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South Puget Sound Regional Background

Final Data Evaluation and Summary Report

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Table of Contents

List of Tables

List of Figures

Acknowledgments

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Acronyms and Abbreviations

AICc	Aikake Information Criterion
COCs	contaminants of concern
cPAH	carcinogenic polycyclic aromatic hydrocarbon
CSL	Cleanup Screening Level
Ecology	Washington State Department of Ecology
EIM	Environmental Information Management System
EM	expectation-maximization
i.i.d	independently and identically distributed
KM	Kaplan-Meier
LOTT	Lacey, Olympia, Tumwater, and Thurston County [Wastewater Treatment Plant]
m	meter
NADA	Nondetects and Data Analysis statistical software package
ng/kg	nanograms per kilogram
PCB	polychlorinated biphenyl
PQL	practical quantitation limit
ProUCL	statistical software package for analyzing environmental data sets
QQ	Quantile-Quantile
SCO	sediment cleanup objective
SCUM II	Sediment Cleanup User's Manual II
SD	standard deviation
SMS	Sediment Management Standards
SVOCs	semivolatile organic compounds
TBT	tributyltin
TEC	toxic equivalent concentration
TEQ	toxic equivalent quotient
TOC	total organic carbon
UCL	upper confidence limit
µg/kg	micrograms per kilogram
UTL	upper tolerance limit
WAC	Washington Administrative Code

1.0 Introduction

In early 2013, the Washington State Department of Ecology (Ecology) revised the Sediment Management Standards (SMS) (Chapter 173-204 WAC) to establish a new framework for identifying and cleaning up contaminated sediment sites. A key component of this framework is the concept of regional background sediment concentrations, which can serve as the Cleanup Screening Level (CSL) for sediment sites. During the rule revision, the advisory group recommended that Ecology be responsible for establishing regional background sediment concentrations for areas of the state. This report provides Ecology's evaluation of existing data for South Puget Sound to establish regional background.

1.1 Regional Background

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

The SMS rule includes a two-tiered framework used to establish sediment cleanup levels. It incorporates *natural background* as one component of the Sediment Cleanup Objective (SCO), and *regional background* as one component of the CSL. The SMS rule provides a definition for regional background in WAC 173-204-505(16) and parameters for establishing it in 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 provides flexibility in establishing regional background on a case-by-case basis and does not prescribe specifically how regional background should be established. Ecology's approach to establishing regional background has evolved over time by working on various areas and receiving comments from numerous stakeholders and tribes. Current guidance for establishing regional background is based on these discussions.

Ecology has established regional background concentrations for Port Gardner, Bellingham Bay, and the North Olympic Peninsula (Ecology 2014, 2015b, 2016) using methods that rely primarily on collecting new data. However, SCUM II also allows regional background to be established using existing data if the data are sufficient and statistically robust. A regional background concentration for cPAHs has been developed for the Lake Washington Area using existing data (Ecology 2017). Based on the Lake Washington Area approach, Chapter 10 in SCUM II (Ecology 2015a) is being revised to include an updated summary of the recommended approach for using existing data to calculate regional background concentrations, along with important limitations for using this approach.

In addition, in cases where an entire water body may be directly influenced by identifiable sites and sources, the SMS includes a provision to establish regional background using data from an alternative but similar geographic area(s) that is not directly influenced by known sources as a substitute:

> **WAC 173-204-560 (5)(f):** If a water body is not beyond the direct influence of a significant contaminant source, the department may use alternative geographic approaches to determine regional background for a contaminant. Several factors must be evaluated when determining an alternate geographic approach including:
>
> > (i) Proximity of sampling to the site;
> > (ii) Similar geologic origins as the site sediment;
> > (iii) Similar fate and transport and biological activities as the site; and
> > (iv) Chemical similarity with the site.

This approach was used in both the North Olympic Peninsula and Lake Washington Area approaches to calculate regional background for a larger area than would otherwise have been possible.

1.2 South Puget Sound Regional Background

This report establishes regional background concentrations for dioxins/furans and cPAHs in South Puget Sound using existing data. Existing data were analyzed from portions of South Puget Sound (see Section 2), including:

- Henderson Inlet
- Budd Inlet (Olympia)
- Eld Inlet
- Totten Inlet

- Oakland Bay (Shelton)

These inlets in the South Puget Sound are geographically proximate and have similar fjord-like hydrogeologic and biological characteristics. The bays have been impacted by similar regional stormwater runoff and atmospheric deposition sources.

After analyzing this existing data set, Ecology determined that sufficient data were available to evaluate whether regional background could be established for dioxins/furans and cPAHs. However, there are insufficient congener data for PCBs to calculate regional background. Metals and other chemicals were not evaluated.

Ecology has determined that regional background generally applies to the following areas in South Puget Sound as follows (Figure 1):

- For cPAHs and dioxins/furans:
    - Budd Inlet (Olympia)
    - Shelton Harbor in Oakland Bay

- For dioxins/furans only:
    - Oakland Bay outside Shelton Harbor

Ecology will consider whether regional background for dioxins/furans and cPAHs applies to other areas of South Puget Sound on a site-specific basis. Some of the more undeveloped areas within South Puget Sound area may have ambient sediment concentrations closer to natural background (SCUM II, Table 10-1). For example, existing data in Oakland Bay outside of Shelton Harbor shows that ambient sediment concentrations for cPAHs are near natural background. In the event that a cleanup site is identified in these areas, Ecology will likely require data to be collected during the remedial investigation to determine whether natural or regional background applies.

The SMS rule allows Ecology to determine if regional background can be used as a sediment cleanup level for a particular site (WAC 173-204-560) as follows:

- When setting site-specific sediment cleanup levels, the SCO and CSL are first identified. Natural and regional background are one component of determining the SCO and CSL, respectively (WAC 173-204-560(3) – (4)).

- The sediment cleanup level is initially set at the SCO (which may be natural background) and can be adjusted upwards to the CSL (which may be regional background).

- This upwards adjustment from the SCO is based upon whether:
  - It is technically possible to meet and maintain the sediment cleanup level (WAC 173-204-560(a)(i)(A)). This decision can be informed by the potential for recontamination by ambient sediment concentrations that are not part of the site (SCUM II Chapter 7, subsection 7.2.3).
  - Meeting the cleanup level will have a net adverse environmental impact (WAC 173-204-560(a)(i)(B); SCUM II Chapter 7, subsection 7.2.3).

If a cleanup site is located in an area with ambient sediment concentrations near natural background, Ecology may determine that an upwards adjustment of the sediment cleanup level is not appropriate due to the high potential of meeting and maintaining the sediment cleanup level at the SCO.

2.0 Conceptual Model

Existing data were reviewed within South Puget Sound to evaluate regional background concentrations, including data from areas surrounding Squaxin Island, south of Harstine Island, and five fjord-like inlets that are hydrologically connected to this central area (Figure 1):

- Hammersley Inlet and Oakland Bay, including the Shelton waterfront,
- Totten Inlet and Oyster Bay,
- Eld Inlet,
- Budd Inlet, including the Olympia waterfront, and
- Henderson Inlet.

