Bay area of interest

Washington State Plane North Coordinate System
NAD 83 Datum
Date: 1/9/2015

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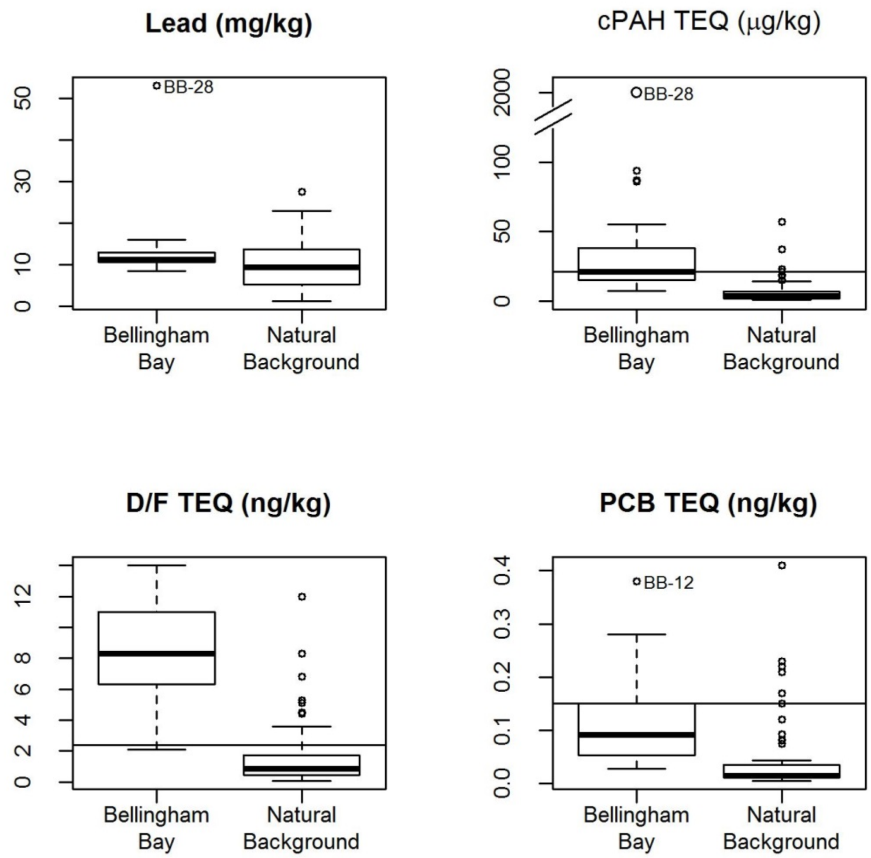

Figure 9. Boxplots showing the distribution of analyte concentrations in Bellingham Bay sediments and Puget Sound wide natural background (Bold Plus).

Note: The 1st, 2nd, and 3rd quartiles are estimated using Kaplan-Meier for censored data; horizontal lines indicate the level of the highest detection limit. Note the break in the scale of the y-axis to accommodate the single extreme cPAH value in Bellingham Bay.

Appendices A-E. Available Upon Request

Appendix F. Data Tables

Table F-1. Summary of Bellingham Bay Sediment Conventionals, Metals, and Carcinogenic Polycyclic Aromatic Hydrocarbons.

Location ID	BB-01-S	Q	BB-02-S	Q	BB-03-S	Q	BB-04-S	Q	BB-05-S	Q	BB-06-S	Q	BB-07-S	Q
Date/Time	**9/11/2014**	**834**	**9/10/2014**	**1135**	**9/10/2014**	**1512**	**9/10/2014**	**1438**	**9/10/2014**	**1410**	**9/10/2014**	**1115**	**9/10/2014**	**1356**
Conventionals														
Total Organic Carbon	1.22		1.3		1.5		0.984		1.11		1.53		0.967	
Total Solids	40.73		54.68		45.98		42.02		44.47		49.29		55.83	
Particle/Grain Size, Phi Scale <-1	0.1	U	0.1	U	0.2		0.1	U	0.1	U	0.2		0.1	
Particle/Grain Size, Phi Scale -1 to 0	0.4		0.2		0.1		0.6		0.1		0.1		0.2	
Particle/Grain Size, Phi Scale 0 to 1	0.5		0.2		0.2		0.6		0.2		0.2		0.4	
Particle/Grain Size, Phi Scale 1 to 2	0.5		0.2		0.3		0.4		0.1		0.2		0.3	
Particle/Grain Size, Phi Scale 2 to 3	0.3		0.1		0.3		0.3		0.1		0.1		0.2	
Particle/Grain Size, Phi Scale 3 to 4	0.5		1.2		0.5		1.1		0.3		0.1		0.6	
Particle/Grain Size, Phi Scale 4 to 5	4.7		13.9		6.4		5		5.4		5.8		11.6	
Particle/Grain Size, Phi Scale 5 to 6	31.3		26.4		18.8		22.4		19.8		17.4		27.9	
Particle/Grain Size, Phi Scale 6 to 7	24.2		20.5		21.9		23.3		27.2		23.3		21.7	
Particle/Grain Size, Phi Scale 7 to 8	8.9		11.8		15.5		14.3		13.1		16.2		11.7	
Particle/Grain Size, Phi Scale 8 to 9	6.7		7.2		10.6		9		9.2		10.5		7.4	
Particle/Grain Size, Phi Scale 9 to 10	7.4		5.7		8.2		7.9		8.3		7.3		5.3	
Particle/Grain Size, Phi Scale >10	14.4		12.5		17.1		15.2		16.2		18.5		12.6	
Particle/Grain Size, Fines (Silt/Clay)	97.7		98.1		98.5		97		99.2		99		98.2	
Metals (mg/kg DW)														
Lead	10.1		8.4		10.6		9		9.6		10.9		8.4	
carcinogenic PAH (ug/kg DW)														
Benzo(a)anthracene	9.14		6.37	J	25.7		14.1		10.8		13.9	J	15.4	
Chrysene	21.6		14.4	J	43		27.6		26.6		23.7	J	51	
Benzo(b)fluoranthene	15.2		10.2	J	28.9		19.2		17.3		16.6	J	21.5	
Benzo(k)fluoranthene	4.29		3.17	J	10.3		6.24		5.45		6.15	J	7.49	
Benzo(a)pyrene	7.65		4.87	J	19		9.64		8.79		11.1	J	10.9	
Indeno(1,2,3-cd)pyrene	6.17		3.67	J	14.8		8.1		7.48		8.77	J	8.61	
Dibenz(a,h)anthracene	2.41	U	2.42	UJ	4.95	U	4.96	U	4.82	U	4.86	UJ	4.87	U
cPAH TEQ (0 DL)	11.3		7.36		27.4		14.7		13.2		15.9		16.7	
cPAH TEQ (1/2 DL)	11.4		7.40		27.5		14.8		13.2		16.0		16.8	
cPAH TEQ (1 DL)	11.4		7.44		27.6		14.9		13.3		16.1		16.9	
cPAH TEQ (KM)	11.4		7.44		27.6		14.9		13.3		16.1		16.9	

U-the analytie was analyzed for, but was not detected above the reported sample quantitation limit
J-the analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample
UJ-the analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate.
L-the detection frequency of compounds within a sample was <50%, the numeric value indicates the number of non-detects
KM-Kaplan-Meier DW-dry weight Q-qualifier TEQ-toxicity equivalent DL-detection limit Avg-average of field duplicates

Table F-1. Summary of Bellingham Bay Sediment Conventionals, Metals, and Carcinogenic Polycyclic Aromatic Hydrocarbons (continued).

Location ID	BB-08-S	Q	BB-09-S	Q	BB-10-S	Q	BB-11-S	Q	BB-12-S	Q	BB-13-S	Q	BB-14-S	Q
Date/Time	9/9/2014	933	9/9/2014	1540	9/9/2014	1147	9/11/2014	1024	9/10/2014	1330	9/9/2014	1423	9/11/2014	853
Conventionals														
Total Organic Carbon	1.72	J	1.12	J	1.87	J	1.28		20.8		1.11	J	1.4	
Total Solids	31.45		34.47		37.96		33.33		40.37		32.05		38.4	
Particle/Grain Size, Phi Scale <-1	0.1		0.1		0.2		0.1		7.4		0.1	U	0.1	U
Particle/Grain Size, Phi Scale -1 to 0	3.4		0.1		0.1	U	0.2		4.6		0.1		0.2	
Particle/Grain Size, Phi Scale 0 to 1	2.1		0.2		0.1		0.4		9.2		0.1		0.2	
Particle/Grain Size, Phi Scale 1 to 2	0.9		0.2		0.1		0.4		14.9		0.1		0.2	
Particle/Grain Size, Phi Scale 2 to 3	0.6		0.2		0.1		0.2		4.5		0.1		0.2	
Particle/Grain Size, Phi Scale 3 to 4	0.8		0.2		0.1		0.3		4.2		0.1		0.4	
Particle/Grain Size, Phi Scale 4 to 5	2.5		4.1		2.7		3.6		3		2.4		5.1	
Particle/Grain Size, Phi Scale 5 to 6	9.7		15.4		10.5		52.2		11.4		6.6		29.8	
Particle/Grain Size, Phi Scale 6 to 7	17.9		22.9		18.1		14		11.7		17.6		27.6	
Particle/Grain Size, Phi Scale 7 to 8	16.4		14.1		18.6		6.9		7.2		20.2		9.1	
Particle/Grain Size, Phi Scale 8 to 9	14.8		12.8		15		4.2		5.7		16.2		6.5	
Particle/Grain Size, Phi Scale 9 to 10	9.5		9.9		12.1		4.9		5.2		12.7		7.1	
Particle/Grain Size, Phi Scale >10	21.2		19.9		22.5		12.6		10.9		23.9		13.7	
Particle/Grain Size, Fines (Silt/Clay)	92		99.1		99.4		98.3		55.2		99.6		98.8	
Metals (mg/kg DW)														
Lead	12.5		10.2		12		10.6		13.2		11.2		10.5	
carcinogenic PAH (ug/kg DW)														
Benzo(a)anthracene	15	J	15.6		26.9	J	15.5		31.9	J	8.34		11.8	
Chrysene	31.1	J	27.6		41.4	J	28.5		45.6	J	14.9		26	
Benzo(b)fluoranthene	16.2	J	17.3		29.2	J	21.2		31.1	J	10.2		17.7	
Benzo(k)fluoranthene	7.25	J	7.5		12.1	J	6.9		16.4	J	3.81		5.19	
Benzo(a)pyrene	15.5	J	14.9		28	J	13.4		27.2	J	8.83		9.79	
Indeno(1,2,3-cd)pyrene	9.39	J	11.8		20.5	J	12.5		19.1	J	6.65		8.57	
Dibenz(a,h)anthracene	4.85	UJ	4.9	U	9.7	UJ	4.94	U	4.86	UJ	2.42	U	4.87	U
cPAH TEQ (0 DL)	20.6		20.4		37.3		19.3		37.5		11.9		14.4	
cPAH TEQ (1/2 DL)	20.7		20.5		37.5		19.4		37.6		11.9		14.5	
cPAH TEQ (1 DL)	20.8		20.6		37.6		19.5		37.7		12.0		14.5	
cPAH TEQ (KM)	20.8		20.6		37.6		19.5		37.7		12.0		14.5	

U-the analytie was analyzed for, but was not detected above the reported sample quantitation limit
J-the analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample
UJ-the analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate.
L-the detection frequency of compounds within a sample was <50%, the numeric value indicates the number of non-detects
KM-Kaplan-Meier DW-dry weight Q-qualifier TEQ-toxicity equivalent DL-detection limit Avg-average of field duplicates

Table F-1. Summary of Bellingham Bay Sediment Conventionals, Metals, and Carcinogenic Polycyclic Aromatic Hydrocarbons (continued).

Location ID	BB-15-S	Q	BB-16-S	Q	BB-17-S	Q	BB-18-S	Q	BB-19-S	Q	BB-20-S	Q	BB-20-D	Q
Date/Time	9/9/2014	915	9/11/2014	1044	9/9/2014	1524	9/9/2014	1042	9/9/2014	1326	9/10/2014	1530	9/10/2014	1530
Conventionals														
Total Organic Carbon	1.87	J	1.41		1.27	J	3.3	J	2.87	J	1.53		1.39	
Total Solids	27.6		42.49		37.95		33.8		35.65		44.51		44.59	
Particle/Grain Size, Phi Scale <-1	0.3		3.9		0.1	U	0.2		0.1	U	0.1	U	0.2	
Particle/Grain Size, Phi Scale -1 to 0	1.2		0.2		0.1		3.5		0.5		0.1		0.2	
Particle/Grain Size, Phi Scale 0 to 1	1.2		0.3		0.1		3		1.3		0.2		0.1	
Particle/Grain Size, Phi Scale 1 to 2	1		0.3		0.2		1.3		1		0.2		0.2	
Particle/Grain Size, Phi Scale 2 to 3	1		0.3		0.1		1		0.7		0.1		0.2	
Particle/Grain Size, Phi Scale 3 to 4	0.7		0.5		0.1		1.4		0.8		0.3		0.3	
Particle/Grain Size, Phi Scale 4 to 5	6.4		4.2		3.2		2.8		2.5		6		3.2	
Particle/Grain Size, Phi Scale 5 to 6	1.8		19.4		11.7		10.2		15.3		13.6		15	
Particle/Grain Size, Phi Scale 6 to 7	17.9		17.8		19.5		19.7		18.7		20.8		20.8	
Particle/Grain Size, Phi Scale 7 to 8	17.7		15.8		17.5		15.1		14.3		16.8		17.6	
Particle/Grain Size, Phi Scale 8 to 9	15.5		10.6		14.6		12.3		13		12.3		12.3	
Particle/Grain Size, Phi Scale 9 to 10	11.6		9.5		11.3		9.8		10.5		10		9.5	
Particle/Grain Size, Phi Scale >10	23.7		17		21.5		19.8		21.4		19.7		20.6	
Particle/Grain Size, Fines (Silt/Clay)	94.6		94.4		99.3		89.6		95.7		99.2		98.9	
Metals (mg/kg DW)														
Lead	11.6		11.2		11.3		15.7		15.4		11		11.1	
carcinogenic PAH (ug/kg DW)														
Benzo(a)anthracene	8.3	J	20.7		15.2		61.5		41.1	J	20.2	J	22.3	
Chrysene	13.6	J	36.8		26.4		86.4		61.6	J	31.1	J	39.8	
Benzo(b)fluoranthene	9.77	J	23.4		16.2		56.6		38.4	J	22.8	J	27.3	
Benzo(k)fluoranthene	4.12	J	9.83		8.32		32.5		19.3	J	8.23	J	9.77	
Benzo(a)pyrene	9.4	J	17.5		13.6		65.2		41.5	J	14.2	J	17.9	
Indeno(1,2,3-cd)pyrene	7.21	J	15.4		10		42.7		26.6	J	11.1	J	14.4	
Dibenz(a,h)anthracene	2.46	UJ	4.87	U	4.85	U	9.22		5.1	J	4.84	UJ	4.9	U
cPAH TEQ (0 DL)	12.5		24.8		18.8		86.3		55.2		20.7		25.7	
cPAH TEQ (1/2 DL)	12.5		24.9		18.9		86.3		55.2		20.8		25.8	
cPAH TEQ (1 DL)	12.6		25.0		19.0		86.3		55.2		20.9		25.9	
cPAH TEQ (KM)	12.6		25.0		19.0		86.3		55.2		23.4	Avg	--	

U-the analytie was analyzed for, but was not detected above the reported sample quantitation limit
J-the analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample
UJ-the analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate.
L-the detection frequency of compounds within a sample was <50%, the numeric value indicates the number of non-detects
KM-Kaplan-Meier DW-dry weight Q-qualifier TEQ-toxicity equivalent DL-detection limit Avg-average of field duplicates

Table F-1. Summary of Bellingham Bay Sediment Conventionals, Metals, and Carcinogenic Polycyclic Aromatic Hydrocarbons (continued).