Concentrations of PAHs above natural background have been measured in areas of all five inlets. Dioxin/furan concentrations were also elevated above natural background in Oakland Bay and Budd Inlet, the only inlets for which there were data. The central areas had few data with varying concentrations, some within natural background and some somewhat elevated.

The following conceptual model describes features of the South Puget Sound area and the screening process that was used to identify the regional background data sets for dioxins/furans and cPAHs. These data were subjected to further statistical tests and evaluations described in Section 3.

2.1 Geography and Land Use

The five inlets included in the South Puget Sound area are fjord-like inlets formed by glaciation, surrounded by relatively low-elevation topography in the former glacial basin. The inlets are generally long, narrow, and shallow, and have extensive mudflats near their headwaters. The majority of the shorelines surrounding the inlets are residential, forested, agricultural, or recreational, with occasional smaller commercial and industrial businesses. Oakland Bay, Hammersley Inlet, and the northwestern portion of Totten Inlet are located in Mason County, while the southeastern portion of Totten Inlet, Eld Inlet, Budd Inlet, and Henderson Inlet are located in Thurston County.

Larger cities include Shelton, located on the west end of Oakland Bay, and Olympia, at the head of Budd Inlet, which both have commercial and industrial areas along their inner harbors. Residential areas of Olympia and Lacey extend to the western shoreline of Eld Inlet and the southern portion of Henderson Inlet. Highway 101 runs northwest from Olympia and crosses the southwestern ends of Eld and Totten Inlets, and State Route 3 runs along the length of Oakland Bay to the northeast.

Shelton's downtown area lies to the west of Shelton Harbor. Historical and current land uses in Shelton Harbor have been industrial, centering on wood products industries such as sawmills; plywood, insulation board, and fiberboard manufacturing; pulp and paper mills; and log rafting, log transfer, and chip loading operations. Other industries currently or historically present in the harbor include a wastewater treatment plant, a bulk fuel facility, fueling stations, a marine railway, a marina, and a power plant (Herrera 2010). An upland gravel mine operates a barge loading facility for aggregate on the western shore of Oakland Bay.

Olympia's downtown commercial area lies at the south end of Budd Inlet, with the Port of Olympia occupying the northern half of the peninsula between East Bay and West Bay. Relatively dense residential areas line the east side of East Bay and the west side of West Bay, along with a number of parks. The middle and outer areas of Budd Inlet are more suburban or rural in nature, similar to the other inlets. Boston Harbor is a small community that is located at the mouth of Budd Inlet on the eastern shoreline.

The inner portion of Budd Inlet has supported a variety of industries, including lumber mills, plywood mills, Cascade Pole (wood treating), shipping operations, marinas and boat repair, and steel fabrication and painting. Olympia has the only deep water port in the South Puget Sound area, which has operated since 1922 (Port of Olympia 2017). Several large marinas are present in East Bay, West Bay, and Boston Harbor. The Lacey, Olympia, Tumwater, and Thurston County (LOTT) wastewater treatment plant is located on the central peninsula, and the Tamoshan/Beverly Beach and Seashore Villa treatment plants are located on the west and east sides of the inlet, respectively. Each of these treatment plants discharges into the inlet. Numerous wood waste burners (hog fuel boilers), as well as other emissions sources associated with the mills, were historically present in both Shelton and Olympia (NewFields 2016; Anchor QEA 2016).

Nearly all of these inlets have extensive mudflats at low tide, as well as shorelines and spits that support tribal, commercial, and recreational shellfishing, as well as abundant fisheries, bird life, and marine mammals. Manila clams and oysters are the primary shellfish harvested commercially. Shelton Harbor, the northeastern portion of Oakland Bay, and Budd Inlet are closed to shellfishing due to fecal coliform contamination. Additional shellfishing areas are closed seasonally due to biotoxins. Despite closures, shellfish restoration efforts are occurring in many of these bays, including attempts to restore populations of the Olympia Oyster (Herrera 2010).

The Squaxin Island Tribal Reservation is located between Oyster Bay and Little Skookum Inlet in Mason County. The South Puget Sound area is within the Squaxin Island Tribe's usual and accustomed fishing area, and the Tribe harvests and manages shellfish for commercial and subsistence harvest and for restoration. The Squaxin Island Tribe also operates a salmon net pen facility between Squaxin and Harstine Islands (Squaxin Island Tribe 2017). Many commercial shellfish growers also operate in the various inlets and own or lease tidelands, the largest of which is Taylor Shellfish (Taylor Shellfish 2017).

2.2 Hydrology and Bathymetry

All five of the inlets in the study area are long, narrow, and generally quite shallow. The inlets are typically wider and deeper at their mouths and narrow to mudflat estuaries at their heads. Each has a number of small rivers and streams that contribute fresh water at the head and along the shorelines (Ecology 2006). Budd Inlet receives substantial freshwater inputs, primarily from the Deschutes River, but also from several smaller creeks that drain the Olympia and Black Lake areas. With a watershed of 420 km^2, the Deschutes River flows over 83 km from the Snoqualmie National Forest into Capitol Lake, which was once part of the Deschutes River estuary, and from there into Budd Inlet (Thurston County 2009).

South Puget Sound has a large tidal range of approximately 4.4 m (14 ft). However, due to stratification and the narrow and complex geomorphology of the inlets and passages, the water in South Puget Sound has a relatively long residence time of 1-2 months. Stratification in the inlets can persist for most of the year, particularly in Budd Inlet, which has relatively large freshwater input from the Deschutes River. The strong stratification in Budd Inlet results in very low dissolved oxygen in bottom waters of the inner Inlet, improving toward the outer Inlet where the water is more mixed. Many of the shallower inlets are nutrient-rich and support large populations of plankton, which are a primary food source for bivalves. This is one reason that shellfish are abundant in South Puget Sound (Ecology 2002).

Oakland Bay is quite shallow, ranging from less than 3 m throughout most of the bay to 11 m in depth near the confluence with Hammersley Inlet. Nine major creeks empty into Oakland Bay, with Goldsborough and Shelton Creeks discharging through the city of Shelton. Oakland Bay is connected to Pickering Passage by Hammersley Inlet. Due to the long, narrow geomorphology of Hammersley Inlet, sediments are largely retained within Oakland Bay and there is little flushing of water out of the bay (Herrera 2010).

Budd Inlet is about 30 m deep at its mouth, is about 10 m deep in mid-Inlet, and shallows to sandy beaches near Priest Point Park and extensive mudflats through most of the rest of the inner inlet. Budd Inlet can be divided into three hydrodynamic regimes (Figure 2). In the inner Inlet, there is very little circulation or sediment transport, other than episodic fluxes from Capitol Lake into West Bay. There is freshwater flow into West Bay from the Deschutes River through the Capitol Lake dam, which then flows up the east side of the Inlet past Priest Point. In the central Inlet, more saline water flows in at depth to the west, while freshwater flows out to the east, setting up a central gyre. Finer-grained sediments transported to this area of the Inlet eventually settle out, forming fairly homogeneous conditions in bottom sediments. The western outer Inlet receives inputs from Dana Passage, with water flowing out to the east, in the vicinity of Boston Harbor.

A federal navigation channel extends from near Big Tykle Cove near the middle of the western shoreline to the Port of Olympia in the West Bay and the marinas in the East Bay. The federally authorized depth of the turning basin near the Port of Olympia is -30 MLLW plus 2' overdredge, and the maintenance depth of the berth areas is -40 MLLW plus 2' overdredge. A smaller channel extends across the top of the peninsula and into East Bay, which is maintained to -15 MLLW (SAIC 2008).

2.3 Sedimentation, Grain Size, and Organic Carbon

Figures 3 and 4 show grain size and total organic carbon for locations sampled in the South Puget Sound area, using data downloaded from Ecology's Environmental Information Management System (EIM). Much of the South Puget Sound area has high percent fines (silt and clay), typically ranging from 60 to 100%. Exceptions include the following areas:

- Hammersley Inlet has strong tidal currents, which scour the bottom sediments at its confluence with Oakland Bay. This area of Oakland Bay has fines ranging from 5 to 40%.

- Just north of East Bay in Budd Inlet, there is a sandy beach surrounding the mouth of Ellis Creek near Priest Point Park.

- North of the peninsula in inner Budd Inlet, there is a sandy intertidal cap placed as part of cleanup of the Cascade Pole site.

- There are additional sandier areas immediately along the west shoreline of West Bay and the east shoreline of East Bay. A railroad trestle runs shoreward of the southwest corner of West Bay, bordering a shoreline lagoon.

- Areas with lower fines are present along the east shoreline of Henderson Inlet, within and downstream of Woodard Bay. This area has a large historic railway trestle and some shoreline modification by homeowners.

The majority of the South Puget Sound area has TOC concentrations ranging from 2 to 3%. Exceptions include:

- TOC is much lower in the scoured area of Oakland Bay near the entrance to Hammersley Inlet.

- TOC is 3 to 6% in quiescent areas of Shelton Harbor and mudflats on the east side of Oakland Bay. TOC concentrations may be elevated by wood waste deposition in Shelton Harbor.

- TOC is low in Budd Inlet in the sandy beach near Ellis Creek at Priest Point and in the sand cap offshore of the former Cascade Pole site.

- TOC is typically 3 to 4% in the southern half of Budd Inlet, with some areas along the shoreline ranging up to 6%. Some of these higher TOC concentrations are in areas of known wood waste deposits associated with cleanup sites.

- TOC is highly variable in Woodard Bay in the vicinity of the old railroad trestle. This could in part be due to the historic use of the trestle for log transfer and the associated rafting activities in the bay.

The most significant source of sedimentation to inner Budd Inlet is from Capitol Lake outflows, and is highly dependent on tides and lake flushing events. Deposition of up to 20 cm in just over a year has been documented following several flushing events in dredged berthing areas in West Bay. Deposition rates in other areas of inner Budd Inlet are estimated to range from 0.12 to 1.2 cm/yr (Anchor QEA 2016). There is little sedimentation information for other areas of Budd Inlet, or other adjacent inlets. Sedimentation rates in central Oakland Bay range from 0.25 to 0.51 cm/yr, and up to 1 cm/yr near creek deltas (Herrera 2010).

2.4 Unrepresentative Areas

Samples from some areas were considered unrepresentative of regional background and were removed from the data set:

- Priest Point. Sediments in the delta around Ellis Creek at Priest Point were removed from the data set, because they had uncharacteristically low percent fines and low TOC for Budd Inlet, and had concentrations of dioxins/furans in the natural background range.

- Southwest Shoreline of West Bay, Budd Inlet. Several samples in both the cPAH and dioxin/furan data set were located immediately along the southwestern shoreline of West Bay in Budd Inlet. These samples were collected along an old railroad trestle in an intertidal zone constructed of non-native material, and varied widely in TOC. The trestle could also be a potential source of cPAHs to sediments nearby. Additional beach samples along the shoreline north of the trestle were also removed due to uncertainty about the nature of the substrate and representativeness of subtidal areas.

2.5 Sites and Sources

The SMS rule states that areas primarily influenced by cleanup sites and known sources cannot be used to establish regional background. Sediment cleanup sites and other sources historically or currently present within South Puget Sound are mainly located in Shelton Harbor and inner Budd Inlet (Figure 5).

2.5.1 Oakland Bay

Known sites and potential sources of contamination in Oakland Bay are described in detail in NewFields (2010) and Herrera (2010) and are summarized below:

- The Rayonier Pulp Mill operated on the south side of Shelton Harbor from the 1920s through the late 1950s, and discharged untreated chlorine bleaching process wastewater and sulfite waste liquor into the harbor. The Rayonier Mill likely used pentachlorophenol in its industrial processes, and burned salt-laden wood and other process wastes.

- The Rayonier and Simpson Mills, Simpson Power Plant, Olympic Plywood, and other smaller wood products industries contributed to air emissions containing dioxins/furans from mill stacks and wood-fired power plant/hog fuel boiler emissions.

- Fly ash from the Simpson hog fuel power plant containing dioxins/furans were discharged in slurries to the former and current wastewater treatment plants at the northeast and southeast ends of Shelton Harbor, respectively.

- The ITT Rayonier Research Laboratory discharged laboratory wastes to the harbor from the 1930s to the mid-1990s.

- The Simpson Timber Company used a product containing pentachlorophenol (Permatox) as a wood preservative, and a dip tank was located on the property.

- Disposal of pulp mill sulfite liquor wastes occurred in a variety of other ways over the years, including burning, landfilling, spraying onto roadways, and disposal at the Goose Lake site.

- Wastes from the sulfite liquor burner at the Rayonier pulp mill were landfilled at the shoreline of Oakland Bay at the Bayshore Golf Course, and were documented to have leached into the bay.

- Approximately 30,000 cubic yards of dredge spoils from an area close to the outfall of the Rayonier Pulp mill were discharged to a location at the intersection of Shelton Harbor, Oakland Bay, and Hammersley Inlet.

- Bunker C fuel oil leaked from above-ground tanks in the Simpson log sort yard adjacent to Goldsborough Creek. Limited soil was removed but contamination remained in place due to concerns about stability of nearby site structures. Groundwater testing did not reveal groundwater contamination. The site received a No Further Action determination and is subject to a restrictive covenant.

- Numerous other spills have been reported at the Simpson log sort yard and other waterfront locations of various petroleum products and PCB-containing products.

- Log-rafting occurred widely in the harbor, and over 4,000 creosote and pentachlorophenol-treated pilings have been installed in the harbor. Thick deposits of wood waste are present in certain areas, such as near the chip loading area at Simpson.