Location ID	BB-20-T	Q	BB-21-S	Q	BB-22-S	Q	BB-23-S	Q	BB-24-S	Q	BB-24-D	Q	BB-24-T	Q
Date/Time	9/10/2014	1530	9/9/2014	1453	9/9/2014	1026	9/10/2014	942	9/9/2014	1353	9/9/2014	1353	9/9/2014	1353
Conventionals														
Total Organic Carbon	1.45		1.86	J	2.09	J	1.88		1.62	J	1.45	J	1.48	J
Total Solids	43.93		36.95		40.07		40.87		36.96		37.08		36.88	
Particle/Grain Size, Phi Scale <-1	0.1	U	0.1	U	0.5		3.4		2.3		0.9		0.1	
Particle/Grain Size, Phi Scale -1 to 0	0.1	U	0.1	U	1.8		0.8		0.1	U	0.1	U	0.1	U
Particle/Grain Size, Phi Scale 0 to 1	0.1		0.1		2.4		0.7		0.1		0.2		0.1	
Particle/Grain Size, Phi Scale 1 to 2	0.1		0.1		1.8		0.5		0.1		0.1		0.1	
Particle/Grain Size, Phi Scale 2 to 3	0.1		0.1	U	2.2		0.4		0.2		0.1		0.1	
Particle/Grain Size, Phi Scale 3 to 4	0.2		0.1		1.7		0.5		0.1		0.1		0.1	
Particle/Grain Size, Phi Scale 4 to 5	4.2		0.8		2.8		2.5		5.8		3.4		1.6	
Particle/Grain Size, Phi Scale 5 to 6	15.3		8.4		11.1		12.3		9.6		8.8		8.8	
Particle/Grain Size, Phi Scale 6 to 7	21.3		18.7		16.9		19.5		16.9		17.6		18	
Particle/Grain Size, Phi Scale 7 to 8	16.3		19.7		14.7		16.7		17.9		18.5		18.2	
Particle/Grain Size, Phi Scale 8 to 9	11.9		16.1		12.9		12.7		14.2		15.4		16.8	
Particle/Grain Size, Phi Scale 9 to 10	10.6		12.5		9.7		10.4		10.9		11.4		12.4	
Particle/Grain Size, Phi Scale >10	19.9		23.3		21.6		19.8		21.8		23.4		24	
Particle/Grain Size, Fines (Silt/Clay)	99.5		99.6		89.6		93.8		97.2		98.6		99.5	
Metals (mg/kg DW)														
Lead	--		10.7		15.5		16		11.3		11		--	
carcinogenic PAH (ug/kg DW)														
Benzo(a)anthracene	--		8.68		61.9	J	60.1	J	16.9	J	19.3		--	
Chrysene	--		15.5		87.5	J	112	J	26.6	J	33.8		--	
Benzo(b)fluoranthene	--		11.1		63.6	J	43.3	J	17.9	J	20.5		--	
Benzo(k)fluoranthene	--		3.9		34.8	J	21.6	J	8.53	J	9.81		--	
Benzo(a)pyrene	--		8.49		70.7	J	38.7	J	17.4	J	19.6		--	
Indeno(1,2,3-cd)pyrene	--		7.59		51.4	J	23.9	J	14.2	J	15.6		--	
Dibenz(a,h)anthracene	--		2.45	U	9.59	J	5.57	J	4.8	UJ	4.81	U	--	
cPAH TEQ (0 DL)	--		11.8		93.7		55.3		23.4		26.5		--	
cPAH TEQ (1/2 DL)	--		11.8		93.7		55.3		23.5		26.5		--	
cPAH TEQ (1 DL)	--		11.9		93.7		55.3		23.6		26.6		--	
cPAH TEQ (KM)	--		11.9		93.7		55.3		25.1	Avg	--		--	

U-the analytie was analyzed for, but was not detected above the reported sample quantitation limit
J-the analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample
UJ-the analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate.
L-the detection frequency of compounds within a sample was <50%, the numeric value indicates the number of non-detects
KM-Kaplan-Meier DW-dry weight Q-qualifier TEQ-toxicity equivalent DL-detection limit Avg-average of field duplicates

Table F-1. Summary of Bellingham Bay Sediment Conventionals, Metals, and Carcinogenic Polycyclic Aromatic Hydrocarbons (continued).

Location ID	BB-25-S	Q	BB-26-S	Q	BB-27-S	Q	BB-28-S	Q	BB-29-S	Q	BB-30-S	Q
Date/Time	9/11/2014	950	9/10/2014	1012	9/11/2014	923	9/9/2014	1129	9/11/2014	1103	9/9/2014	1507
Conventionals												
Total Organic Carbon	2.13		2.09		1.6		3.68	J	1.51		1.59	J
Total Solids	42.7		38.15		45		36.73		37.11		35.61	
Particle/Grain Size, Phi Scale <-1	0.1	U	2.8		0.3		1		0.1	U	0.1	
Particle/Grain Size, Phi Scale -1 to 0	0.5		0.2		0.1		2.5		0.1		0.1	U
Particle/Grain Size, Phi Scale 0 to 1	0.7		0.4		0.2		3.1		0.2		0.2	
Particle/Grain Size, Phi Scale 1 to 2	0.5		0.4		0.2		2.7		0.3		0.3	
Particle/Grain Size, Phi Scale 2 to 3	0.6		0.4		0.2		2.7		0.3		0.2	
Particle/Grain Size, Phi Scale 3 to 4	1.1		0.7		0.4		3.8		0.4		0.2	
Particle/Grain Size, Phi Scale 4 to 5	3.9		3.5		5.1		3.7		2.9		2.3	
Particle/Grain Size, Phi Scale 5 to 6	17.4		14.7		15.2		11		32.2		12.4	
Particle/Grain Size, Phi Scale 6 to 7	20.1		22.4		21.9		17.4		20		24.7	
Particle/Grain Size, Phi Scale 7 to 8	15		14.5		16.9		11.9		12.1		15.6	
Particle/Grain Size, Phi Scale 8 to 9	12		11.1		11		12.7		7.2		12.9	
Particle/Grain Size, Phi Scale 9 to 10	9.1		9.9		9.7		8.3		7.9		10.7	
Particle/Grain Size, Phi Scale >10	19.2		18.8		19		19.3		16.4		20.4	
Particle/Grain Size, Fines (Silt/Clay)	96.6		95		98.7		84.2		98.8		99	
Metals (mg/kg DW)												
Lead	15.2		12.8		9.8		53		12.3		11.1	
carcinogenic PAH (ug/kg DW)												
Benzo(a)anthracene	82.5		34.3	J	14.7		824		28.6		15.9	
Chrysene	107		52.5	J	29.5		1430		43.9		31.6	
Benzo(b)fluoranthene	77.5		33.3	J	20.7		1310		30.2		16.7	
Benzo(k)fluoranthene	37.7		14.1	J	6.32		678		13.9		8.36	
Benzo(a)pyrene	60.8		27	J	11.5		1620		23.5		14.4	
Indeno(1,2,3-cd)pyrene	43.1		20	J	11.1		1070		21.1		10.4	
Dibenz(a,h)anthracene	8.19		4.96	UJ	4.9	U	233		4.93	U	4.87	U
cPAH TEQ (0 DL)	86.8		37.7		17.1		2050		33.3		19.9	
cPAH TEQ (1/2 DL)	86.8		37.8		17.2		2050		33.4		19.9	
cPAH TEQ (1 DL)	86.8		37.9		17.3		2050		33.5		20.0	
cPAH TEQ (KM)	86.8		37.9		17.3		2050		33.5		20.0	

U-the analytie was analyzed for, but was not detected above the reported sample quantitation limit
J-the analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample
UJ-the analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate.
L-the detection frequency of compounds within a sample was <50%, the numeric value indicates the number of non-detects
KM-Kaplan-Meier DW-dry weight Q-qualifier TEQ-toxicity equivalent DL-detection limit Avg-average of field duplicates

Table F-2. Summary of Bellingham Bay Dioxin/Furan Congener Data.

Location ID	BB-08-S	Q	BB-09-S	Q	BB-10-S	Q	BB-11-S	Q	BB-12-S	Q	BB-13-S	Q	BB-14-S	Q	BB-15-S	Q
Date/Time	9/9/2014	933	9/9/2014	1540	9/9/2014	1147	9/11/2014	1024	9/10/2014	1330	9/9/2014	1423	9/11/2014	853	9/9/2014	915
Dioxin/Furan Congeners (ng/kg DW)																
2,3,7,8-TCDD	1.1		0.866		1.07		0.334		0.501		0.944		0.156	J	0.623	
1,2,3,7,8-PECDD	2.94		2.13		2.28	J	0.958	J	1.22		1.51		0.473	J	1.01	U
1,2,3,4,7,8-HXCDD	12.2		8.5		9.59		3.17		2.99		4.97		0.947	J	4.48	
1,2,3,6,7,8-HXCDD	17.6		12.4		13		5.67		10.9		8.1		2.57		7.35	
1,2,3,7,8,9-HXCDD	16.1		11.4		9.94		5.01		6.34		7.64		2.21		7.13	
1,2,3,4,6,7,8-HPCDD	188		160		153		74.8		214		90.9		41.7		86.8	
OCDD	892		924		770		461		1850		507		327		503	
2,3,7,8-TCDF	16.3		13.8		17.6		4.86		5.98		10.5		1.83		6.62	
1,2,3,7,8-PECDF	1.11		0.933	J	0.875	J	0.348	J	1.18		0.75	U	0.195	U	0.665	J
2,3,4,7,8-PECDF	1.42		1.22		1.14		0.437	J	1.29		0.854	J	0.374	J	0.867	J
1,2,3,4,7,8-HXCDF	2.06		1.52		1.51		0.967	J	3.32		1.13		0.598	J	1.27	
1,2,3,6,7,8-HXCDF	1.31		1.06		1.12		0.615	J	1.28		0.645	J	0.38	U	0.778	J
1,2,3,7,8,9-HXCDF	0.153	J	0.132	J	0.077	J	0.054	U	0.188	U	0.122	J	0.053	U	0.162	J
2,3,4,6,7,8-HXCDF	0.962		0.699	J	0.817	J	0.433	J	0.881	J	0.589	J	0.264	J	0.649	J
1,2,3,4,6,7,8-HPCDF	21.4		17.5		16.7		10.7		26.9		10.9		6.6		12.8	
1,2,3,4,7,8,9-HPCDF	1.39		1.22		1.04		0.657	J	1.61		0.672	J	0.458	U	0.874	J
OCDF	59.3		61.8		49.1		29.9		70		33.9		19.6		34.9	
Dx/F TEQ (0 DL)	13.6		10.4		11.0		4.51		8.31		7.27		2.17		4.91	
Dx/F TEQ (1/2 DL)	13.6		10.4		11.0		4.52		8.32		7.28		2.20		5.42	
Dx/F TEQ (1 DL)	13.6		10.4		11.0		4.52		8.33		7.29		2.22		5.92	
Dx/F TEQ (KM)	13.6		10.4		11.0		4.52		8.33		7.28		2.19		5.92	L

U-the analytie was analyzed for, but was not detected above the reported sample quantitation limit

J-the analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample

UJ-the analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate.

L-the detection frequency of compounds within a sample was <50%, the numeric value indicates the number of non-detects

KM-Kaplan-Meier DW-dry weight Q-qualifier TEQ-toxicity equivalent DL-detection limit Avg-average of field duplicates

Table F-2. Summary of Bellingham Bay Dioxin/Furan Congener Data (continued).

Location ID	BB-16-S	Q	BB-17-S	Q	BB-18-S	Q	BB-19-S	Q	BB-20-S	Q	BB-20-D	Q	BB-21-S	Q	BB-22-S	Q	BB-23-S	Q
Date/Time	9/11/2014	1044	9/9/2014	1524	9/9/2014	1042	9/9/2014	1326	9/10/2014	1530	9/10/2014	1530	9/9/2014	1453	9/9/2014	1026	9/10/2014	942
Dioxin/Furan Congeners (ng/kg DW)																		
2,3,7,8-TCDD	0.317		0.549		0.565		0.582		0.268		0.253		1.17		0.458		0.711	
1,2,3,7,8-PECDD	0.969	J	1.55	J	1.62		1.44		0.937	J	0.572	J	2.34		2.24		2.06	J
1,2,3,4,7,8-HXCDD	3.33		6.67		5.41		5		2.62		1.92		8.58		7.18		6.66	
1,2,3,6,7,8-HXCDD	6.23		10.2		13.2		9.02		5.79		4.47		13.5		13.1		16.6	
1,2,3,7,8,9-HXCDD	5.62		8.97		9.73		6.5		4.76		3.37		13.1		10.7		11.8	
1,2,3,4,6,7,8-HPCDD	93.4		130		278		174		106		83.4		135		190		355	
OCDD	669		752		2190		1310		779		657		564		1220		3120	
2,3,7,8-TCDF	4.24		9.41		7.54		8.37		3.29		2.54		14.1		13.1		7.11	
1,2,3,7,8-PECDF	0.467	J	0.58	J	0.84	J	0.789	J	0.434	U	0.374	J	0.851	J	1.15		1.18	
2,3,4,7,8-PECDF	0.526	J	0.875	J	1.02		0.955	J	0.624	J	0.424	J	1.22		1.19		1.45	
1,2,3,4,7,8-HXCDF	1.23		1.42		3.03		1.93		1.47		1.22		1.48		2.57		4.97	
1,2,3,6,7,8-HXCDF	0.632	J	0.838	J	1.48		0.992		0.798	U	0.565	J	1.02		1.48		2.03	
1,2,3,7,8,9-HXCDF	0.079	U	0.089	J	0.184	U	0.099	J	0.093	U	0.102	U	0.096	J	0.135	J	0.25	J
2,3,4,6,7,8-HXCDF	0.451	J	0.632	J	1.22		0.801	J	0.522	J	0.463	J	0.632	J	1.05		1.35	
1,2,3,4,6,7,8-HPCDF	12.5		14.9		54.2		25.2		15.9		12.8		12.2		31.6		61	
1,2,3,4,7,8,9-HPCDF	0.824	J	1.13		2.98		2.06		1.08		0.82	J	0.806	J	1.99		4.01	
OCDF	39.1		42.6		158		90.8		43.7		37.7		36.2		82.7		214	
Dx/F TEQ (0 DL)	4.91		7.90		10.7		8.04		4.71		3.60		10.8		10.6		13.5	
Dx/F TEQ (1/2 DL)	4.91		7.90		10.7		8.04		4.77		3.60		10.8		10.6		13.5	
Dx/F TEQ (1 DL)	4.92		7.90		10.8		8.04		4.82		3.61		10.8		10.6		13.5	
Dx/F TEQ (KM)	4.92		7.90		10.8		8.04		4.18	Avg	--		10.8		10.6		13.5	

U-the analytie was analyzed for, but was not detected above the reported sample quantitation limit
J-the analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample
UJ-the analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate.
L-the detection frequency of compounds within a sample was <50%, the numeric value indicates the number of non-detects
KM-Kaplan-Meier DW-dry weight Q-qualifier TEQ-toxicity equivalent DL-detection limit Avg-average of field duplicates

Table F-2. Summary of Bellingham Bay Dioxin/Furan Congener Data (continued).

Location ID	BB-24-S	Q	BB-24-D	Q	BB-25-S	Q	BB-26-S	Q	BB-27-S	Q	BB-28-S	Q	BB-29-S	Q	BB-30-S	Q
Date/Time	9/9/2014	1353	9/9/2014	1353	9/11/2014	950	9/10/2014	1012	9/11/2014	923	9/9/2014	1129	9/11/2014	1103	9/9/2014	1507
Dioxin/Furan Congeners (ng/kg DW)																
2,3,7,8-TCDD	1.6		1.5		0.423		0.332		0.112	U	0.591		0.378		0.867	
1,2,3,7,8-PECDD	2.75	J	3.12		1.62		1.05		0.476	J	2.22		1.32		1.92	
1,2,3,4,7,8-HXCDD	12.4		13.2		4.04		3.33		1.58		5.38		4.69		8.81	
1,2,3,6,7,8-HXCDD	18.3		17.9		14.3		8.22		2.82		12.6		8.88		12.7	
1,2,3,7,8,9-HXCDD	16.6		18.1		9.08		6.43		2.61		11.1		7.95		12.3	
1,2,3,4,6,7,8-HPCDD	172		175		329		166		43.2		210		132		150	
OCDD	645		638		2760		1510		313		1610		996		706	
2,3,7,8-TCDF	21.5		21.6		4.33		4.57		1.63		7.34		5.91		11.4	
1,2,3,7,8-PECDF	1.14		1.02		1.54		0.64	J	0.272	U	1.1		0.545	J	0.705	J
2,3,4,7,8-PECDF	1.44		1.39		1.74		0.733	J	0.289	J	1.31		0.659	J	1.05	
1,2,3,4,7,8-HXCDF	1.68		1.49		8.4		2.22		0.669	U	2.78		1.58		1.44	
1,2,3,6,7,8-HXCDF	1.37		1.24		2.63		0.971	J	0.37	U	1.51		0.809	J	0.995	
1,2,3,7,8,9-HXCDF	0.117	J	0.096	J	0.391	U	0.142	U	0.13	U	0.126	J	0.117	U	0.102	J
2,3,4,6,7,8-HXCDF	0.762	J	0.811	J	1.47		0.688	J	0.316	U	1.27		0.595	J	0.715	J
1,2,3,4,6,7,8-HPCDF	13.6		13.7		63.6		24.7		6.64		46.2		18.2		13.4	
1,2,3,4,7,8,9-HPCDF	0.933	J	0.913	J	4.62		1.91		0.477	U	2.83		1.25		1.08	
OCDF	38.4		44.1		165		96.5		20.4		164		62.3		46.3	
Dx/F TEQ (0 DL)	14.2		14.6		11.9		6.67		2.03		10.6		6.79		9.84	
Dx/F TEQ (1/2 DL)	14.2		14.6		11.9		6.68		2.16		10.6		6.79		9.84	
Dx/F TEQ (1 DL)	14.2		14.6		11.9		6.69		2.30		10.6		6.80		9.84	
Dx/F TEQ (KM)	14.4	Avg	--		11.9		6.69		2.10		10.6		6.80		9.84	

U-the analytie was analyzed for, but was not detected above the reported sample quantitation limit

J-the analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample

UJ-the analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate.

L-the detection frequency of compounds within a sample was <50%, the numeric value indicates the number of non-detects

KM-Kaplan-Meier DW-dry weight Q-qualifier TEQ-toxicity equivalent DL-detection limit Avg-average of field duplicates

Table F-3. Summary of Bellingham Bay Polychlorinated Biphenyl (PCB) Congener Data.