- Several bulk fuel storage facilities operated along northern Shelton Harbor.

- Simpson operated a marine railway along northern Shelton Harbor where TBT, copper and petroleum products have been identified.

- A landfill of solidified residues from incomplete combustion in wood fired boilers (aka “clinker”) is present adjacent to Shelton Creek, close to where the creek discharges to the northeast part of Shelton Harbor. Tests of this material contained elevated dioxins/furans. Leaching or erosion from this pile likely contributed dioxins/furans to the harbor.

- Shelton Harbor has had a variety of additional point and non-point discharges, including storm drains, industrial discharges, wastewater treatment plant outfalls, septic system discharges, and creeks carrying industrial wastes.

2.5.2 Budd Inlet

Known sites and potential sources of contamination in Budd Inlet are described in detail in NewFields (2016) and Anchor QEA (2016) and are summarized below:

- From 1940 to 1986, the Cascade Pole Company operated on the peninsula separating East Bay and West Bay in inner Budd Inlet. Prior to 1967, creosote was the primary wood preservative used, and after that date, pentachlorophenol (containing dioxins/furans) was used at the facility to treat wood. Process water and waste products were discharged to the inlet, and soil, groundwater, and sediments were contaminated with oil, creosote, pentachlorophenol, and dioxins/furans. The following cleanup actions have been conducted since 1993 at the Cascade Pole Site:

- Installation of the sheet pile wall to provide a physical barrier to DNAPL migration into Budd Inlet, and to minimize the amount of seawater infiltration from Budd Inlet into groundwater.
- Installation of a 3,600-linear-feet slurry cut-wall to provide containment for the groundwater contamination.
- Dredging 40,000 cubic yards of contaminated sediment from Budd Inlet and storing it in an upland sediment containment cell.
- Installation of a second sheet pile wall in front of the first sheet pile wall.
- Storm water runoff control and storm drain remediation.
- Capping the site.
- On-going semiannual groundwater monitoring program and sediment monitoring in the excavated area every five years, annual cathodic protection testing of the sheet pile wall, and operation of the groundwater treatment system to provide hydraulic control of the groundwater.
- Soil removal from the North Point area to MTCA Method A cleanup levels.

- The Port of Olympia has an uncovered log storage yard on the peninsula on which sap-stain treated wood products were stored in the 1980s and 1990s. Concentrations of dioxins/furans in Port of Olympia storm drains are elevated, indicating potential ongoing sources on the property. An opening in the pier (historical pit) is associated with sediments contaminated with dioxins/furans, SVOCs, metals, PAHs, and PCBs. High concentrations of dioxins have also been measured in sediments along the berthing areas and sloughing into the berthing areas.

- The East Bay Redevelopment Site is located on the peninsula at the southwest end of East Bay and is currently undergoing a cleanup (uplands only) for total petroleum hydrocarbons, cPAHs, dioxins and furans, arsenic, lead, and total naphthalene contamination.

- Surface sediments in the south part of East Bay have some of the highest remaining concentrations of dioxins/furans and PCBs in Budd Inlet.

- Several marinas and the Swantown Boat Works surround the peninsula in East and West Bays, and may be sources of lower levels of PAHs and metals to sediments.

- Elevated concentrations of COCs are present near the outlets of some municipal storm drains and creeks, particularly Moxlie Creek, in inner Budd Inlet. It is uncertain whether the origin of the COCs is from these sources or from sediments in the Inlet. Other areas, such as that near the mouth of Ellis Creek at Priest Point, have very low concentrations of dioxins/furans.

- The LOTT wastewater treatment plant has an outfall discharging treated municipal sewage off the north end of the peninsula, as well as smaller outfalls in the vicinity. Sediment data in the vicinity does not suggest that sediments near the outfall have been significantly impacted.

- The Tamoshan/Beverly Beach treatment plant located on the west side of the inlet discharges into the shallow subtidal area, while the Seashore Villa plant and outfall discharges along the east side of Budd Inlet.

- Solid Wood Inc./West Bay Park was a small lumber mill with a railroad, remnants of which still run along the west shoreline of West Bay. An interim Action was performed in 2009 during city park construction, which included removal of contaminated soil and sediment. Ecology is currently reviewing the remedial investigation/feasibility study report for the remaining portions of the site. Concentrations of total petroleum hydrocarbons and cPAHs in soil remain above cleanup levels in areas outside the park. The draft remedial investigation/feasibility study report does not propose additional sediment cleanup.

- Reliable Steel was also a lumber mill until 1941, after which the property was used for boatbuilding, welding, and steel fabrication. Site soils contain concentrations of arsenic, cadmium, lead, mercury, total petroleum hydrocarbons, and cPAHs above MTCA cleanup levels. Groundwater at the site contains total petroleum hydrocarbons and metals above MTCA cleanup levels. Site sediments contain total petroleum hydrocarbons, mercury, PAHs, and phthalates above SMS cleanup levels. A draft Cleanup Action Plan was prepared in 2013, but needs to be revised to incorporate the 2013 SMS revisions.

- Hardel Mutual Plywood was another lumber mill located just north of Reliable Steel. The facility was destroyed by fire in 1996, which may have contributed contaminants to Budd Inlet. Although this site has undergone cleanup, hog fuel boiler ash is still present in soils and dioxin/furan concentrations are elevated in offshore areas of the property.

- West Bay Marina/Buchanan Lumber Company. This marina is currently located on the west shoreline of central Budd Inlet, north of Hardel Mutual Plywood. A lumber mill was formerly located here, along with a hog fuel burner. Ash is present in the upland areas and wood waste is present in the intertidal and subtidal sediments between the marina and Buchanan Lumber. The property has elevated concentrations of dioxins/furans in soils and sediments.

- At least 9 hog fuel burners have been identified as formerly located along the shoreline of inner Budd Inlet, and historical photos suggest that additional burners and smokestacks were likely present throughout Budd Inlet's early history. The hog fuel burners are likely significant sources of dioxins/furans through air emissions and direct deposition to aquatic environments, aerial deposition to soils followed by stormwater runoff, and ash piles in soils and sediments.

2.5.3 Henderson Inlet and Other Areas

The only additional known source identified is the large historical railroad trestle located in Woodard Bay in Henderson Inlet. Sporadically elevated levels of cPAHs near the trestle could be related to deterioration of the treated wood structure or diffusion of creosote into sediments.

Henderson Inlet also receives stormwater from more commercial and heavily residential areas of Lacey through its headwaters. All of the inlets receive stormwater and overland runoff from light residential, agricultural, and forested areas in the watershed, and some receive runoff from Interstate 5, Highway 101, State Route 3, and/or local arterials.