Location ID	BB-01-S	Q	BB-02-S	Q	BB-03-S	Q	BB-04-S	Q	BB-05-S	Q	BB-06-S	Q
Date/Time	9/11/2014	834	9/10/2014	1135	9/10/2014	1512	9/10/2014	1438	9/10/2014	1410	9/10/2014	1115
PCB Congeners (ng/kg DW)												
PCB-001	4.22		2.79		23.7		4.46		3.33	J	17.5	
PCB-002	6.9		5.63		11.1		3.72		4.44		11.3	
PCB-003	6.23		5.4		25.2		5.56		5.21		24.2	
PCB-004	3.74		2.59	UJ	11.2		3.1		2.4	J	8.78	
PCB-005	0.473	U	1.45	UJ	0.876		0.155	U	0.833	U	2.08	U
PCB-006	4.13		3.66	UJ	14.4		3.81		3.46	U	14.8	
PCB-007	0.815	U	1.34	UJ	3.05		0.68		0.767	U	2.66	J
PCB-008	15.4		11.5	J	48.6		12		12.7		62.6	
PCB-009	0.676	J	1.29	UJ	2.66		0.608		0.742	U	1.84	U
PCB-010	0.405	U	1.28	UJ	0.54	U	0.131	U	0.735	U	1.82	U
PCB-011	20.7		15.8	J	26		12		15.8		27	
PCB-012/013	5.13	U	5.18	UJ	12.7		3.54		3.18	U	10.8	
PCB-014	0.443	U	1.36	UJ	0.562		0.103	U	0.78	U	1.99	U
PCB-015	16.3		13.3		52.2		12.2		12		65	
PCB-016	4.86		3.98		13.2		3.29		3.92		18.6	
PCB-017	7.14		5.46		24.1		6.2		6.68		33.5	
PCB-018/030	12.6		9.94		37.4		9.67		11.1		47.9	
PCB-019	1.26	U	1.39	U	4		1.1		1.15		4.7	
PCB-020/028	43.8		39.5		143		33.8		37.2		206	
PCB-021/033	15.5		13		49.7		11.9		12.7		83.1	
PCB-022	12		10.7		40.4		9.89		10.4		59.5	
PCB-023	0.191	U	0.208	U	0.176	J	0.0497	U	0.0551	U	0.243	J
PCB-024	0.2	U	0.177	U	0.607		0.178	J	0.188	J	0.862	
PCB-025	4.37		3.14		14.2		3.64		3.9		19.1	
PCB-026/029	9.24		7.32		29.6		7.37		8.22		37.7	
PCB-027	1.41	J	1.08	J	4.63		1.23		1.31		5.58	
PCB-031	30.7	J	27.3		94.6		24.2		27		141	
PCB-032	4.89		3.84		16.4		4.14		4.45		25.9	
PCB-034	0.185	U	0.21	U	0.773		0.175	J	0.198	J	1.01	
PCB-035	1.38	U	1.3	J	4.35		1.08		1.26		6.33	
PCB-036	0.487	U	0.354	J	0.757		0.308	J	0.451		0.934	
PCB-037	10.9		10.1		37.1		8.32		9.19		50	
PCB-038	0.191	U	0.223	U	0.538	U	0.176	J	0.212	J	0.638	
PCB-039	0.235	U	0.26	U	0.851		0.226	J	0.23	J	1.29	
PCB-040/041/071	14		12.2		44		10.8		11.8		62.9	
PCB-042	6.82		6.28		20.4		4.9		5.44		28.6	
PCB-043	0.895	J	0.875	J	2.73		0.741		0.84		4.01	
PCB-044/047/065	27.7		22.6		81.1		20.8		22.8		124	
PCB-045/051	3.67		2.96		11		2.9		3.13		15.3	
PCB-046	1.13	J	0.813	J	3.25		0.819		0.932		4.6	
PCB-048	4.66		3.96		14.9		3.37		3.62		21.7	
PCB-049/069	20.4		17.5		63.3		15.7		17.5		86.2	
PCB-050/053	3.17		2.48		10.5		2.82		2.99		13.8	
PCB-052	35.8		29.3		102		28.3		29.8		186	
PCB-054	0.11	U	0.0748	U	0.212	U	0.078	U	0.059	U	0.201	J
PCB-055	0.239	U	0.346	U	2		0.604		0.502		4.2	
PCB-056	15.3		15.1		43.7		10.1		11		70.6	
PCB-057	0.214	U	0.324	U	0.574		0.166	J	0.172	J	1	
PCB-058	0.224	U	0.336	U	0.258	U	0.0932	U	0.134	U	0.306	U
PCB-059/062/075	2.52		2.47		8.27		1.93		2.16		11.3	
PCB-060	8.26		9.27		24.9		5.86		6.36		40.3	
PCB-061/070/074/076	63.4		61.5		182		44.7		49.2		334	
PCB-063	1.31	J	1.35	U	4.15		0.953		1.09		6.85	
PCB-064	11.3		9.74		33.4		8.89		9.31		50.8	
PCB-066	33.9		32.4		95.3		22.4		25.2		156	
PCB-067	1.16	J	0.958	J	3.97		0.799		0.879		5.98	
PCB-068	0.427	J	0.45	J	1.04		0.323	J	0.342	J	1.28	
PCB-072	0.551	U	0.579	J	1.61		0.353	J	0.433		2.19	
PCB-073	0.0489	U	0.174	U	0.054	U	0.048	U	0.0482	U	0.0505	U

Location ID	BB-01-S	Q	BB-02-S	Q	BB-03-S	Q	BB-04-S	Q	BB-05-S	Q	BB-06-S	Q
Date/Time	9/11/2014	834	9/10/2014	1135	9/10/2014	1512	9/10/2014	1438	9/10/2014	1410	9/10/2014	1115
PCB-077	3.9		3.24		11.7		2.87		3.24		16.4	
PCB-078	0.25	U	0.353	U	0.255	U	0.092	U	0.133	U	0.33	U
PCB-079	0.749	J	0.673	J	1.81		0.493		0.474		4.98	
PCB-080	0.216	U	0.334	U	0.789		0.0853	U	0.123	U	0.281	U
PCB-081	0.231	U	0.313	U	0.647		0.157	U	0.137	J	0.754	
PCB-082	5.28		5.38		15.8		4.83	J	5.49		36.5	
PCB-083/099	30.5		33.8		96.1		26.6		30.4		162	
PCB-084	10.5		10.8		0.129	U	10.2		10.6		60.2	
PCB-085/116/117	9.88		9.55		28.9		7.55		8.32		49.5	
PCB-087/097/108/119/125	31.8		30.7		100		28.3		29.9		176	
PCB-088/091	6.5		6.55		20.5		6.02		6.43		32.5	
PCB-089	0.552	U	0.363	U	1.35		0.439	U	0.379	J	2.28	
PCB-090/101/113	42.2		51.4		141		39.8		44.1		256	
PCB-092	7.33		9.4		26.4		7.79		8.4		44.9	
PCB-093/095/098/100/102	32.6		31.4		98.2		28.9		30.3		171	
PCB-094	0.292	J	0.35	U	0.123	U	0.213	U	0.244	U	0.947	
PCB-096	0.354	J	0.233	J	0.815	U	0.239	J	0.197	J	1.02	
PCB-103	0.586	U	0.479	U	0.095	U	0.558		0.62		2.43	
PCB-104	0.0489	U	0.0521	U	0.0574	U	0.048	U	0.0482	U	0.0505	U
PCB-105	20.3		19.2		62.7		15.4		16.7		128	
PCB-106	0.2	U	0.484	U	0.261	U	0.131	U	0.0733	U	0.673	U
PCB-107/124	1.74	U	1.88	J	6.63		1.78		1.69		12.9	
PCB-109	4.09		3.99		13.3		3.15		3.53		27.1	
PCB-110/115	55.3		52.4		162		41.6		44.9		300	
PCB-111	0.0945	U	0.265	U	0.146	U	0.08	J	0.0659	U	0.168	U
PCB-112	0.0867	U	0.255	U	0.0756	U	0.0524	U	0.0628	U	0.0614	U
PCB-114	0.969	U	0.811	U	3.39		0.873		0.994		7.72	
PCB-118	50.5		47.4		148		35.7		39.1		294	
PCB-120	0.239	U	0.31	U	0.806		0.204	J	0.269	J	0.888	
PCB-121	0.0928	U	0.262	U	0.0827	U	0.0573	U	0.0686	U	0.0622	U
PCB-122	0.831	J	0.56	U	2		0.444		0.492		4.46	
PCB-123	1.28	U	1.33	J	2.92		0.883		0.987		5.79	
PCB-126	0.398	J	0.562	U	0.816		0.259	U	0.265	J	0.954	
PCB-127	0.243	U	0.566	U	0.269	U	0.135	U	0.0757	U	0.678	U
PCB-128/166	12.1		9.7		34.2		0.203	U	0.262	U	1.27	U
PCB-129/138/160/163	73.4		55.6		185		55.2		60.6		384	
PCB-130	4.67		3.71		12.2		3.32	J	3.37	J	22.4	
PCB-131	0.75	U	0.534	U	2.46	J	0.585	U	0.281	U	3.91	J
PCB-132	20.9		13.6		50.5		14.9		13.5		109	
PCB-133	1.11	U	0.872	J	2.79	J	0.84	U	0.845	J	4.22	U
PCB-134/143	0.175	U	1.98	J	8.94		2.13	J	2.21	U	15.7	
PCB-135/151/154	17.7		13.7		43.5		11		13.7		96.8	
PCB-136	4.97		4.49		15.2		4.05	J	4.6		30.5	
PCB-137	3.4		2.78	U	10.1		2.51	U	2.73	U	19.6	
PCB-139/140	1.24	J	0.905	U	2.96	J	1.1	J	1.02	J	6.03	J
PCB-141	8.3		6.71		25.5		7.01		7.15		58.2	
PCB-142	0.187	U	0.286	U	0.647	U	0.225	U	0.283	U	1.31	U
PCB-144	2.33	U	1.76	J	5.9	U	1.76	J	1.68	U	13.7	
PCB-145	0.063	U	0.0497	U	0.076	U	0.106	U	0.0482	U	0.0505	U
PCB-146	9.84		9.68		25.8		6.79		6.7		48.9	
PCB-147/149	44.9		32.5		103		32.3		34.4		242	
PCB-148	0.151	UJ	0.0497	U	0.307	U	0.048	U	0.147	U	0.519	U
PCB-150	0.0489	U	0.116	U	0.0461	U	0.048	U	0.0482	U	0.361	U
PCB-152	0.0489	U	0.0497	U	0.0461	U	0.112	U	0.066	U	0.177	U
PCB-153/168	56.7		51.8		139		40.5		42.2		317	
PCB-155	0.084	U	0.095	U	0.0823	U	0.048	U	0.0482	U	0.085	J
PCB-156/157	6.22		7.48		21.1		5.23		5.58		43.3	
PCB-158	5.95		4.82		16.1		4.82	J	4.18		35.3	
PCB-159	0.53	U	0.229	U	1.79	J	0.368	U	0.563	U	4.89	J
PCB-161	0.132	U	0.2	U	0.483	U	0.159	U	0.197	U	0.981	U
PCB-162	0.24	J	0.233	U	0.549	U	0.388	J	0.231	U	1.11	U

Location ID	BB-01-S	Q	BB-02-S	Q	BB-03-S	Q	BB-04-S	Q	BB-05-S	Q	BB-06-S	Q
Date/Time	9/11/2014	834	9/10/2014	1135	9/10/2014	1512	9/10/2014	1438	9/10/2014	1410	9/10/2014	1115
PCB-164	3.93		3.76		12.2		3.09	J	3.37	U	22.1	
PCB-165	0.147	U	0.23	U	0.55	U	0.177	U	0.227	U	1.12	U
PCB-167	2.43		2.3	U	7.29		1.83		2.01		14.4	
PCB-169	0.162	U	0.282	U	0.553	U	0.218	U	0.229	U	1.15	U
PCB-170	11.4		11.6		34.3		9.37		9.35		84	
PCB-171/173	4.34		3.64	U	12.3		3.31		3.75		26.8	
PCB-172	2.5	U	2.78		6.94		1.83		1.93		17.7	
PCB-174	13		10.3		35.7		10.3		10.8		95.7	
PCB-175	0.666	J	0.727	U	1.98		0.534		0.588		4.4	
PCB-176	2.1		1.36	J	5.49		1.44		1.65		12.2	
PCB-177	8.83		7.38	U	23.8		7.33		8.09		53.3	
PCB-178	3.94	U	3.26	U	9.76		2.81		3.1		21.4	
PCB-179	6.24		4.67	U	16.7		4.86		5.24		43	
PCB-180/193	24.1		23.6		71.4		19.3		20.1		229	
PCB-181	0.206	U	0.0497	U	0.561		0.0821	U	0.163	U	0.771	
PCB-182	0.205	U	0.176	U	0.384	U	0.115	J	0.113	U	0.505	U
PCB-183/185	10.5		9.66		29.1		8.46		8.59		79.9	
PCB-184	0.075	U	0.124	U	0.123	U	0.0562	U	0.084	U	0.117	U
PCB-186	0.0489	U	0.0497	U	0.0839	U	0.0666	U	0.0504	U	0.0649	U
PCB-187	22.4		22.3		57.4		16.3		18.2		146	
PCB-188	0.14	J	0.123	U	0.188	U	0.077	J	0.082	J	0.197	U
PCB-189	0.452	J	0.666	U	1.61		0.446		0.46		3.55	
PCB-190	2.22		1.94	U	6.89		1.9	J	2.21	J	16.9	
PCB-191	0.565	J	0.435	U	1.33		0.446		0.45		3.94	
PCB-192	0.0489	U	0.0497	U	0.0813	U	0.0645	U	0.0488	U	0.0822	U
PCB-194	7.41	U	5.83		22.6		6.38		6.44		101	
PCB-195	2.61		2.01		7.74		1.97		1.96		36.1	
PCB-196	4.04		3.27		12.1		3.55		3.64		49.7	
PCB-197/199	1.48	U	1.18	U	4.3		1.11		1.16		17.2	
PCB-198/201	13		11.5		30		8.74	U	10		115	
PCB-200	1.49	U	1.43	U	3.72		0.951		0.983		14.5	
PCB-202	3.05		2.84	U	7.04		2.2		2.44		23.8	
PCB-203	6.31		6.12		17.9		5.33		5.8		73.6	
PCB-204	0.0489	U	0.0497	U	0.0461	U	0.048	U	0.0482	U	0.0505	U
PCB-205	0.404	U	0.516	U	0.987		0.31	J	0.301	J	4.07	
PCB-206	8.22		8.44		17.6		6.18		7.13		40.8	
PCB-207	1.04	J	1.22	J	5.64		1.05	J	0.941	J	6.78	
PCB-208	3.4		3.09		10.4		2.73		3.03		16.3	
PCB-209	7.47		7.18	U	132		7.97		7.5		25.8	
Total PCBs*	1240		1090		3750		965		1030		6870	
PCB TEQ (0 DL)	0.0426		0.00259		0.0904		0.0021		0.0288		0.112	
PCB TEQ (1/2 DL)	0.0451		0.0350		0.0987		0.0183		0.0323		0.129	
PCB TEQ (1 DL)	0.0476		0.0675		0.107		0.0346		0.0357		0.147	
PCB TEQ (KM)	0.0429		0.0592	L6	0.0913		0.0283	L	0.0291		0.114	

*total PCBs represents the sum of all detected congeners
U-the analytie was analyzed for, but was not detected above the reported sample quantitation limi
J-the analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sampl
UJ-the analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate
L-the detection frequency of compounds within a sample was <50%, the numeric value indicates the number of non-detect
KM-Kaplan-Meier DW-dry weight Q-qualifier TEQ-toxicity equivalent DL-detection limit Avg-average of field duplicate

Table F-3. Summary of Bellingham Bay Polychlorinated Biphenyl (PCB) Congener Data (continued).

Location ID	BB-07-S	Q	BB-08-S	Q	BB-09-S	Q	BB-10-S	Q	BB-11-S	Q	BB-12-S	Q
Date/Time	9/10/2014	1356	9/9/2014	933	9/9/2014	1540	9/9/2014	1147	9/11/2014	1024	9/10/2014	1330
PCB Congeners (ng/kg DW)												
PCB-001	4.5		54.5		51.4		46.9		15.9		55.6	
PCB-002	7.31		32.7		23.4		22.8		12.7		12.2	
PCB-003	5.9		57.7		53.1		52.7		18		82.6	
PCB-004	3.14		16.8		15.5		13.1		7.74		31.1	
PCB-005	1.5	U	2.58	U	1.73	U	1.44		1.26	U	3.14	U
PCB-006	3.87	U	16.8		18.4		15.9		7.6		32.5	
PCB-007	1.38	U	5.06		4.56		4.88		1.15	U	6.87	
PCB-008	13.3		89		74.3		73.5		30.9		193	
PCB-009	1.33	U	3.56	J	2.89	J	2.79		1.11	U	6.97	
PCB-010	1.32	U	2.15	U	1.51	U	0.61	U	1.08	U	1.64	U
PCB-011	14.6	U	48.6		36.2		35.9		28.2		24.2	
PCB-012/013	4.19	U	19		20.7	U	15.7		11.6	U	23.6	
PCB-014	1.4	U	2.37	U	1.63	U	1.56	U	1.18	U	1.8	U
PCB-015	13.8		107		93.7		88.5		38.6		170	
PCB-016	4.32		14.9		12.4		11.9		6.83		80.3	
PCB-017	7.39		25.4		25.8		20.4		13		119	
PCB-018/030	12.4		45.9		52.9		33.5		22.2		222	
PCB-019	1.27		4.37		4.64		3.71		2.15		21.9	
PCB-020/028	46.6		174		152		129		78.2		602	
PCB-021/033	17.1		52.2		52.8		44		24.8		285	
PCB-022	13.6		43		39.5		32.4		20.1		210	
PCB-023	0.0694	U	0.41	J	0.386	U	0.4		0.312	U	0.583	J
PCB-024	0.152	J	0.542	U	0.614		0.592	U	0.272	J	1.72	U
PCB-025	4.82		18.7		20.1		15		8.33		43.2	
PCB-026/029	9.92		36.4		40.4		28.2		17.6		98	
PCB-027	1.47		5.21	U	6.42		4.54		2.76		15.2	
PCB-031	31.2		136		126		91		58.2		472	
PCB-032	5.99		22.2		20.4		15.1		9.08		90.3	
PCB-034	0.242	J	0.78	J	0.894	J	0.703		0.44		2.43	J
PCB-035	1.7		6.73		5.86		5.16		2.87		10.9	
PCB-036	0.388	J	2.4		1.67		1.64		1.1		9.98	
PCB-037	11.8		45.6		35.5		31.6		21.1		137	
PCB-038	0.359	J	1.12		0.807		0.728	U	0.468		0.512	U
PCB-039	0.308	J	1.4		1.11		0.936		0.534		3.68	J
PCB-040/041/071	14.7		44.3		39.9		33		23		222	
PCB-042	6.88		21.5		18.9		15.9		10.3		113	
PCB-043	0.831		2.33		2.26		2.21	U	1.27		24.7	
PCB-044/047/065	27.6		82		78.4		61.9		44		437	
PCB-045/051	3.65		9.67		10.8		8.21		5.67		66.5	
PCB-046	1.03		3.21		3.3		2.62		1.76		22.2	
PCB-048	4.77		13.5		12.3		10.3		7.1		100	
PCB-049/069	20.3		64.5		65.3		49.7		34		293	
PCB-050/053	3.4		10.3		11.3		7.89		5.86		50.6	
PCB-052	38.7		103		114		80.9		55.6		583	
PCB-054	0.065	U	0.284	J	0.239	J	0.169	J	0.11	J	1.09	U
PCB-055	0.788		2.8		2.23		1.85		1		20.5	
PCB-056	14.8		52		46.6		38.4		22.7		234	
PCB-057	0.212	J	0.827	U	0.8		0.491		0.376	J	2.73	J
PCB-058	0.161	U	0.56		0.569		0.361	U	0.162	U	2.42	U
PCB-059/062/075	2.76		8.28		8.01		6.06		4.48		43.8	
PCB-060	8.46		29.8		25.1		22.1		12.7		154	
PCB-061/070/074/076	64.5		218		193		163		95.9		977	
PCB-063	1.4		5.35		4.55		3.73		2.24		20.4	
PCB-064	11.8		34.3		31.4		25.8		17.7		217	
PCB-066	32.8		115		106		82.8		48.4		449	
PCB-067	1.06		4.23		3.88		3.08		1.98		16.7	
PCB-068	0.399		1.4		1.32		1.09		0.687		2.16	J
PCB-072	0.583		2.11		2.06		1.33		0.985		5.51	J
PCB-073	0.0519	U	0.411		0.43		0.538	U	0.0499	U	0.236	U