2.6 Regional Background Data Sets

The intent of the SMS definition of regional background is to identify areas primarily influenced by diffuse sources rather than within the direct influence of known sites and sources. In South Puget Sound, differentiating these areas presented challenges due to the long narrow morphology of the inlets and the magnitude of historical discharges to the inlets. In both Budd Inlet and Oakland Bay, the chemical signatures of identifiable historical sources were overlain on that of diffuse sources throughout much of these areas, with few areas that could be considered unimpacted by specific and overlapping sites and sources. Concentrations of COCs remain elevated in these areas long after discontinuation of industrial activities at the sites due to limited sediment transport, mixing, and sediment deposition.

Nevertheless, Ecology determined that regional background concentrations consistent with the SMS rule can be identified in the South Puget Sound area. Multiple lines of evidence were used to distinguish these more diffuse concentrations from the signatures of individual sites and sources. cPAHs and dioxins/furans are discussed separately below, as the data sets and lines of evidence differ for these COCs.

2.6.1 cPAHs

Figure 6 shows the data set available for cPAHs in the South Puget Sound Area. Most of the data are located in Oakland Bay and Budd Inlet, with a few data points in Totten, Eld, and Henderson Inlets.

Oakland Bay data were excluded from the data set, because the cPAH data in Shelton Harbor were determined to be primarily influenced by known sites and sources in that area, while the cPAHs in the remaining areas of Oakland Bay had concentrations within the natural background range. There did not appear to be an intermediate area of diffuse regional background concentrations in Oakland Bay, potentially due to the strong currents and scouring that occurs at the confluence of Oakland Bay with Hammersley Inlet.

Budd Inlet presented a difficult challenge due to the magnitude of historical cPAH and dioxin/furan discharges from the former Cascade Pole and other sites, potentially overwhelming cPAH signatures from diffuse urban sources, as well as smaller sediment sites in inner Budd Inlet. Both of these COCs have gradual south to north concentration gradients away from the former Cascade Pole site, with higher concentrations along the eastern shore, consistent with circulation patterns. There is no clear break point defining where the primary influence of Cascade Pole ends and regional background begins. However, at some point, the cPAH concentration likely approaches that of regional background that would be expected to be present in the more urbanized areas of Budd Inlet, were it not for Cascade Pole and other large sources.

Totten and Eld Inlets were included as candidate regional background areas because cPAH concentrations were elevated above natural background concentrations and were not directly influenced by known sites or sources.

Much of Henderson Inlet was within the natural background distribution, with a few elevated stations in and downstream of Woodard Bay and Chapman Bay. These stations were adjacent to or downstream of the large former rail trestle that is currently in deteriorating condition. Therefore, the data from Henderson Inlet were excluded from the regional background data set.

Given the above, the following cPAH data were included in the regional background distribution for South Puget Sound (Figure 7):

- Data from Totten and Eld Inlets were included, as these areas clearly met the SMS definition of regional background.

- Data from the outer portion of Budd Inlet were included, based on the following:
    - cPAH concentrations were similar to those within Totten and Eld Inlets.

- The samples were collected from areas north of the central gyre in Budd Inlet that tends to retain sediments from more contaminated areas in inner Budd Inlet.

- Samples collected within the western half of West Bay within inner Budd Inlet were also included. This area receives sedimentation from Capitol Lake and is considered to be representative of urban background in areas that may recover more quickly than other areas of inner Budd Inlet. A 750-foot buffer from the eastern shoreline of West Bay was established, and intertidal areas along the former railway along the southwestern shoreline were excluded.

2.6.2 Dioxins/furans

Figure 8 shows the data set available for dioxins/furans in the South Puget Sound Area. No dioxin/furan data were available for Totten Inlet, Eld Inlet, or Henderson Inlet.

In Oakland Bay, dioxin/furan concentrations were elevated throughout Oakland Bay, both in Shelton Harbor as well as in the northeastern portions of the Bay. Only a small area scoured by high currents from Hammersley Inlet fell within the natural background range, with no intermediate areas. Therefore, data from Oakland Bay were excluded from the regional background data set, as it has apparently been influenced throughout by known sites and sources.

Budd Inlet presented similar challenges for dioxins/furans as for cPAHs, in that a clear south to north concentration gradient was apparent away from Cascade Pole, diminishing gradually and without obvious break points to levels that remained above natural background at the outlet of Budd Inlet.

Chemometric analyses have been conducted using dioxin/furan congener data for both Oakland Bay and Budd Inlet (NewFields 2014, 2017). Chemometrics, or environmental forensics, is a term that encompasses several multivariate statistical methods used with the goal of reducing the complexity of the data set. The chemometric analyses identified three different factors that represent unique dioxin/furan sources.

Factors identified for Budd Inlet and/or Oakland Bay included:

- Factor 1, correlated with hog fuel boiler ash and emissions. Nine hog fuel boilers historically operated in Budd Inlet, with an additional five in Oakland Bay (Figure 5). Individual hog fuel boilers represent point sources, while combined emissions from hog fuel boilers at locations where they can no longer be traced to their sources may be considered part of diffuse sources on a regional scale.

- Factor 2, correlated with pentachlorophenol, which was used for wood treatment at Cascade Pole in Budd Inlet and at Simpson Timber and Johns Prairie Industrial Park in Oakland Bay, as well as other possible sites. Factor 2 was the dominant contributor to dioxin/furan TEQ in most samples.

- Factor 3, containing furan peaks representative of PCBs, as well as additional unidentified congener peaks. The presence of this factor was limited to Budd Inlet, where the greatest contributions were found near Berth 3 in the West Bay and at the south end of East Bay (Figure 5).

Figure 9 shows the TEQ concentrations and Figure 10 shows the relative contributions of Factors 1, 2, and 3 in surface sediments in Budd Inlet, moving south to north along the x-axis. As expected, there was a large amount of variability in each factor in the inner inlet given the presence of direct sources. The contribution of Factor 2 diminished somewhat to the north, but remained higher than the other two factors even in outer Budd Inlet, likely indicating a large impact from Cascade Pole. As with cPAHs, however, the outer area of Budd Inlet was considered representative of regional background, in that it showed a mix of diffuse urban sources and other non-direct influences from identifiable sources.

Given the above, the following dioxin/furan data were included in the regional background distribution for South Puget Sound (Figure 11):

- Data from the outer portion of Budd Inlet were included, based on the following:
    - The overall patterns and distributions of dioxins/furans and cPAHs were very similar in Budd Inlet. The cPAH data in outer Budd Inlet was found appropriate for use as regional background based on data from Totten and Eld Inlets.
    - The samples were collected from areas north of the central gyre in Budd Inlet that tends to retain sediments from more contaminated areas in inner Budd Inlet.
    - The total dioxin/furan and individual factor TEQ concentrations (Figure 9) were highly variable in the inner inlet due to the presence of direct sources. These concentrations decreased moving north toward the outer inlet, but remained above natural background concentrations and are likely representative of regional background concentrations.
    - Figure 10 shows the relative percentage of each factor approaching a stable level in the outer harbor. These concentrations are above natural background levels and likely include the contributions from diffuse sources along with some influence from specific sources, but this influence can no longer be considered a direct or primary influence.