Location ID	BB-07-S	Q	BB-08-S	Q	BB-09-S	Q	BB-10-S	Q	BB-11-S	Q	BB-12-S	Q
Date/Time	9/10/2014	1356	9/9/2014	933	9/9/2014	1540	9/9/2014	1147	9/11/2014	1024	9/10/2014	1330
PCB-077	4.27		15.7		12		10.6		6.98		36.7	
PCB-078	0.173	U	0.347	U	0.203	U	0.338	U	0.165	U	2.61	U
PCB-079	0.9		2.47		1.96		1.86		1.01		16	
PCB-080	0.148	U	0.34	U	0.131	U	0.331	U	0.144	U	2.38	U
PCB-081	0.184	U	0.71	U	0.456		0.507	U	0.351	J	2.55	U
PCB-082	6.42		16.5		16.4		11.8		8.89		105	
PCB-083/099	32.1		96.6		86.8		73.7		54.8		456	
PCB-084	11.5		28.3		31		23.1		17		181	
PCB-085/116/117	9.43		27.7		26.5		21.5		15.2		144	
PCB-087/097/108/119/125	33.2		90.2		83.9		70.7		49.9		552	
PCB-088/091	6.47		17.6		19.3		15.3		10.7		97.6	
PCB-089	0.428		1.12	J	1.24		0.989		0.7	U	8.05	
PCB-090/101/113	47.3		134		131		108		75.1		825	
PCB-092	9.63		24.6		23.1		19.3		13.9		142	
PCB-093/095/098/100/102	33.2		84.9		93.5		72.5		50		535	
PCB-094	0.248	U	0.585		0.592		0.4		0.294	J	3.31	U
PCB-096	0.255	J	0.714		0.828		0.529		0.46	U	3.62	J
PCB-103	0.631		1.89		2.04		1.52		1.11		5.39	U
PCB-104	0.0619	U	0.068	J	0.0642	U	0.0854	U	0.0643	U	0.164	U
PCB-105	24.7		69		55.3		51.1		35.3		299	
PCB-106	0.167	U	0.57	U	0.155	U	0.183	U	0.14	U	2.56	U
PCB-107/124	2.46		6.59		5.84		5.44		3.18		28.5	
PCB-109	6.01		15.1		11.8		11.5		7.01		57.3	
PCB-110/115	56.3		163		160		131		84.8		870	
PCB-111	0.096	U	0.212	J	0.233	U	0.148	J	0.145	U	0.517	U
PCB-112	0.0802	U	0.429	U	0.255	J	0.593		0.0741	U	0.494	U
PCB-114	1.39		3.69		2.87		2.79		1.84		16.7	
PCB-118	55.2		167		141		124		82		726	
PCB-120	0.328	J	0.921		0.772	U	0.857		0.564	U	1.85	J
PCB-121	0.0812	U	0.118	U	0.091	J	0.112	U	0.0811	U	0.495	U
PCB-122	0.957		1.79		1.96		1.75		1.11	U	9.67	
PCB-123	1.3		3.42		3.01		2.6		1.85		12.2	U
PCB-126	0.421		1.34		1.1		0.933		0.505	U	3.41	U
PCB-127	0.168	U	0.606	U	0.156	U	0.251	J	0.162	U	3.13	U
PCB-128/166	0.228	U	37.3		32.6		33.5		18.9		155	
PCB-129/138/160/163	74.2		215		167		171		107		983	
PCB-130	3.67	J	11.7	U	9.02		8.78		7.56	U	64.3	
PCB-131	0.557	J	2.05	U	1.31	J	1.43	U	0.411	U	12.3	
PCB-132	20.2		54.9		47.7		43.7		30.6		302	
PCB-133	1.29	U	3.21	U	2.15	U	2.14		1.16	U	13.1	
PCB-134/143	3.5	U	8.55		7.13		6.65		4.31	J	44.2	
PCB-135/151/154	17.6		41.8		42.5		35.8		24.4		235	
PCB-136	6.13		12.2		14.5		10.9		7.47		83.7	
PCB-137	3.38	U	9.18		7.6	U	6.37		4.57	U	47.2	
PCB-139/140	1.34	J	2.93	J	2.43	J	2.51		1.7	U	15.4	
PCB-141	10.6		22.3		19.3		18.7		13		157	
PCB-142	0.246	U	0.71	U	0.827	U	0.37	U	0.436	U	2.02	U
PCB-144	2.22	U	5.25		5.17		4.3		3.08	J	36.1	
PCB-145	0.0492	U	0.0478	U	0.156	U	0.0492	U	0.085	U	0.0478	U
PCB-146	11		26.2		23.7		20.5		14.7		127	
PCB-147/149	45.3		113		105		102		65.7		626	
PCB-148	0.213	U	0.674	U	0.409	U	0.387	J	0.185	J	0.991	J
PCB-150	0.0492	U	0.492	J	0.634	U	0.419	J	0.0491	U	1.81	J
PCB-152	0.0492	U	0.0478	U	0.083	U	0.093	U	0.087	U	0.588	J
PCB-153/168	57.1		151		129		117		82.9		741	
PCB-155	0.0557	U	0.0919	U	0.13	U	0.119	U	0.082	U	0.17	U
PCB-156/157	8.59		21.9		18.7		17.7		11.4	J	96.8	
PCB-158	6.82		16.8		14		14.1		8.91		100	
PCB-159	0.863	U	1.87	U	1.74	J	2.07		1.02	J	5.85	
PCB-161	0.172	U	0.47	U	0.594	U	0.245	U	0.307	U	1.51	U
PCB-162	0.201	U	1.19	J	0.791	U	0.563	U	0.347	U	2.29	U

Location ID	BB-07-S	Q	BB-08-S	Q	BB-09-S	Q	BB-10-S	Q	BB-11-S	Q	BB-12-S	Q
Date/Time	9/10/2014	1356	9/9/2014	933	9/9/2014	1540	9/9/2014	1147	9/11/2014	1024	9/10/2014	1330
PCB-164	4.92	J	11.3		9.22		8.32		6.29		59.7	
PCB-165	0.198	U	0.545	U	0.7	U	0.284	U	0.342	U	1.72	U
PCB-167	3.1		7.99		6.69		6.21		4.11		32	
PCB-169	0.186	U	0.793	U	0.696	U	0.466	U	0.404	U	1.72	U
PCB-170	15.4		39.4		33.5		35.5		19.3		138	
PCB-171/173	4.64		13		10.8		11		5.81		51.9	
PCB-172	3.1		7.4		6.53		6.21		3.68		28.7	
PCB-174	13.1		41.6		33.5		35.9		19.2		153	
PCB-175	0.647		2.45		1.79		1.98		1.13		7.27	
PCB-176	1.8		6.53		5.27		5.94		2.84		22.1	
PCB-177	8.91		28.1		22.4		23.5		13.3		95.4	
PCB-178	3.87		13.8		10.2		10.8		5.88		34.7	
PCB-179	5.54		22.9		18.6		19.6		9.92		65.7	
PCB-180/193	31.8		92.1		69.1		80		38.9		278	
PCB-181	0.181	J	0.496	U	0.387	J	0.355	J	0.27	J	2.84	U
PCB-182	0.0726	U	0.621		0.42		0.44		0.265	U	0.0478	U
PCB-183/185	10.7		36.7		26.8		31		16.2		117	
PCB-184	0.0492	U	0.301	J	0.306	U	0.315	U	0.157	J	0.296	U
PCB-186	0.0556	U	0.114	U	0.0597	U	0.154	U	0.0773	U	0.0478	U
PCB-187	20.4		82.3		56.1		66.3		33.4		207	
PCB-188	0.081	J	0.407	U	0.272	J	0.323	J	0.164	J	0.437	U
PCB-189	0.714	U	1.87		1.59		1.6		0.958		4.76	J
PCB-190	2.96	U	9.23		6.06		7.46		3.58	J	24	
PCB-191	0.592		1.77		1.31		1.36		0.821		7.27	
PCB-192	0.0705	U	0.108	U	0.0507	U	0.145	U	0.0738	U	0.0478	U
PCB-194	11		33.4		19.7		29.5		13		50.5	
PCB-195	3.86		10.9		8.37		10.1		4.46		18	
PCB-196	5.7		16.6		10.6		16.3		6.51		27.5	
PCB-197/199	1.41		6.72		4.78		5.83		2.56		10.1	
PCB-198/201	14.8		54.5		31.6		45.3		19.6		75.7	
PCB-200	1.58	U	5.89		4.11		6.16		2.18		10.6	
PCB-202	3.42		11.9		7.73		10.9		4.52		18.6	
PCB-203	8.97		27		17.8		29.2		10.5		39.5	
PCB-204	0.0492	U	0.192	U	0.0507	U	0.119	J	0.0491	U	0.0478	U
PCB-205	0.439		1.46		0.971		1.22		0.544		2.74	U
PCB-206	10.2		32.8		21.5		30.6		12.3		21.1	
PCB-207	1.28	J	4.47		3.33	J	5.05		1.72	U	3.15	J
PCB-208	4.1		14.6		9.93		12.2		5.11		13.1	
PCB-209	10.9		37.6		34.1		30.5		12.9		30.8	U
Total PCBs*	1290		4300		3810		3430		2040		17700	
PCB TEQ (0 DL)	0.0454		0.144		0.118		0.101		0.00493		0.0389	
PCB TEQ (1/2 DL)	0.0482		0.156		0.129		0.108		0.0362		0.236	
PCB TEQ (1 DL)	0.0510		0.168		0.139		0.115		0.0675		0.433	
PCB TEQ (KM)	0.0458		0.145		0.119		0.101		0.0560	L	0.385	L

*total PCBs represents the sum of all detected congeners

U-the analytie was analyzed for, but was not detected above the reported sample quantitation limi

J-the analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sampl

UJ-the analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate

L-the detection frequency of compounds within a sample was <50%, the numeric value indicates the number of non-detect

KM-Kaplan-Meier DW-dry weight Q-qualifier TEQ-toxicity equivalent DL-detection limit Avg-average of field duplicate

Table F-3. Summary of Bellingham Bay Polychlorinated Biphenyl (PCB) Congener Data (continued).

Location ID	BB-13-S	Q	BB-14-S	Q	BB-15-S	Q	BB-16-S	Q	BB-17-S	Q	BB-18-S	Q
Date/Time	9/9/2014	1423	9/11/2014	853	9/9/2014	915	9/11/2014	1044	9/9/2014	1524	9/9/2014	1042
PCB Congeners (ng/kg DW)												
PCB-001	31.7		7.16		39.2		20.5		33.7		36.8	
PCB-002	21.6		8.91		26.2		10.8		23.3		16.7	
PCB-003	35.5		9.46		35.9		23.1		42.8		38.7	
PCB-004	9.59		4.9		26		9.84		13.7		16.1	
PCB-005	0.874		0.359	J	1.55		2.04	U	1.17		1.56	
PCB-006	9.27		5.8		19.8		12.1		16.6		18.7	
PCB-007	3.39		1.21	U	4.99		1.85	U	4.13		4.51	
PCB-008	53.5		21		103		43.1		63.5		71.3	
PCB-009	1.97		1		4.67		1.79	U	2.44		3.4	
PCB-010	0.412		0.237	U	0.926		1.74	U	0.521		0.694	
PCB-011	35.6		26		43.1		23		37		34.8	
PCB-012/013	10.5		6.04		15		10.5		16.2		15.7	
PCB-014	0.801	U	0.596	U	1.02	U	1.91	U	1.69	U	1.13	U
PCB-015	64.9		23.9		87.7		41.8		73.7		70.7	
PCB-016	10.9		6.43	U	37.9		9.53		13.4		15	
PCB-017	16.5		10.8		43.2		18		23.2		24.2	
PCB-018/030	27.1		17.7		75.6		29.4		41.4		43.8	
PCB-019	2.54		2.2	U	8.5		3.06		4.05		4.29	
PCB-020/028	98		57.7		224		95.9		128		152	
PCB-021/033	36.6		21.9		108		31.8		46.1		64.3	
PCB-022	27.3		15.4		75.5		24.9		34		38.2	
PCB-023	0.235	J	0.461	U	0.393	J	0.141	J	0.276	J	0.348	U
PCB-024	0.436		0.331	U	1.6		0.418		0.511		0.568	
PCB-025	9.18		5.86	J	18.6		10.9		16.9		16.9	
PCB-026/029	18		12.2		37.7		23.2		32.4		33.3	
PCB-027	3.19		2.31	J	7.36		3.8		5.46		5.43	
PCB-031	75.9		45		196		72.4		107		118	
PCB-032	11.4		7.28		31		12.3		16.7		21.3	
PCB-034	0.559		0.447	U	1.04		0.544		0.72		0.789	
PCB-035	4.14		1.62	J	6.27		3.29		5.23		4.98	
PCB-036	1.64		0.895	J	1.57		0.801		1.46		1.14	
PCB-037	26.4		16.4		62.6		24.3		32		38	
PCB-038	0.675		0.461	U	0.603		0.385	J	0.75	U	0.8	
PCB-039	0.718		0.44	U	1.22		0.583		0.83		1.04	
PCB-040/041/071	30.2		18.8		59.5		29.1		38.3		46.9	
PCB-042	13.8		8.78		26.5		13.5		18		23	
PCB-043	1.77		1.21		3.63		1.66		2.31		2.66	
PCB-044/047/065	54.4		36.9		91.2		54.2		70.9		103	
PCB-045/051	6.55		4.63		14.4		7.75		9.51		10.9	
PCB-046	2.21		1.37		4.87		2.24		2.92		3.73	
PCB-048	9.29		6.01		20.9		9.13		11.5		14.6	
PCB-049/069	39.4		27.4		61.1		42.2		55.6		78.6	
PCB-050/053	6.23		4.26		12		7.42		9.85		11.8	
PCB-052	68.2		46.5		91.4		68.8		96.3		159	
PCB-054	0.127	J	0.127	J	0.246	J	0.172	J	0.225	J	0.247	J
PCB-055	1.86		0.785	U	4.19		1.4		2.37		2.13	
PCB-056	31.6		18.9		62.8		27.5		40.6		50.5	
PCB-057	0.414		0.234	J	0.879		0.454		0.654		0.712	
PCB-058	0.315	J	0.0808	U	0.31	J	0.24	U	0.468		0.508	U
PCB-059/062/075	5.46		3.55		10.2		5.63		7.48		9.2	
PCB-060	18.8		0.0829	UJ	40.8		15.1		23.1		28	
PCB-061/070/074/076	128		79.3		221		116		171		248	
PCB-063	2.92		1.88		5.45		2.7		4.11		5.19	
PCB-064	22.5		14.5		40.7		21.6		29.4		39.4	
PCB-066	70.1		42.2		118		57.3		94.5		115	
PCB-067	2.48		1.54		5.17		2.32		3.56		4.08	
PCB-068	0.832		0.61		1.02		0.762		1.3		1.32	
PCB-072	1.12		0.729		1.49		1.08		1.86		2.2	
PCB-073	0.508		0.049	U	0.593		0.0623	U	0.397		0.483	