- Data from the western half of West Bay within inner Budd Inlet were also included. This area receives sedimentation from Capitol Lake and is considered to be representative of urban background in areas that may recover more quickly than other areas of inner Budd Inlet. A 750-foot buffer from the eastern shoreline of West Bay was established, and intertidal areas along the former railway along the southwestern shoreline were excluded.

3.0 Data Screening and Analysis

To ensure consistency with the SMS, existing data for South Puget Sound were downloaded from EIM and screened to develop the data sets used to calculate regional background. The entire unscreened data set for this geographic region can be downloaded from EIM using the study and location IDs listed in Table A-1. Table A-1 shows the data that were screened out and the reasons for screening. Table A-2 and Figures 7 and 11 show the final data sets for dioxin/furan TEQ and cPAH TEQ after screening and statistical analysis.

The data set was first screened to ensure that samples were of appropriate quality with respect to recency, depth, replicates, and detection limit issues (Section 3.1). The data set was subsequently screened through statistical analysis, including sample independence, population analysis, outlier identification, and calculation of precision (Section 3.2, Appendix B).

3.1 Quality Control/Assurance

3.1.1 Data Recency

The standard 10-year cutoff was used for this analysis, incorporating data from 2007 and later.

3.1.2 Detection Limits

Sample results for cPAH TEQ or dioxin/furan TEQ influenced by non-detected values above the PQL-based cleanup levels identified in SCUM II, Chapter 11 were excluded to avoid bias from elevated detection limits.

3.1.3 Depths, Time Series, and Replicates

Several initial screens were applied to obtain the most recent and representative surface sediment samples at each station:

- Data that were not collected from within the top 0 to 10 cm in depth were excluded.
- When multiple samples were collected at different depths at the same location, data were averaged or the most representative depth (0 to 10 cm) was selected.
- When multiple samples were collected at the same location over time, only the most recent sample was used.
- When replicate samples were collected at the same location at the same time, the data were averaged.

3.2 Statistical Analysis

The resulting data set was evaluated further from a statistical perspective to address issues specific to using existing data, as described below and in Appendix B.

3.2.1 cPAH and Dioxin/Furan TEQ Summing

Kaplan-Meier (KM) TEQs were calculated for the dioxins/furans and cPAHs in each sample consistent with the recommendations in SCUM II. The KM sums reported for the retained TEQ data were calculated using R version 3.2.2 (R Core Team 2016) using the *cenfit* function from the NADA package (Lee 2013). The KM sum was calculated as the KM mean multiplied by the number of congeners (Helsel 2012). The following rules were applied to calculate and qualify the final KM TEQs:

- If the number of non-detected values for a sample exceeded 50 percent (4 or more out of 7), the KM TEQ was qualified as a "less than" value (L-qualified), followed by the number of non-detected values. For example, if 4 of the 7 cPAHs were undetected, the detection frequency would be 57% and the KM TEQ would be calculated and qualified with "L4."

- If the lowest toxic equivalent concentration (TEC) was based on a non-detected value, 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 value.

- Normally, if the highest value is a non-detect, it is excluded by the statistical software used to conduct KM calculations. However, all of the dioxins/furans or cPAHs must be included when calculating a TEQ value. Therefore, the highest TEC value was always treated as a detected value (at the detection limit) for calculating the KM TEQ. The TEQ was qualified with an L if the highest TEC was originally a non-detected value.

- All L-qualified TEQ values were treated as censored (upper-bound) values in the distributional assessments and when calculating summary statistics across samples.

The final data sets used to calculate regional background concentrations are shown in Figures 7 and 11 and in Table A-2. Summary statistics for the dioxin/furan and cPAH data sets are shown in Table 1.

3.2.2 Sample Independence

A spatial autocorrelation analysis was conducted to identify the autocorrelation distance, which is the minimum distance required between samples to consider the results statistically independent. Samples that were spatially isolated or clear outliers were temporarily removed for this analysis, to reduce variability that would disproportionately affect the model.

The analytes were not expected to have identical spatial concentration distributions, because of differing sources. For this data set, there was no evidence of spatial autocorrelation for either dioxin/furan TEQ or cPAH TEQ. A detailed description of the autocorrelation analysis methods and results can be found in Appendix B.

3.2.3 Identification of Subpopulations and Outliers

A detailed analysis of the data set for each analyte was conducted to exclude outliers and isolate the subset of data that most closely represents the SMS definition of regional background (Appendix B, Tables B-1 and B-2).

A population separation analysis was conducted to identify the regional background population from any subpopulations present in the data set. This analysis used likelihood methods to find the most likely breakpoints for mixtures of subpopulations. Both the cPAH and dioxin/furan data sets were determined to be best addressed as single populations and did not require population separation.

A single cPAH outlier of 240 µg/kg TEQ was identified by the QQ plots and outlier analysis. This cPAH value was more than 3 times greater than the next highest value and reduced the goodness of fit of the distribution. Therefore, it was removed from the data set prior to calculating precision and the regional background 90/90 UTL (see Appendix B, Section B.3.1).

A single possible dioxin/furan outlier of 25 ng/kg TEQ was also identified by a statistical outlier test. This dioxin/furan value was further evaluated using the outlier evaluation process outlined in SCUM II, Section 10.3.3. This value was retained in the data set based on the following considerations:

- The station is not near any identified source.
- The sample does not appear to be influenced by another factor that could influence the concentration (e.g., TOC, grain size).
- The fit to a normal distribution with this value retained is acceptable (correlation coefficient of 0.97) and similar to that with the value excluded (0.99).
- The precision of the distribution with the value retained is 20%, well within Ecology's acceptability guidelines of 25%. Removing the outlier improves the precision by only 2%.
- The 90/90 UTL with the value is 19 ng/kg TEQ, and without the value is 17 ng/kg TEQ. These values are similar and within analytical variability.

3.2.4 Precision

In the evaluations above, the precision of the resulting data set was used as one measure of whether the data set a) could be considered a single population, and b) was sufficiently cohesive to represent regional background. This is important because a data set with poor precision will have broader tails and higher upper percentiles. Ecology's target precision for regional background data sets is 25%, although it is recognized that data sets made up of existing data may have poorer precision than those collected through a single field study.

After identifying the regional background data sets through the evaluations described above, the precision of each data set was calculated as the width of the 95 percent upper confidence limit (95 UCL) on the mean divided by the mean (%), where a lower percent value indicates greater precision. Precision of the mean expressed in this way is a common method for quantifying uncertainty in the data set used to calculate the 90/90 UTL.

The data sets representing regional background for dioxin/furan TEQ and cPAH TEQ were evaluated in ProUCL to determine the most appropriate distributions, then associated summary statistics were calculated (Table 1). The precision for both dioxin/furan TEQ and cPAH TEQ data sets is 20%.

4.0 Regional Background Concentrations

4.1 Data Distributions

Overall, the following observations regarding the South Puget Sound regional background data sets can be made.