Location ID	BB-13-S	Q	BB-14-S	Q	BB-15-S	Q	BB-16-S	Q	BB-17-S	Q	BB-18-S	Q
Date/Time	9/9/2014	1423	9/11/2014	853	9/9/2014	915	9/11/2014	1044	9/9/2014	1524	9/9/2014	1042
PCB-077	9.97		5.73		14.1		7.27		10.8		14.9	
PCB-078	0.199	U	0.0798	U	0.263	U	0.245	U	0.213	J	0.35	U
PCB-079	1.45		0.812		1.48		1.05		1.81		3.77	
PCB-080	0.175	U	0.365	J	0.258	U	0.213	U	0.188	U	0.343	U
PCB-081	0.432		0.275	J	0.643		0.29	J	0.439	U	0.615	
PCB-082	13.7		7.93		14.6		12.8		16.6		27.5	
PCB-083/099	70.3		45.1		65.3		61.6		78.2		158	
PCB-084	20.8		15.4		20.9		22		25.2		64.9	
PCB-085/116/117	20.6		13.1		20.6		17		22.8		46.2	
PCB-087/097/108/119/125	67		44.4		63.9		57.7		74		174	
PCB-088/091	12.7		9.09		13.3		13		16.4		35.7	
PCB-089	0.921		0.612		1.2		0.87		1.08		2.62	J
PCB-090/101/113	92.8		63.7		91.8		86.1		108		265	
PCB-092	18		11.6		16.5		16.1		20.1		49	
PCB-093/095/098/100/102	63.9		45.5		62.5		60.6		72.8		188	
PCB-094	0.453	U	0.308	U	0.404	U	0.402		0.424		1.1	
PCB-096	0.527		0.329	U	0.597		0.496	U	0.605		1.26	
PCB-103	1.14		0.891		1.27		1.18		1.56		3.4	
PCB-104	0.048	U	0.049	U	0.0816	U	0.0543	U	0.072	U	0.068	J
PCB-105	44.8		27.2		44.5		37.7		51.3		103	
PCB-106	0.282	U	0.165	U	0.489	U	0.158	U	0.291	U	0.385	U
PCB-107/124	4.53		2.74		3.9		3.8		5.08		11.3	
PCB-109	9.46		5.82		9.17		7.27		10.5		21.9	
PCB-110/115	114		68.6		104		98.5		136		311	
PCB-111	0.21	J	0.15	J	0.171	U	0.121	U	0.219	J	0.204	U
PCB-112	0.252	U	0.0612	U	0.21	U	0.0654	U	0.261	J	0.387	
PCB-114	2.34		1.44		2.45		2.09		2.72		5.7	
PCB-118	104		64.2		101		89.1		126		256	
PCB-120	0.747		0.395		0.762		0.509	U	0.728	U	1.07	U
PCB-121	0.102	U	0.067	U	0.156	U	0.0716	U	0.107	U	0.092	U
PCB-122	1.57		0.844		1.4		1.34		1.62		3.46	
PCB-123	2.4		1.62		2.09		2.24		2.78		4.7	
PCB-126	0.735		0.487		0.848		0.446		0.732	U	1.37	
PCB-127	0.302	U	0.17	U	0.521	U	0.182	U	0.289	U	0.547	
PCB-128/166	23.1		0.236	UJ	23.2		0.474	U	28.9		75.7	
PCB-129/138/160/163	132		85.6		136		122		155		386	
PCB-130	7.44		5.42	UJ	9		8.37	U	9.09		20.2	
PCB-131	1.19	J	0.975	J	1.44	U	1.59	U	1.06	U	4.07	U
PCB-132	36		25.3		44.1		35.9		38		99.8	
PCB-133	1.32	U	1.48	U	2.64		2.48	U	1.88	U	5.55	
PCB-134/143	4.78		2.77	UJ	6.15		5.32	J	5.41	U	13.9	
PCB-135/151/154	27.6		19.5		37.6		30.2		32.2		74.9	
PCB-136	9.39		6.08		12.2		9.4		10.5		26.7	
PCB-137	5.44		3.81	J	6.67		6.07	U	7.99		17.5	
PCB-139/140	1.7	J	1.6	J	2.81		2.3	J	1.84	J	6.29	
PCB-141	13.5		11.3		16.3		16.7		17.3		43.4	
PCB-142	0.644	U	0.262	U	0.476	U	0.526	U	0.688	U	0.755	U
PCB-144	3.42		2.57	J	4.56		3.62	J	4.03		10.3	
PCB-145	0.056	U	0.185	U	0.158	U	0.072	U	0.127	U	0.173	U
PCB-146	19.3		11.7		23.3		14.9		19.2		43.8	
PCB-147/149	74.2		47.4		98.4		73.8		95.5		203	
PCB-148	0.323	U	0.223	U	0.339	J	0.259	U	0.518	J	1.11	U
PCB-150	0.278	U	0.049	U	0.329	U	0.0501	U	0.311	U	0.852	J
PCB-152	0.049	U	0.049	U	0.142	U	0.0501	U	0.127	U	0.0469	U
PCB-153/168	96.8		67.6		115		91.2		109		244	
PCB-155	0.138	U	0.065	U	0.0901	U	0.075	U	0.126	U	0.212	J
PCB-156/157	14.3		8.69		12.7		12.3		17.5		39	
PCB-158	10.7		6.99	U	11.6		10.3		12.8		37.3	
PCB-159	1.13	U	0.642	U	1.27	U	1.29	J	1.65	J	3.17	J
PCB-161	0.463	U	0.184	U	0.33	U	0.371	U	0.494	U	0.5	U
PCB-162	0.616	U	0.267	U	0.641		0.48	U	0.659	U	1.44	J

Location ID	BB-13-S	Q	BB-14-S	Q	BB-15-S	Q	BB-16-S	Q	BB-17-S	Q	BB-18-S	Q
Date/Time	**9/9/2014**	**1423**	**9/11/2014**	**853**	**9/9/2014**	**915**	**9/11/2014**	**1044**	**9/9/2014**	**1524**	**9/9/2014**	**1042**
PCB-164	6.62	U	5.87	U	7.52		7.71		7.96		20.4	
PCB-165	0.545	U	0.205	U	0.392	U	0.413	U	0.582	U	0.579	U
PCB-167	5.01		3.23		4.47		4.27		6.13		13.6	
PCB-169	0.518	U	0.289	U	0.285	U	0.406	U	0.604	U	1.01	U
PCB-170	24.2		14.9		24.1		20.5		28		60	
PCB-171/173	8.23		5.28		8.13		6.96		9.01		21.2	
PCB-172	4.51		2.9		4.17	U	3.84		5.52		11.2	
PCB-174	22.8		15.6		23.5		23.1		28.1		67.2	
PCB-175	1.38		0.836	U	1.37		1.21		1.66		3.56	
PCB-176	3.43		2.33		3.68		3.4		4.15		10.5	
PCB-177	16.7		11		17.4		14.7		20.1		40.1	
PCB-178	7.82		4.97		7.7		6.33		8.15		20.3	
PCB-179	12.5		7.85		13.5		11.6		15.3		36.9	
PCB-180/193	49.9		31		48		41.6		58.6		137	
PCB-181	0.301	J	0.259	U	0.274	U	0.31	U	0.372	J	0.853	
PCB-182	0.368	J	0.277	U	0.3	U	0.285	U	0.373	J	1.11	
PCB-183/185	19.2		12.9		19.5		18.3		22.2		59.3	
PCB-184	0.215	J	0.115	U	0.228	J	0.111	U	0.232	U	0.215	J
PCB-186	0.0896	U	0.0601	U	0.162	U	0.102	U	0.0948	U	0.083	U
PCB-187	41.7		28.2		46		35.6		47.8		125	
PCB-188	0.228	U	0.146	J	0.17	U	0.166	U	0.237	J	0.762	
PCB-189	1.06		0.703		1.09		0.994		1.31		2.61	
PCB-190	4.49	U	2.49	J	4.73		4.29	J	5.38		14.5	
PCB-191	0.988		0.641		0.888		0.858		1.22		2.78	
PCB-192	0.0863	U	0.0582	U	0.153	U	0.0975	U	0.09	U	0.0783	U
PCB-194	15.9		10.2		16.4		12.3		16.5		50.5	
PCB-195	5.74		3.26		5.43		4.47		6.34		15.6	
PCB-196	8.28		5.07		8.81		6.69		9.55		27.4	
PCB-197/199	3.17		1.9		3.33		2.51		3.93		10.8	
PCB-198/201	24.5		15.2		30.5		18.4		28.9		84	
PCB-200	3.15		1.62		3.14		2.28		3.27		9.14	
PCB-202	5.97		3.6		6.31		4.47		6.53		18.9	
PCB-203	12.7		8.51		13.2		11.4		15.4		45.7	
PCB-204	0.056	U	0.09	U	0.171	U	0.126	U	0.0495	U	0.0469	U
PCB-205	0.757		0.405		0.877		0.578	U	0.906		1.96	
PCB-206	19.9		9.7		19.1		12.4		16.8		46.2	
PCB-207	3.21		1.53	U	2.72	U	2.13	J	2.54	U	6.7	
PCB-208	8.56		4.14		8.23		5.53		7.81		22.3	
PCB-209	43.5		11.5		19.8		14.8		21.8		54	
Total PCBs*	2700		1600		3830		2380		3290		6030	
PCB TEQ (0 DL)	0.0798		0.0526		0.0915		0.0499		0.00731		0.151	
PCB TEQ (1/2 DL)	0.0876		0.0569		0.0957		0.0560		0.0530		0.167	
PCB TEQ (1 DL)	0.0954		0.0612		0.100		0.0621		0.0988		0.182	
PCB TEQ (KM)	0.0805		0.0530		0.0922		0.0505		0.0814	L	0.153	

*total PCBs represents the sum of all detected congeners

U-the analytie was analyzed for, but was not detected above the reported sample quantitation limi

J-the analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sampl

UJ-the analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate

L-the detection frequency of compounds within a sample was <50%, the numeric value indicates the number of non-detect

KM-Kaplan-Meier DW-dry weight Q-qualifier TEQ-toxicity equivalent DL-detection limit Avg-average of field duplicate

Table F-3. Summary of Bellingham Bay Polychlorinated Biphenyl (PCB) Congener Data (continued).

Location ID	BB-19-S	Q	BB-20-S	Q	BB-20-D	Q	BB-21-S	Q	BB-22-S	Q	BB-23-S	Q
Date/Time	9/9/2014	1326	9/10/2014	1530	9/10/2014	1530	9/9/2014	1453	9/9/2014	1026	9/10/2014	942
PCB Congeners (ng/kg DW)												
PCB-001	50.9		19.6		14.9		28.7		67.2	J	90.7	
PCB-002	30.6		13.3		9.68		17.7		43.1	J	30.8	
PCB-003	51.3		21.8		19.7		37.1		73.4	J	98.7	
PCB-004	26.6		11		9.65		8.09		32.1		99.3	
PCB-005	1.73		0.718		0.743		1.11		2.55		4.95	
PCB-006	36.1		15.7		13		10.7		31.3		154	
PCB-007	4.88		2.72		2.12		3.54		8.03		14.4	
PCB-008	109		44.4		37.7		53		139		357	
PCB-009	4.34		2.24		1.8		2.22		5.59		14.2	
PCB-010	0.848		0.44		0.366	J	0.359	J	1.1		3.29	
PCB-011	37.7		28.6		25		40.8		51.3		48.5	
PCB-012/013	26.7		12.9		10.8		13.5		30.5		90.7	
PCB-014	1.24		0.555	U	0.491		1.19		2.3		1.25	
PCB-015	92.1		51.7		43.8		70.5		154		259	
PCB-016	26.8		11.2		9.89		10.4		47.5		102	
PCB-017	49.1		20.3		17.8		16.6		76.6		200	
PCB-018/030	97.8		33.2		28.5		28.8		121		358	
PCB-019	10.1		3.98		3.33		2.53		13		39.2	
PCB-020/028	224		135		111		111		351		863	
PCB-021/033	79		45		40.6		45.8		122	J	307	
PCB-022	60		34.9		30.6		30.1		98.3		221	
PCB-023	0.381	J	0.422	U	0.53	U	0.251	J	0.603	J	0.623	
PCB-024	1.28		0.461		0.385	J	0.485		1.64		4.13	
PCB-025	36.5		16.7		13.6		11		32.4		155	
PCB-026/029	74.7		32.2		27.6		21.7		67.7		315	
PCB-027	13.3		4.51		3.85		3.17		13.9		52.9	
PCB-031	224		99.3		80.1		86.3		253		836	
PCB-032	34.5		15.9		13.8		12		45.1	J	140	
PCB-034	1.29		0.701		0.537		0.725		1.52		5.31	
PCB-035	5.82		4.31		3.51		5.14		10.6		14.7	
PCB-036	1.41		1.04		0.761		2.02		2.19		1.29	
PCB-037	45.9		32.7		26.7		29		78.9		166	
PCB-038	0.771		0.654		0.454		0.888	U	1.43		1.31	
PCB-039	1.32		0.872		0.658		0.985		2.55		4.54	
PCB-040/041/071	74		35.6		29.2		31.6		129		246	
PCB-042	33.8		17.1		14		15.2		62.9		119	
PCB-043	4.05		2.17		1.74		1.83		6.59		16.5	
PCB-044/047/065	146		66.4		55.6		57.7		245		493	
PCB-045/051	22.4		8.7		7.76		6.46		35		87.1	
PCB-046	6.74		2.79		2.26		2.31		11.6		23.8	
PCB-048	20.6		11.6		9.16		10.1		41.6		77.4	
PCB-049/069	129		54.5		44.4		43.8		173		458	
PCB-050/053	25		9.24		7.52		6.37		32.9		94.5	
PCB-052	234		91.6		78.9		73.4		309		738	
PCB-054	0.522		0.189	J	0.161	U	0.12	J	0.524		1.91	
PCB-055	3.71		1.92		1.46		1.81		4.98		13.4	
PCB-056	64.3		40.4		30.3		35.5		112		218	
PCB-057	1.23		0.601		0.479		0.454		1.29		4.03	
PCB-058	0.81	U	0.165	U	0.21	U	0.433	U	1.11		2.59	
PCB-059/062/075	14.5		6.9		5.73		5.86		23.4		50.8	
PCB-060	33.5		22.5		16.4		20.5		64.2		104	
PCB-061/070/074/076	297		168		131		148		490		941	
PCB-063	6.16		3.92		2.94		3.47		9.76		23.1	
PCB-064	59.7		27.6		22.6		24.8		101		196	
PCB-066	157		90		68.6		81.1		247		544	
PCB-067	5.2		3.52		2.67		2.84		8.66		21.3	
PCB-068	1.69		1.11		0.841		0.974		2.32		6.32	
PCB-072	2.86		1.62		1.2		1.28		3.59		11.3	
PCB-073	1.39		0.0545	U	0.049	U	0.344	J	0.583		5.05	

Location ID	BB-19-S	Q	BB-20-S	Q	BB-20-D	Q	BB-21-S	Q	BB-22-S	Q	BB-23-S	Q
Date/Time	9/9/2014	1326	9/10/2014	1530	9/10/2014	1530	9/9/2014	1453	9/9/2014	1026	9/10/2014	942
PCB-077	15.8		10.5		8.22		11.9		25.5		45.9	
PCB-078	0.288	U	0.178	U	0.226	U	0.305	U	0.617	U	0.925	U
PCB-079	3.49		1.92		1.84		1.83		6.13		8.3	
PCB-080	0.253	U	1.11	J	0.193	UJ	0.268	U	0.55	U	0.883	U
PCB-081	0.608	U	0.504		0.401		0.511		1.14	U	1.73	
PCB-082	31		15.7		14.3		13.1		43.7		62.8	
PCB-083/099	178		73.9		64.6		75.4		266		420	
PCB-084	68.8		24.7		23.3		20.7		104		157	
PCB-085/116/117	50.3		22.1		18.7		22.3		77.3		106	
PCB-087/097/108/119/125	184		72.5		64.5		69.8		275		365	
PCB-088/091	45		15.2		13.4		13.3		58		109	
PCB-089	2.43		0.881		0.802		0.935		3.64		5.89	
PCB-090/101/113	245		108		96		101		414		568	
PCB-092	47.1		19.8		17.8		19.1		74.1		109	
PCB-093/095/098/100/102	201		71.7		65.2		64.4		325		448	
PCB-094	1.13		0.514		0.392	U	0.453		1.61		2.56	
PCB-096	1.79		0.594		0.469		0.483		2.26		4.72	
PCB-103	3.42		1.52		1.31		1.25		5.08		10.3	
PCB-104	0.142	J	0.0543	U	0.049	U	0.0512	U	0.111	U	0.469	
PCB-105	97.4		53.4		45.8		48.8		164	J	223	
PCB-106	0.287	U	0.244	U	0.205	U	0.277	U	0.355	U	1.27	U
PCB-107/124	10.1		5.97		4.95		4.98		16		21.7	
PCB-109	20.5		12.7		10.7		10.4		30.2		49.9	
PCB-110/115	329		128		113		120		480		744	
PCB-111	0.15	U	0.176	J	0.083	U	0.176	J	0.437		0.395	J
PCB-112	0.553		0.0548	U	0.0684	U	0.361	J	0.121	U	1.96	
PCB-114	5.51		2.95		2.57		2.55		8.02		13	
PCB-118	244		130		111		114		384		607	
PCB-120	0.728	U	0.726	U	0.495		0.834	U	1.77		2.2	
PCB-121	0.14	U	0.0555	U	0.0693	U	0.087	U	0.195	U	0.191	U
PCB-122	3.28		1.82		1.72		1.66		5		7.56	
PCB-123	5.16		2.65		2.28		2.4		7.76	U	12.1	
PCB-126	1.1		0.693		0.625		0.968		2		1.74	
PCB-127	0.445		0.246	U	0.207	U	0.31	J	0.882		1.26	U
PCB-128/166	58		0.759	UJ	24.7	J	25.7		75		133	
PCB-129/138/160/163	346		162		142		139		465		877	
PCB-130	22.6		10.9		8.79		8.38	U	29.4		48.5	
PCB-131	5.01		1.72	J	1.51	J	1.15	U	4.95		9.06	
PCB-132	116		45.9		45.3		37.9		120	J	244	
PCB-133	3.53		1.82	U	1.84	J	1.83	J	7.09		7.77	
PCB-134/143	19.2		7.71		6.86		5.84		19.5		40.4	
PCB-135/151/154	83.6		39.3		35.6		31.4		127		193	
PCB-136	35.3		11.5		11.3		9.51		42.8		78	
PCB-137	17.7		8.09		7.69		5.28		22.4		34.3	
PCB-139/140	7.22		2.52	J	2.51	J	1.87	J	7.84		14.3	
PCB-141	43.3		22.1		19.1		14.9		63		96.8	
PCB-142	0.409	U	0.842	U	0.508	U	0.678	U	0.36	U	2.04	U
PCB-144	11		4.68	J	4.46	J	3.87	J	16.5		23.6	
PCB-145	0.163	J	0.104	U	0.286	U	0.153	U	0.191	J	0.484	U
PCB-146	35.2		21.2		20		20.7		62.9		87.8	
PCB-147/149	269		91.9		81.7		77.4		301		641	
PCB-148	0.546		0.379	U	0.291	U	0.349	U	1.19	U	1.16	U
PCB-150	1.27		0.284	U	0.054	U	0.266	U	1.24		2.88	
PCB-152	0.346	J	0.0484	U	0.173	U	0.107	U	0.422		0.523	U
PCB-153/168	205		130		111		110		373		511	
PCB-155	0.222	U	0.09	J	0.058	U	0.113	U	0.214	U	0.306	J
PCB-156/157	34.2		18.2		16.2		15.1		52.5		76.8	
PCB-158	33.1		14.1		12.9		11.7	U	41.6		67.1	
PCB-159	2.55		1.43	U	1.35	J	1.35	U	3.62		6.92	
PCB-161	0.28	U	0.593	U	0.379	U	0.488	U	0.247	U	1.47	U
PCB-162	1.22		0.67	U	0.658	U	0.65	U	1.84		1.95	U

Location ID	BB-19-S	Q	BB-20-S	Q	BB-20-D	Q	BB-21-S	Q	BB-22-S	Q	BB-23-S	Q
Date/Time	9/9/2014	1326	9/10/2014	1530	9/10/2014	1530	9/9/2014	1453	9/9/2014	1026	9/10/2014	942
PCB-164	22		9.93		8.36		7.14		28		51.2	
PCB-165	0.331	U	0.661	U	0.432	U	0.574	U	0.343	J	1.73	U
PCB-167	11.6		6.28		5.54		5.61		17.7		26.9	
PCB-169	0.31	U	0.653	U	0.443	U	0.52	U	0.562	U	1.43	U
PCB-170	46.6		30.8		26.4		29.7		84.7		115	
PCB-171/173	22		9.95		8.21		10		26.5		46.9	
PCB-172	8.7		6.51		5		5.71		14.7		20.5	
PCB-174	57.4		26.7		22.6		30		82		142	
PCB-175	2.49		1.4		1.16		1.49		4.39		5.82	
PCB-176	8.86		3.69		3.24		4.74		0.0487	U	22.7	
PCB-177	41.5		18.8		15.7		20.9		51.8		96.3	
PCB-178	12.2		7.42		6.34		9.81		22.2		29.6	
PCB-179	32.6		11.9		10.1		16.1		39.3		80.6	
PCB-180/193	92.9		61.8		51.7		63.6		191		230	
PCB-181	1.04	U	0.355	J	0.351	J	0.411		1.06		2.36	
PCB-182	0.499		0.326	U	0.288	J	0.343	J	1.13		1.17	
PCB-183/185	36.7		22.2		18.4		24.7		70.8		88.7	
PCB-184	0.198	J	0.125	U	0.101	U	0.309	J	0.378	J	0.359	J
PCB-186	0.101	U	0.0751	U	0.0625	U	0.0686	U	0.0487	U	0.19	U
PCB-187	75.6		43.8		35.7		52.7		124		181	
PCB-188	0.498		0.186	U	0.141	U	0.222	J	0.781		1.23	
PCB-189	1.97		1.4		1.11		1.25		3.66		5.03	
PCB-190	12.6		5.52	J	5.19	J	5.74		17		30.4	
PCB-191	2.13		1.36		1.12		1.19		3.45		5.01	
PCB-192	0.097	U	0.0952	U	0.0792	U	0.0661	U	0.0487	U	0.18	U
PCB-194	29		22.6		17.8		20.1		66.3		71.7	
PCB-195	12.4		7.73		6.59		7.77		21.2		31	
PCB-196	14.9		10.4		8.26		10.8	J	34.1		35.3	
PCB-197/199	5.74		3.36		2.83		4.32		10.5	J	14.9	
PCB-198/201	41.9		29.3		20.7		30.7		92.8		95.3	
PCB-200	4.31		3.26		2.57		3.89		11.4		9.88	
PCB-202	10.9		6.12		4.85		7.05		24.1		23.1	
PCB-203	23.3		17.6		11.8		16.4		57.6		53.4	
PCB-204	0.0863	U	0.121	U	0.229	U	0.131	U	0.158	U	0.147	U
PCB-205	1.25		0.96		0.756		1.03		2.95		3.49	
PCB-206	24.1		19.2		13.4		16		82.7		101	J
PCB-207	3.3		2.59	J	1.63	J	2.46	J	10.6		17.3	J
PCB-208	13.6		8.37		6.16		7.4		30.2		35.4	
PCB-209	45.3		20.3		15		19.7		63.2		135	
Total PCBs*	6670		3180		2720		2940		10000		18700	
PCB TEQ (0 DL)	0.124		0.0769		0.0690		0.104		0.221		0.208	
PCB TEQ (1/2 DL)	0.128		0.0867		0.0756		0.112		0.230		0.229	
PCB TEQ (1 DL)	0.133		0.0965		0.0823		0.119		0.239		0.251	
PCB TEQ (KM)	0.125		0.0737	Avg	--		0.105		0.224		0.212	

*total PCBs represents the sum of all detected congeners
U-the analytie was analyzed for, but was not detected above the reported sample quantitation limi
J-the analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sampl
UJ-the analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate
L-the detection frequency of compounds within a sample was <50%, the numeric value indicates the number of non-detect
KM-Kaplan-Meier DW-dry weight Q-qualifier TEQ-toxicity equivalent DL-detection limit Avg-average of field duplicates

Table F-3. Summary of Bellingham Bay Polychlorinated Biphenyl (PCB) Congener Data (continued).

Location ID	BB-24-S	Q	BB-24-D	Q	BB-25-S	Q	BB-26-S	Q	BB-27-S	Q
Date/Time	9/9/2014	1353	9/9/2014	1353	9/11/2014	950	9/10/2014	1012	9/11/2014	923
PCB Congeners (ng/kg DW)										
PCB-001	83.2		67.9		68.6		38		9	
PCB-002	35.2		29.8		25.3		14		6.32	
PCB-003	80.8		72.7		73.4		38		9.96	
PCB-004	15.7		13.9		42.9		31.6		4.52	
PCB-005	1.73		2.16	U	3.85		1.64		0.352	J
PCB-006	15.8		12.4		49		36.7		5.09	
PCB-007	6.61		5.14		9		5.36		1.16	U
PCB-008	90.9		81.9		188		107		18.5	
PCB-009	3.51		2.82	J	7.85		4.44		0.971	
PCB-010	0.525		1.89	U	1.69		1.24		0.17	U
PCB-011	43.4		41.2		37.6		27.1		17.1	
PCB-012/013	17.5		15.4		31		22.9		4.74	
PCB-014	1.99	U	2.03	U	1.16	U	0.741	U	0.253	U
PCB-015	104		107		139		79.5		20.5	
PCB-016	12.6		12.2		56.2		33.7		5.05	
PCB-017	20.1		20.2		96.3		56.1		8.85	
PCB-018/030	33.1		33.2		149		112		14.4	
PCB-019	3.28		3.09		14.7		10.8		1.64	
PCB-020/028	125		118		476		231		48.2	
PCB-021/033	45.4		43.1		195		93.9		16.6	
PCB-022	32.5		32		148		64.6		14	
PCB-023	0.535		0.462		0.497		0.272	J	0.086	U
PCB-024	0.566		0.418		2.6		1.43		0.193	J
PCB-025	13.1		12.6		45.1		35.2		5.19	
PCB-026/029	26.2		26.1		99.4		69.4		11.2	
PCB-027	4.3		4.19		16.6		13		1.85	
PCB-031	96.1		92.6		392		200		34.8	
PCB-032	14.4		14.3		75.9		42.4		6.29	
PCB-034	0.804		0.764		2.97		1.39		0.282	U
PCB-035	5.83		5.6		10.2		5.08		1.6	
PCB-036	2.02		1.86		1.1		0.828		0.477	
PCB-037	30.2		29		97		44.6		12.6	
PCB-038	0.922	U	0.952		0.922		0.577		0.262	U
PCB-039	1.1		1.08		2.68		1.38		0.316	J
PCB-040/041/071	36.7		34.3		139		75.7		17	
PCB-042	17		16.6		68.7		36.2		7.57	
PCB-043	2.03		2.18		11.3		5.36		1.3	
PCB-044/047/065	67.2		64.8		288		145		32.5	
PCB-045/051	8.59		7.65		37.8		24.3		4.27	
PCB-046	2.65		2.62		11.4		6.92		1.31	
PCB-048	11.3		11		52.3		24.1		5.21	
PCB-049/069	52.3		48.9		228		121		24	
PCB-050/053	8.5		7.76		34.4		24.5		4.2	
PCB-052	91.6		82.4		401		210		42.1	
PCB-054	0.181	J	0.186	J	0.616	U	0.457		0.0732	U
PCB-055	2.23		2.18		6.82		3.98		0.855	
PCB-056	38.7		36		136		67.2		15.2	
PCB-057	0.687		0.557		1.89		1.07		0.227	J
PCB-058	0.473		0.356	U	0.413	U	0.682		0.177	U
PCB-059/062/075	7.06		6.59		28.3		14.6		3.11	
PCB-060	22.2		20.4		70.3		35.5		8.89	
PCB-061/070/074/076	163		152		598		291		66	
PCB-063	3.73		3.42		13.3		6.97		1.37	
PCB-064	28.5		27.3		114		57.8		13	
PCB-066	86.5		81.2		294		153		33.2	
PCB-067	3.21		3.13		11.7		6.18		1.32	
PCB-068	1.16		1.12		3.23		1.92		0.386	J
PCB-072	1.55		1.46		5.6		3.33		0.583	
PCB-073	0.439	U	0.353	U	0.0379	U	1.16		0.073	U

Location ID	BB-24-S	Q	BB-24-D	Q	BB-25-S	Q	BB-26-S	Q	BB-27-S	Q
Date/Time	9/9/2014	1353	9/9/2014	1353	9/11/2014	950	9/10/2014	1012	9/11/2014	923
PCB-077	11.6		10.9		27.4		13		4.18	
PCB-078	0.342	U	0.35	U	0.407	U	0.486	U	0.175	U
PCB-079	2.07		2.04		5.75		2.79		0.76	
PCB-080	0.155	U	0.307	U	0.378	U	0.464	U	0.162	U
PCB-081	0.604		0.516	U	1.01		0.56	U	0.186	J
PCB-082	15.3		13.9		51.6		25.5		6.95	
PCB-083/099	89.5		79.7		313		142		37.5	
PCB-084	26.2		22.9		123		53.4		15.8	
PCB-085/116/117	25.8		22.5		80.4		40.2		11	
PCB-087/097/108/119/125	82.7		72.4		319		134		39.1	
PCB-088/091	16.8		14.8		68.5		33		8.25	
PCB-089	1.3		1.05		4.65		1.98		0.708	
PCB-090/101/113	121		107		508		204		57.2	
PCB-092	22.8		20.1		91.4		38.1		10.9	
PCB-093/095/098/100/102	79.2		71.4		356		152		44.7	
PCB-094	0.533		0.596		2.14		0.864		0.255	J
PCB-096	0.669		0.546		2.65		1.21		0.327	J
PCB-103	1.75		1.53		7.05		3.1		0.747	
PCB-104	0.068	U	0.0486	U	0.085	J	0.12	J	0.0586	U
PCB-105	54		47.8		176		79.9		22.1	
PCB-106	0.22	J	0.272	U	0.624	U	0.43	U	0.237	U
PCB-107/124	5.51		5.07		19.1		8.33		2.5	
PCB-109	10.9		10.3		38.8		16		4.81	
PCB-110/115	145		124		514		259		61.2	
PCB-111	0.19	J	0.247	J	0.461		0.126	J	0.103	U
PCB-112	0.318	U	0.188	U	0.12	U	0.742		0.0984	U
PCB-114	3.09		2.56		9.56		4.46		1.22	
PCB-118	131		116		446		199		52.4	
PCB-120	0.868		0.833		2.28		0.869		0.323	J
PCB-121	0.126	U	0.107	U	0.131	U	0.095	U	0.108	U
PCB-122	1.97		1.62		5.51		2.81		0.685	
PCB-123	2.96		2.56		7.73		4.44		0.998	
PCB-126	1.06		0.782		1.42		0.655		0.252	U
PCB-127	0.321	J	0.291	U	0.643	U	0.426	U	0.245	U
PCB-128/166	35.8		25.6		95.2		44.3		0.789	U
PCB-129/138/160/163	176		142		581		261		68.6	
PCB-130	9.99		8.87		38.1		14.8		4.7	J
PCB-131	1.43	J	0.944	J	1.4	U	3.22	U	0.824	U
PCB-132	46.7		37.9		178		72		20.8	
PCB-133	2.51	U	1.85	U	7.7		2.96	U	0.976	U
PCB-134/143	6.32		5.04	U	27.5		11.2		3.22	J
PCB-135/151/154	43		30.7		136		58		16.2	
PCB-136	12.2		10.3		46.8		22.4		6.19	
PCB-137	7.24		5.21		24.9		12		3.36	J
PCB-139/140	2.78		1.92	J	8.77		4.21		0.917	U
PCB-141	21.5		16.1		79.7		28.6		9.17	
PCB-142	0.406	U	0.802	U	1.33	U	0.592	U	0.875	U
PCB-144	5.48		3.61	J	20		7.12		2.21	J
PCB-145	0.101	U	0.083	J	0.0379	U	0.169	J	0.051	U
PCB-146	26.4		20.3		77.7		30.3		9.44	
PCB-147/149	112		84.1		360		165		40	
PCB-148	0.586	U	0.269	U	0.926	J	0.499	U	0.261	U
PCB-150	0.356	U	0.346	U	0.0379	U	0.609	U	0.051	U
PCB-152	0.053	J	0.133	U	0.332	U	0.124	U	0.139	U
PCB-153/168	149		111		449		176		55.2	
PCB-155	0.124	U	0.128	J	0.122	J	0.085	U	0.0669	U
PCB-156/157	17.5		15.5		60.4		26.7		7.57	
PCB-158	15.3		12.1		55.1		21.1		6.04	J
PCB-159	3.45	UJ	1.36	J	5.01		2.26		0.685	U
PCB-161	0.292	U	0.577	U	0.997	U	0.426	U	0.617	U
PCB-162	0.588	J	0.768	U	1.87	J	0.812	J	0.696	U

Location ID	BB-24-S	Q	BB-24-D	Q	BB-25-S	Q	BB-26-S	Q	BB-27-S	Q
Date/Time	9/9/2014	1353	9/9/2014	1353	9/11/2014	950	9/10/2014	1012	9/11/2014	923
PCB-164	9.84		7.86		39.2		14.4		3.6	J
PCB-165	0.343	U	0.679	U	1.14	U	0.501	U	0.687	U
PCB-167	6.2		5.58		21		8.66		2.54	
PCB-169	1.59	U	0.666	U	1.1	U	0.469	U	0.7	U
PCB-170	40.3		29.1		98.4		41.1		13.4	
PCB-171/173	14.3		9.88		37		13.2		4.65	
PCB-172	8.71		5.78		19.2		7.42		2.66	
PCB-174	56.4	J	29.5	J	106		40.1		13.2	
PCB-175	2.8	J	1.62	J	5.72		2.28		0.809	
PCB-176	8.73	J	4.52	J	15.6		6.16		2.06	
PCB-177	31		19.6		66.4		25.4		9.4	
PCB-178	16.5	J	9.44	J	26.2		10.4		3.94	
PCB-179	33.5	J	15.4	J	44.6		22.2		6.26	
PCB-180/193	141	J	63.1	J	208		77.9		28.2	
PCB-181	0.43		0.373	J	1.56		0.659		0.182	J
PCB-182	0.533		0.452		1.08		0.471		0.209	U
PCB-183/185	55.6	J	24.2	J	86.1		30.4		11.4	
PCB-184	0.331	J	0.272	J	0.252	J	0.197	J	0.113	U
PCB-186	0.0898	U	0.0756	U	0.078	U	0.124	U	0.104	U
PCB-187	122	J	53.2	J	155		61.6		22.9	
PCB-188	0.347	J	0.319	J	0.547		0.338	U	0.153	U
PCB-189	1.56		1.39	U	4.5		1.77		0.601	
PCB-190	8.93		6.53		19.7		8.07		2.59	U
PCB-191	1.91		1.22		4.74		1.73		0.544	
PCB-192	0.0865	U	0.0728	U	0.0639	U	0.118	U	0.101	U
PCB-194	81.9	J	22.4	J	58.5		22.6		10.8	
PCB-195	22.2	J	8.11	J	20.5		8.52		3.28	
PCB-196	44.3	J	11.7	J	26.8		12.3		5.29	
PCB-197/199	17.5	J	4.66	J	11.3		4.85		1.75	
PCB-198/201	130	J	32.4	J	79.8		34.4		14.6	
PCB-200	16.9	J	4.29	J	9.74		4.11	U	1.69	
PCB-202	29.7	J	7.81	J	18.7		8.33		3.33	
PCB-203	95.9	J	19.8	J	49.1		20		9.05	
PCB-204	0.132	U	0.264	U	0.071	U	0.0517	U	0.056	U
PCB-205	2.82	J	1.08	J	2.66		1.05		0.408	
PCB-206	92.3	J	21.5	J	36.3		21.9		12.3	
PCB-207	15	J	3.67	J	5.9		2.83		1.71	J
PCB-208	28.8	J	8.54	J	22.9		11.5		4.9	
PCB-209	34.9	J	19.8	J	51		34.4		13.3	
Total PCBs*	4340		3250		11900		5680		1410	
PCB TEQ (0 DL)	0.114		0.0850		0.167		0.0765		0.0031	
PCB TEQ (1/2 DL)	0.138		0.0951		0.183		0.0837		0.0262	
PCB TEQ (1 DL)	0.162		0.105		0.200		0.0908		0.0493	
PCB TEQ (KM)	0.100	Avg	--		0.170		0.0779		0.0286	L

*total PCBs represents the sum of all detected congeners

U-the analytie was analyzed for, but was not detected above the reported sample quantitation limi

J-the analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sampl

UJ-the analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate

L-the detection frequency of compounds within a sample was <50%, the numeric value indicates the number of non-detect

KM-Kaplan-Meier DW-dry weight Q-qualifier TEQ-toxicity equivalent DL-detection limit Avg-average of field duplicate

Table F-3. Summary of Bellingham Bay Polychlorinated Biphenyl (PCB) Congener Data (continued).