<u>cPAH TEQs</u>

- The cPAH TEQ concentrations within the South Puget Sound regional background data set were fairly consistent, with one notable exception (240 µg/kg TEQ in northeast Budd Inlet).

- There was a tendency toward slightly higher concentrations in the West Bay near the outlet from Capitol Lake, but these concentrations as a group were not identified as a distinctly different subpopulation from the remainder of the South Puget Sound regional background dataset. A few locations in the northeast portion of Budd Inlet had similar concentrations to those in the West Bay.

<u>Dioxin/Furan TEQs</u>

- The dioxin/furan TEQ values within the South Puget Sound regional background data set had a very smooth distribution. There was one slightly elevated value (25 ng/kg TEQ) in northeast Budd Inlet that was retained in the data set (see Section 3.2.3).

4.2 South Puget Sound Regional Background Values

Table 1 presents the South Puget Sound 90/90 UTL values for dioxin/furan and cPAH TEQs alongside the Puget Sound 90/90 UTL natural background value (SCUM II, Chapter 10). The 90/90 UTL values were calculated in ProUCL 5.0 (USEPA 2013) consistent with the recommendations in SCUM II, Chapter 10.

The regional background concentrations are as follows:

- The regional background value for dioxin/furan TEQ based on the 90/90 UTL is 19 ng/kg TEQ. The data set on which this value is based is fairly limited in size (n = 26) for the area it is intended to characterize and is best described by a normal distribution.

- The regional background value for cPAH TEQ based on the 90/90 UTL is 78 µg/kg TEQ. The data set on which this value is based is fairly limited in size (n = 22) for the area it is intended to characterize and is best described by a gamma distribution, after excluding one clear outlier.

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Tables

Table 1: Summary statistics and precision for South Puget Sound regional background data sets.

Analyte	N	Detection Frequency	Distribution	Mean	SD	South Puget Sound Regional Background 90/90 UTL	Puget Sound Natural Background 90/90 UTL	Precision
Dioxins/furans	26	23/26	Normal	9.6	5.6	19 ng/kg TEQ	4 ng/kg TEQ	20%
cPAHs	22[1]	22/22	Gamma	41	18	78 µg/kg TEQ	21 µg/kg TEQ	20%

[1] After excluding one elevated value with 240 µg/kg TEQ.