Location ID	BB-28-S	Q	BB-29-S	Q	BB-30-S	Q
Date/Time	9/9/2014	1129	9/11/2014	1103	9/9/2014	1507
PCB Congeners (ng/kg DW)						
PCB-001	63.5		26.9		36.3	J
PCB-002	37		16.6		18.5	J
PCB-003	58.2		30.4		41.1	J
PCB-004	37		15.9		10.1	
PCB-005	2.15	J	0.842	U	1.06	
PCB-006	42.8		22.8		12	
PCB-007	7.96		3.14		3.46	
PCB-008	174		68		53.7	
PCB-009	7.59		2.67		2.1	
PCB-010	2.07	U	0.541	J	0.359	J
PCB-011	41.6		27		32.2	
PCB-012/013	28.2		16.9		11.3	
PCB-014	2.64	J	0.587	U	0.922	
PCB-015	141		65.1		66.5	
PCB-016	63.4		14.1		10.4	
PCB-017	87.3		29		17.8	
PCB-018/030	190		53.4		29	
PCB-019	20.2		5.45		2.68	
PCB-020/028	490		141		91.6	
PCB-021/033	210		48.2		33.1	
PCB-022	133		34.8		24.4	
PCB-023	0.75	U	0.251	U	0.31	J
PCB-024	2.19		0.589	U	0.408	
PCB-025	46.2		19		10.5	
PCB-026/029	97.5		40.5		21	
PCB-027	21.2		6.49		3.54	
PCB-031	402		113		65.1	
PCB-032	84.9		21.3		10.2	
PCB-034	2.59	J	0.685	J	0.555	
PCB-035	15.5		3.34		3.99	
PCB-036	2.37		0.232	U	1.38	
PCB-037	110		33.3		25	
PCB-038	1.77	U	0.416	U	0.574	U
PCB-039	4.03		0.786	U	0.765	
PCB-040/041/071	198		42.7		28.6	
PCB-042	92.5		20.3		14.3	
PCB-043	13		2.58		1.67	
PCB-044/047/065	365		88.5		56.6	
PCB-045/051	53.4		11.5		7.23	
PCB-046	16.9		3.18		2.17	
PCB-048	59.3		12.7		9.09	
PCB-049/069	292		72.1		44.7	
PCB-050/053	49.6		12.6		7.1	
PCB-052	527		123		72.1	
PCB-054	0.82	U	0.27	U	0.201	J
PCB-055	9		0.806	U	1.41	
PCB-056	180		48.5		29.2	
PCB-057	2.23	U	0.719	U	0.421	
PCB-058	1.89	J	0.749	U	0.33	J
PCB-059/062/075	41.3		8.35		5.33	
PCB-060	104		25.8		15.8	
PCB-061/070/074/076	734		211		129	
PCB-063	15.2		4.18		2.63	
PCB-064	151		34.2		23	
PCB-066	386		110		68	
PCB-067	12.6		3.39		2.32	
PCB-068	2.99	U	0.998	J	0.784	
PCB-072	6.03		1.6	J	1.06	
PCB-073	3.84	U	0.0486	U	0.189	J

Location ID	BB-28-S	Q	BB-29-S	Q	BB-30-S	Q
Date/Time	9/9/2014	1129	9/11/2014	1103	9/9/2014	1507
PCB-077	37.5		9.65		10.1	
PCB-078	1.41	U	0.809	U	0.206	U
PCB-079	10.1		2.07		1.54	
PCB-080	1.33	U	0.737	U	0.183	U
PCB-081	1.63	U	0.744	U	0.43	U
PCB-082	69.4		16.7		9.41	
PCB-083/099	387		110		68.3	
PCB-084	169		37		22.9	
PCB-085/116/117	123		28.7		20.3	
PCB-087/097/108/119/125	423		102		69.5	
PCB-088/091	92.9		23		14.2	
PCB-089	8.14		1.6	J	0.965	
PCB-090/101/113	670		165		104	
PCB-092	118		28		18.4	
PCB-093/095/098/100/102	519		108		76.3	
PCB-094	3.08		0.477	U	0.329	J
PCB-096	3.86		0.727	U	0.52	
PCB-103	7.25		1.86	U	1.27	
PCB-104	0.112	J	0.093	U	0.123	U
PCB-105	245		60.9		48.5	
PCB-106	0.714	U	0.462	U	0.241	U
PCB-107/124	26		5.62		4.73	
PCB-109	54.9		12.2		8.92	
PCB-110/115	739		186		125	
PCB-111	0.541	U	0.141	U	0.167	U
PCB-112	0.963		0.135	U	0.0851	U
PCB-114	13.5		3.14		2.17	
PCB-118	601		164		114	
PCB-120	2.75		0.691	J	0.667	U
PCB-121	0.198	J	0.135	U	0.0844	U
PCB-122	8.37		1.85	J	1.41	
PCB-123	12.7		3.25		2.54	U
PCB-126	2.44		0.598	J	2.43	
PCB-127	1.41		0.564	U	0.284	J
PCB-128/166	130		30.2		30.6	
PCB-129/138/160/163	786		176		176	
PCB-130	39.9		11.2		11.2	
PCB-131	8.72	U	2.19		1.87	
PCB-132	212		54.5		49.4	
PCB-133	9.61		2.55		2.53	
PCB-134/143	36.2		7.98		7.45	
PCB-135/151/154	186		41.7		42	
PCB-136	66.5		14.9		15	
PCB-137	30.5		8.91		7.96	
PCB-139/140	12.2		3.54		2.7	
PCB-141	94.6		22.7		23.8	
PCB-142	1.22	U	0.463	U	0.178	U
PCB-144	27.3		5.7		5.43	
PCB-145	0.488	U	0.148	U	0.071	U
PCB-146	88.4		24.2		22.7	
PCB-147/149	496		108		107	
PCB-148	1.41	J	0.296	U	0.312	U
PCB-150	1.83	U	0.603	U	0.394	
PCB-152	0.871	J	0.131	U	0.123	J
PCB-153/168	532		134		130	
PCB-155	0.188	U	0.13	U	0.228	U
PCB-156/157	70.1		19.2		19.7	
PCB-158	68.7		15.2		15.3	
PCB-159	6.28	U	1.14	J	1.22	
PCB-161	0.811	U	0.346	U	0.122	U
PCB-162	2.44	J	0.491	U	0.742	

Location ID	BB-28-S	Q	BB-29-S	Q	BB-30-S	Q
Date/Time	9/9/2014	1129	9/11/2014	1103	9/9/2014	1507
PCB-164	44.1		10.6		11.7	
PCB-165	0.94	U	0.394	U	0.141	U
PCB-167	25.4		6.66		8.1	
PCB-169	1.16	U	0.412	U	0.235	U
PCB-170	105		28.3		35	
PCB-171/173	38.1		10.7		10.6	
PCB-172	19.6		5.99		5.52	
PCB-174	117		30.3		28.7	
PCB-175	6.81		1.51	J	1.62	U
PCB-176	19.8		4.43		3.83	
PCB-177	67		20.3		19.4	
PCB-178	33.6		8.06		7.36	
PCB-179	68.3		13.8		12.3	
PCB-180/193	241		57.9		64.9	
PCB-181	1.37		0.0486	U	0.43	U
PCB-182	1.44		0.0486	U	0.41	
PCB-183/185	103		24.1		21.5	
PCB-184	0.502		0.117	U	0.267	J
PCB-186	0.135	U	0.0486	U	0.082	U
PCB-187	204		49.1		38.2	
PCB-188	2.5		0.243	U	0.255	U
PCB-189	4.77		1.52	J	1.66	
PCB-190	23.4		5.14		6.26	
PCB-191	4.72		1.38	U	1.33	U
PCB-192	0.127	U	0.0486	U	0.0476	U
PCB-194	66.9		16.5		16.3	
PCB-195	24.3		4.78		5.95	
PCB-196	42.5		7.94		8.2	
PCB-197/199	15.9		3.71		2.68	J
PCB-198/201	126		24.2		23	
PCB-200	15.7		3.28		2.91	
PCB-202	30.6		6.36		5.86	
PCB-203	74.8		13.8		13	
PCB-204	0.404	U	0.051	U	0.0476	U
PCB-205	3.05		0.917	J	0.8	U
PCB-206	167	J	18.4		15.1	
PCB-207	32.7	J	2.53		2.32	
PCB-208	83.2		8.09		6.12	
PCB-209	207		21.8		18	
Total PCBs*	15200		3860		2960	
PCB TEQ (0 DL)	0.277		0.0685		0.250	
PCB TEQ (1/2 DL)	0.295		0.0748		0.253	
PCB TEQ (1 DL)	0.312		0.0811		0.257	
PCB TEQ (KM)	0.281		0.0696		0.251	

*total PCBs represents the sum of all detected congeners
U-the analytie was analyzed for, but was not detected above the reported sample quantitation limi
J-the analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sampl
UJ-the analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate
L-the detection frequency of compounds within a sample was <50%, the numeric value indicates the number of non-detect
KM-Kaplan-Meier DW-dry weight Q-qualifier TEQ-toxicity equivalent DL-detection limit Avg-average of field duplicate

Appendix G. Statistical Evaluation of the Bellingham Bay Data Set

Appendix G: Statistical Evaluation of the Bellingham Bay Data Set

Various statistical methods were used to evaluate the Bellingham Bay data set. This appendix represents a record of the analyses performed. The analyses in Section G.1 were conducted to determine the most appropriate distribution for each analyte. All data were evaluated in Section G.2 to identify if any statistical outliers existed for any of the individual analytes. The correlation analyses of Section G.3 were conducted to further explore patterns in the data and identify any unusual results not obvious from the univariate analysis. Multivariate exploratory analyses can be used to differentiate natural and regional background distributions, but was not necessary with this study because Bellingham Bay sediments clearly differed from natural background for dioxin/furan congeners and cPAHs.

Any samples flagged by the exploratory analyses outside of Sections G.1 and G.2 are not considered outliers for the purpose of calculating the 90/90 upper tolerance limits (90/90 UTL).

G.1 Distributional Analysis

The distributions for each chemical analyte plus total organic carbon (TOC) were evaluated individually in R (R Core Team 2014) to generate normal-probability (also referred to as quantile-quantile [QQ]) plots and boxplots, and in ProUCL 5.0 (USEPA 2013) for formal goodness of fit (GOF) tests against the standard distributions (i.e., normal and gamma). The normal probability plots for each of the analytes are shown in Figure G-1, and for TOC in Figure G-2.

These plots were used in part to evaluate the shape of the data distributions and help identify unusual values. Several stations were identified: two with elevated concentrations, and two with concentrations below natural background for dioxin/furan TEQ. The physical location of these samples, either near areas presumed to represent natural background or historical sources, led to the decision to exclude these samples from the calculation of regional background values for one or more analytes. Details for these samples are provided below.

- Station BB-28 was identified as an outlier for lead and cPAHs, and also had a somewhat elevated level of the PCB TEQ (Figure G-1). Review of the potential sites and sources near this sampling location identified a former refueling station that was a likely source for all three of these analytes. Therefore, data for these analytes from Station BB-28 were excluded from the calculation of regional background.
- Station BB-12 was identified as an outlier for TOC (Figure G-2) and a large amount of wood waste was observed at this station during the field investigation. These

observations are indicative of a direct anthropogenic influence. The wood waste in the sample caused elevated detection limits for some analytes, particularly the PCB congeners. One of the elevated detection limits resulted in the PCB TEQ being identified as a statistical outlier at this station. Other analytes were also affected, although less severely. Due to the interference noted in the chemical analyses of PCBs and the wood waste as evidence of anthropogenic influence, all results for this station were excluded from the calculation of regional background.

- Stations BB-14 and BB-27 had concentrations of dioxin/furan congeners that had recovered to levels below natural background (less than 4 ng TEQ/kg). These stations were located adjacent to the boundary of the area that represented dioxin/furan natural background. Consequently, the area occupied by these stations was considered an extension of the dioxin/furan natural background exclusion of the AOI. Dioxin/furan congeners from these two samples were excluded from the calculation of regional background.

After excluding the sample results specified above, probability plots were generated for the remaining data (Figure G-3). Results are shown in Table G-1.

There were no additional statistical outliers found after excluding the samples specified in Table G-1. The data distributions are described below.

- Lead – the data were right skewed. The log-normal distribution had the highest QQ plot correlation coefficient ($r = 0.967$), however, the right tail had a small secondary mode for concentrations greater than 14 mg/kg. A parametric estimate of the upper tolerance limit (UTL) based on the log-normal distribution would underestimate this upper tail. Consequently, non-parametric bootstrap estimates were preferred.
- cPAH TEQ - these data were also right skewed, with a pattern similar to that of lead. Non-parametric bootstrap estimates were preferred.
- Dioxin/Furan TEQ – these data were best described by a normal distribution (QQ plot correlation $r = 0.976$; Shapiro-Wilk's test $p = 0.19$).
- PCB TEQ - The gamma distribution was a good fit to these data (QQ plot correlation $r = 0.992$; goodness of fit tests $p > 0.05$).

G.2 Univariate Investigation of Extreme Values for each Analyte

The term "extreme value" is a statistical term used to define a result that deviates from the population mean but may still be representative of background (SCUM II, Ecology 2013a & 2015). Extreme values are common in data sets that lack sufficient sample sizes to capture the full range of values. Essentially, it is unknown whether an extreme value is an outlier unless more samples are available. The individual analytes were screened for extreme values using a variety of approaches:

- Single extreme values were identified using Rosner's formal outlier test (for $n \geq 25$) or Dixon's outlier test (for $n < 25$) for data that fit a normal distribution (see Table G-1). Both tests were conducted in ProUCL with $\alpha = 0.05$.
- Extreme values were also identified when the single highest concentration sample was the difference between a normal and a non-normal distribution (i.e. if the high concentration sample was excluded, the distribution would be normal).
- High values were flagged as extreme based on the boxplots in Figure G-4, using Tukey's rule of thumb[1].

Screening for extreme values was done to determine whether specific samples may be skewing the distribution for an individual analyte. A summary of the presence of extreme values for each analyte in the Bellingham Bay data set follows:

- Lead presented three extreme values based on Tukey's rule of thumb (Figure G-4). However, these three samples were part of the small secondary mode of five samples with lead concentrations greater than 14 mg/kg, so these are not considered outliers. These stations are adjacent to the shoreline, and are presumed to represent the upper tail of a skewed Bellingham Bay data set distribution. Note that the entire Bellingham Bay data set is contained within the range of natural background.
- cPAH TEQ presented three extreme values based on Tukey's rule of thumb (Figure G-4). These samples represent the small secondary mode of three samples with cPAH values greater than 60 µg TEQ/kg. These stations are adjacent to the shoreline, and are presumed to represent the upper tail of a skewed Bellingham Bay data set distribution.
- Dioxin/furan TEQ presented no extreme values (Figures G-3 and G-4). This was the only analyte for which Dixon's test could be used, and no formal outliers were identified.
- PCB TEQ presented one extreme value based on Tukey's rule of thumb (Figure G-4). However, this rule of thumb is most appropriate for symmetric data, and these data are best described by the gamma distribution. This value appears to be part of the upper tail of a skewed distribution. Note that the entire Bellingham Bay data set is contained within the range of natural background.

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[1] Tukey's rule of thumb flags values as extreme when they exceed the median +/- 1.5*IQR (IQR = interquartile range = 3rd quartile minus the 1st quartile). These points fall outside the whiskers on the boxplots.

G.3 Correlation between Sediment Chemistry Concentrations and TOC

The following bivariate investigation evaluated the distribution of each analyte in relation to percent TOC. Anthropogenic contamination tends to be associated with TOC. As a result there is typically a positive correlation between TOC and sediment chemistry. Deviations from the general trend can be indicative of a different source, or a different geochemical/depositional environment. This exploratory investigation provided information for understanding some of the possible sediment dynamics in Bellingham Bay and may be useful for future investigations. However, these results did not contribute to any decision towards excluding samples as outliers.

Correlations between percent fines and each analyte were also considered. However these correlations were not conducted because there was so little variability in the level of percent fines (i.e., values ranged from 90 to 100 percent, after excluding the samples specified in Section G.1).

The relationships between total organic carbon (as percent TOC) and sediment chemical concentrations are presented graphically as scatterplots in Figure G-4. The TOC for the samples in this data set were fairly evenly distributed throughout the observed range of 1 to 3.7 percent. The scatterplots show that except for dioxin/furan congeners ($p = 0.218$), all correlations are fairly good between each analyte and percent TOC (all statistically significant with $p < 0.01$, Table 4, Section 4.3.1). There were several samples with concentrations of one or more analytes that were higher than expected given the amount of TOC in the sediments. These samples are circled in Figure G-4, and include:

- Sample BB-22 for lead, cPAH and PCB TEQs.
- Sample BB-23 for lead, dioxin/furan and PCB TEQs.
- Sample BB-25 for cPAH and dioxin/furan TEQ.
- Samples BB-08 and BB-24 for dioxin/furan TEQ.
- Sample BB-30 for PCB TEQ.

Table G-1. Best Fit distribution for each analyte in the Bellingham Bay data set.

Analyte	Best Fit Distribution(s)	Correlation Coefficient of the QQ-Plot for the best fit distribution(s)	Detection Frequency	Samples Excluded
Lead	None	0.967 (lognormal)	**28/28**	**BB-12, BB-28**
cPAH TEQ	None	0.969 (lognormal)	**28/28**	**BB-12, BB-28**
Dioxin/Furan TEQ	Normal	0.976	**20/20**	**BB-12, BB-14, BB-27**
PCB TEQ	Gamma	0.992	**27/28**	**BB-12, BB-28**

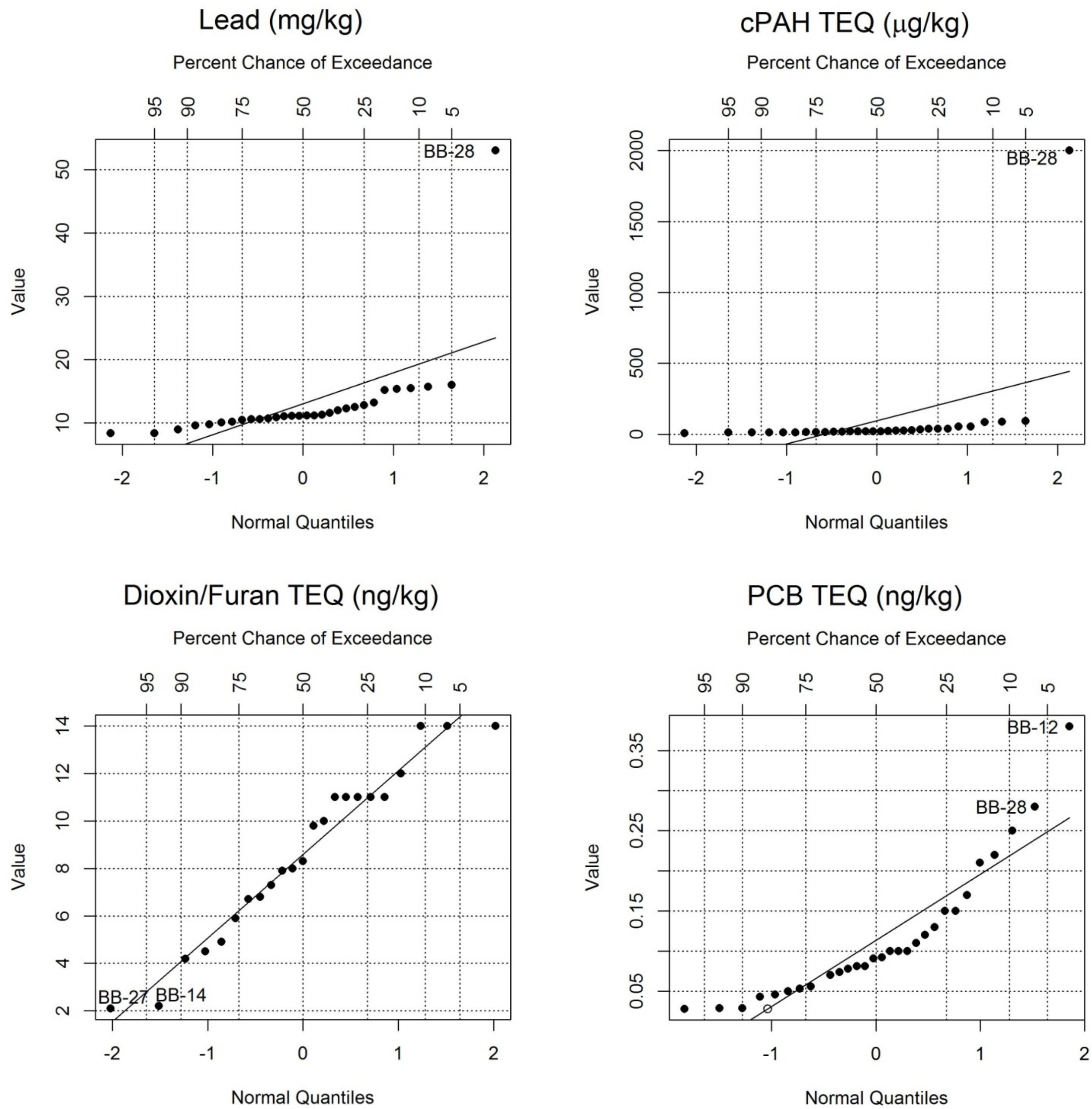

Figure H-1. Normal probability plots for analytes in Bellingham Bay sediments. Note: Censored (non-detect) data points are shown on the graphs as open circles, their quantiles are estimated from the distribution of the detected data using regression on order statistics. The quantiles observed from the sample data (y-axis) are plotted against the corresponding quantiles from the standard normal distribution (bottom x-axis). The top axis and vertical grid lines show the percent chance of exceedance for the normal distribution (e.g., a 5 percent chance of exceedance is the 95th percentile, which intersects the estimated distribution for dioxin/furan TEQ, represented by the line through the data, at a concentration of approximately 14 ng TEQ/kg). When the data points fall along a straight line, they are approximately normally distributed. Extreme values and systematic deviations from normality can be observed on these plots based on where the data points fall relative to the line.

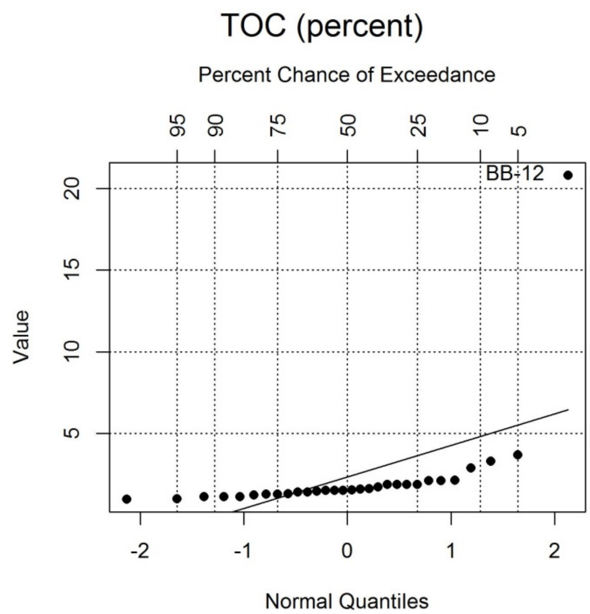

Figure H-2. Normal probability plot for total organic carbon in Bellingham Bay sediments.

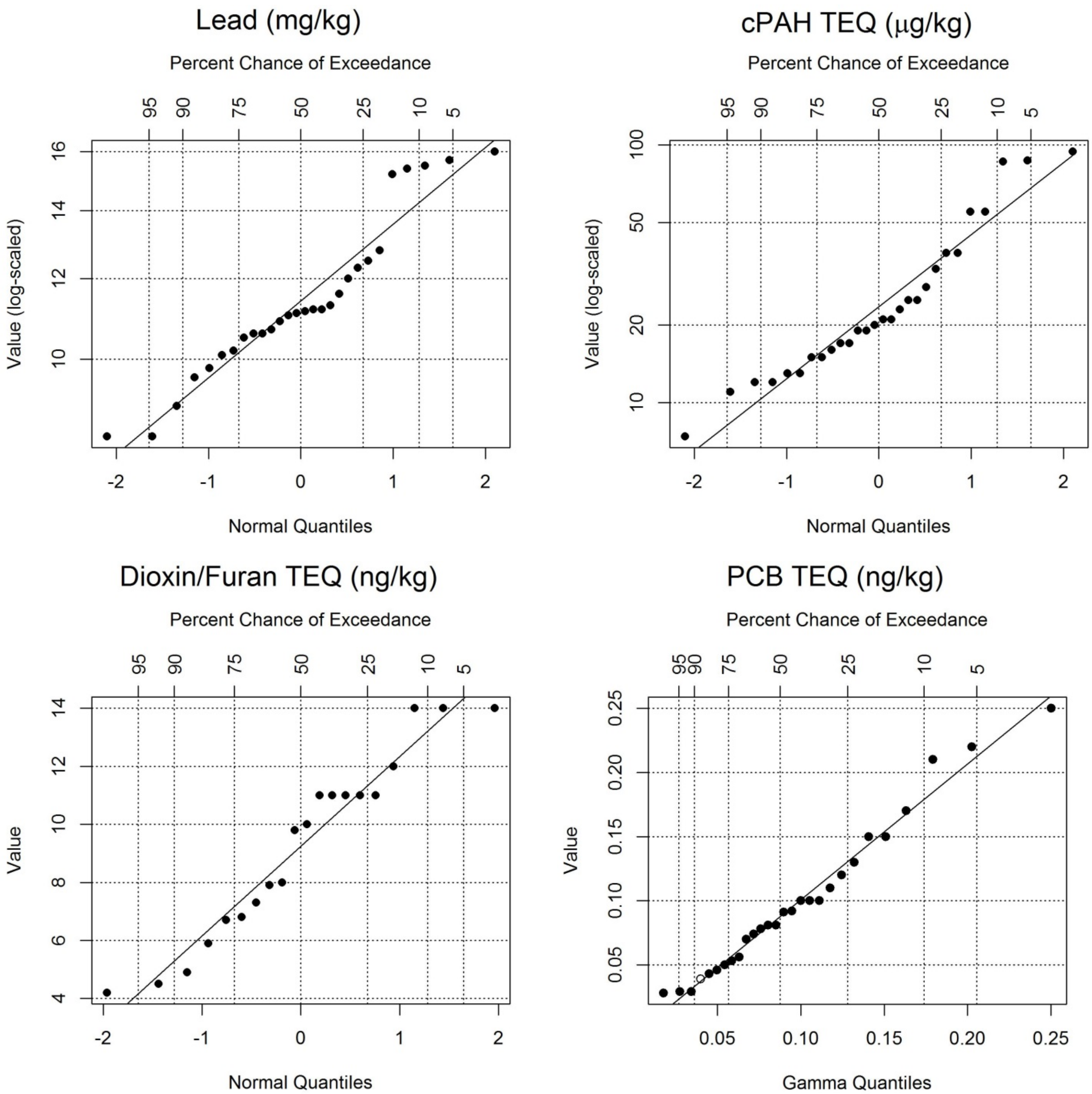

Figure H-3. Probability plots for analytes in Bellingham Bay sediments, excluding samples flagged in Figure H-1. Note: the quantiles for lead and cPAHs are log-scaled, indicating that the log-normal distribution was the best-fit distribution for these data; quantiles for the PCB TEQ are plotted relative to the theoretical gamma quantiles, the best-fit distribution for these data.

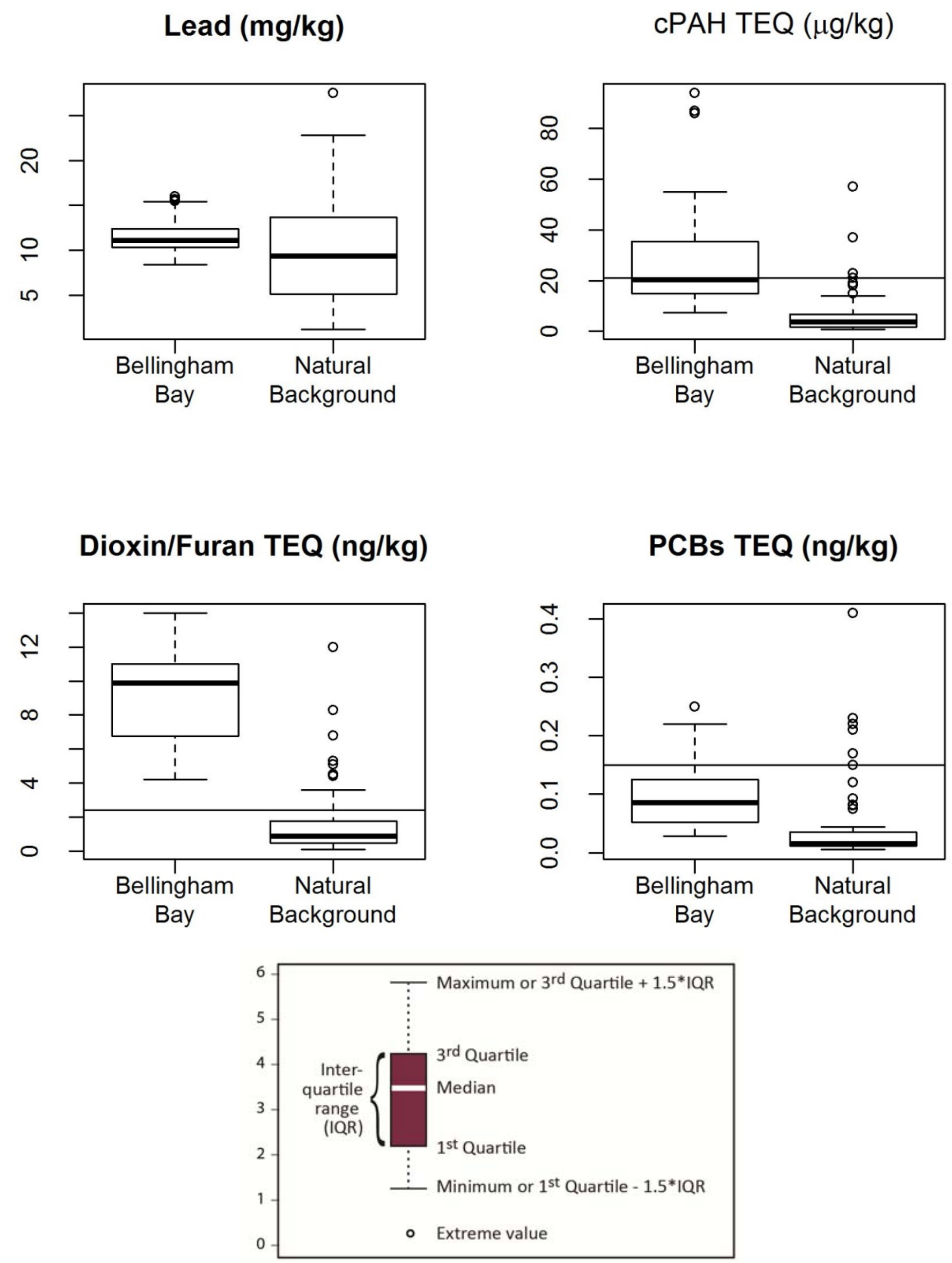

Figure H-4. Boxplots showing the distribution of sediment concentrations in Bellingham Bay sediments.
Note: The 1st, 2nd, and 3rd quartiles are estimated using Kaplan-Meier for censored data; horizontal lines indicate the level of the highest detection limit among the two data sets. The sample sizes for the Bold plus natural background analytes were n= 96 (lead), n=76 (cPAH TEQ), n=91 (dioxin/furan TEQ), and n=70 (PCBs TEQ).

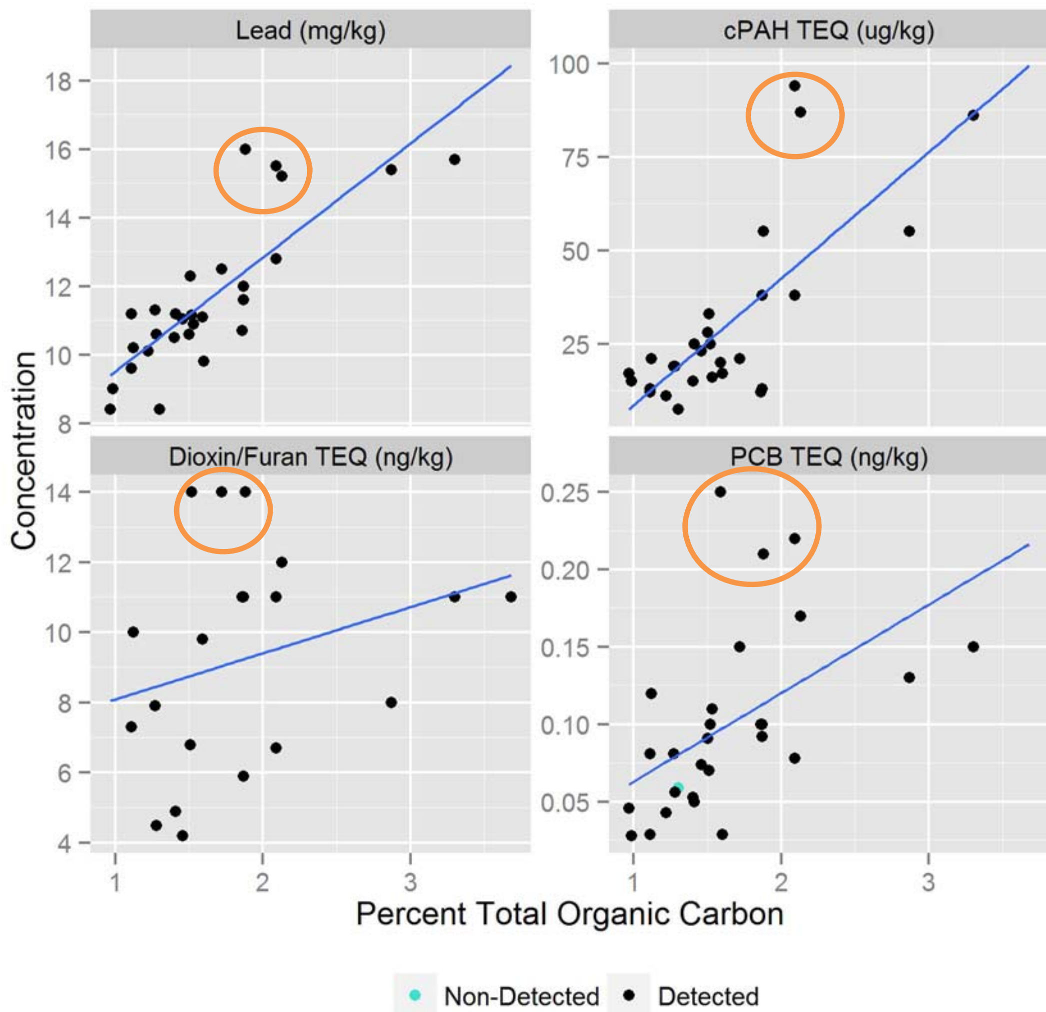

Figure H-5. Relationship between percent total organic carbon and each analyte in Bellingham Bay sediments. Note: Non-detected values (turquoise data points) are shown at the reported detection limit. The ordinary least squares regression line is shown for the data in each panel. Extreme samples identified in Section 1.0 have been omitted from these plots. Circled samples have higher concentrations than expected for the amount of TOC in the sample (see text for more details).