Figures

Figure 1. South Puget Sound

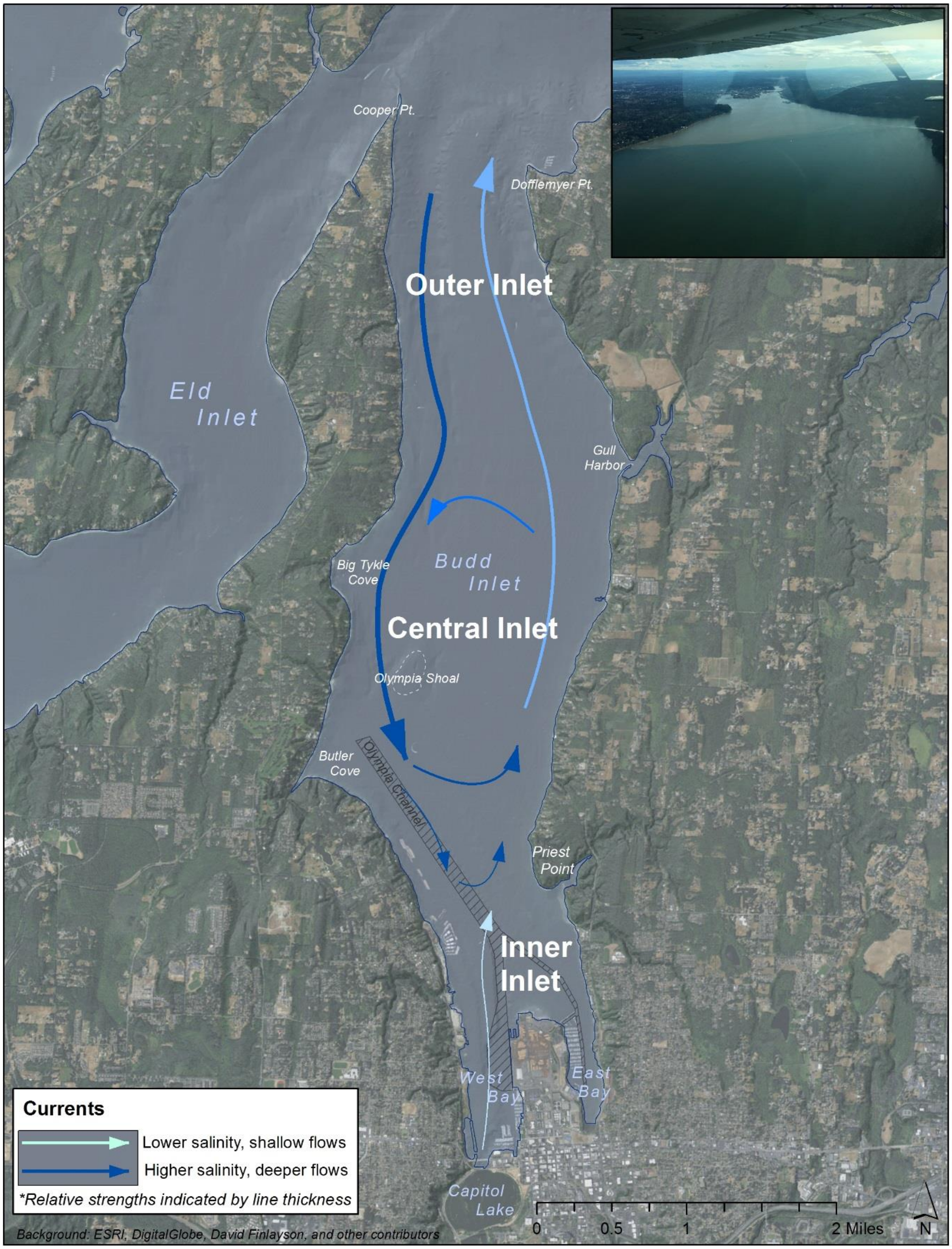

Figure 2. Circulation in Budd Inlet

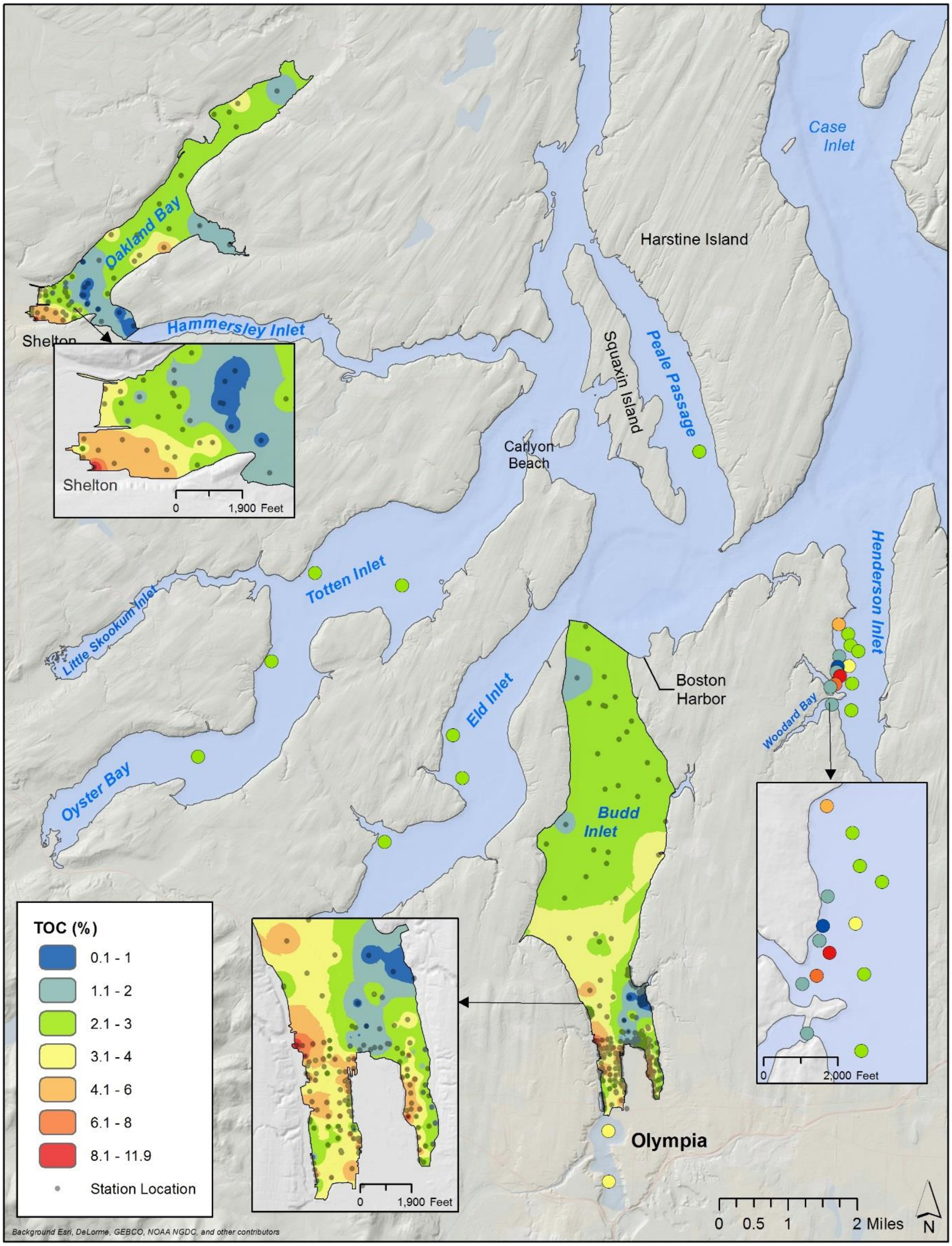

Figure 3. Total Organic Carbon

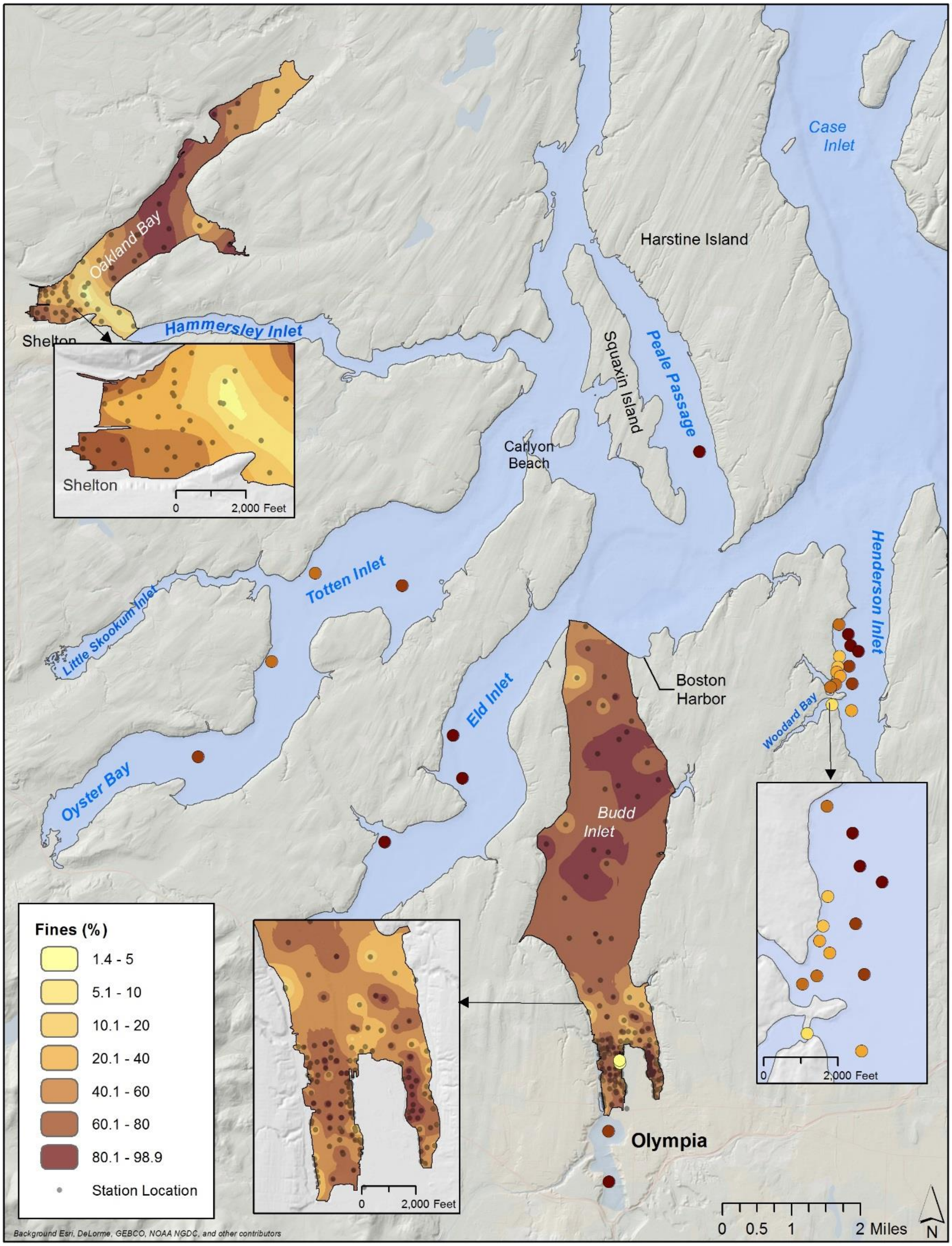

Figure 4. Percent Fines

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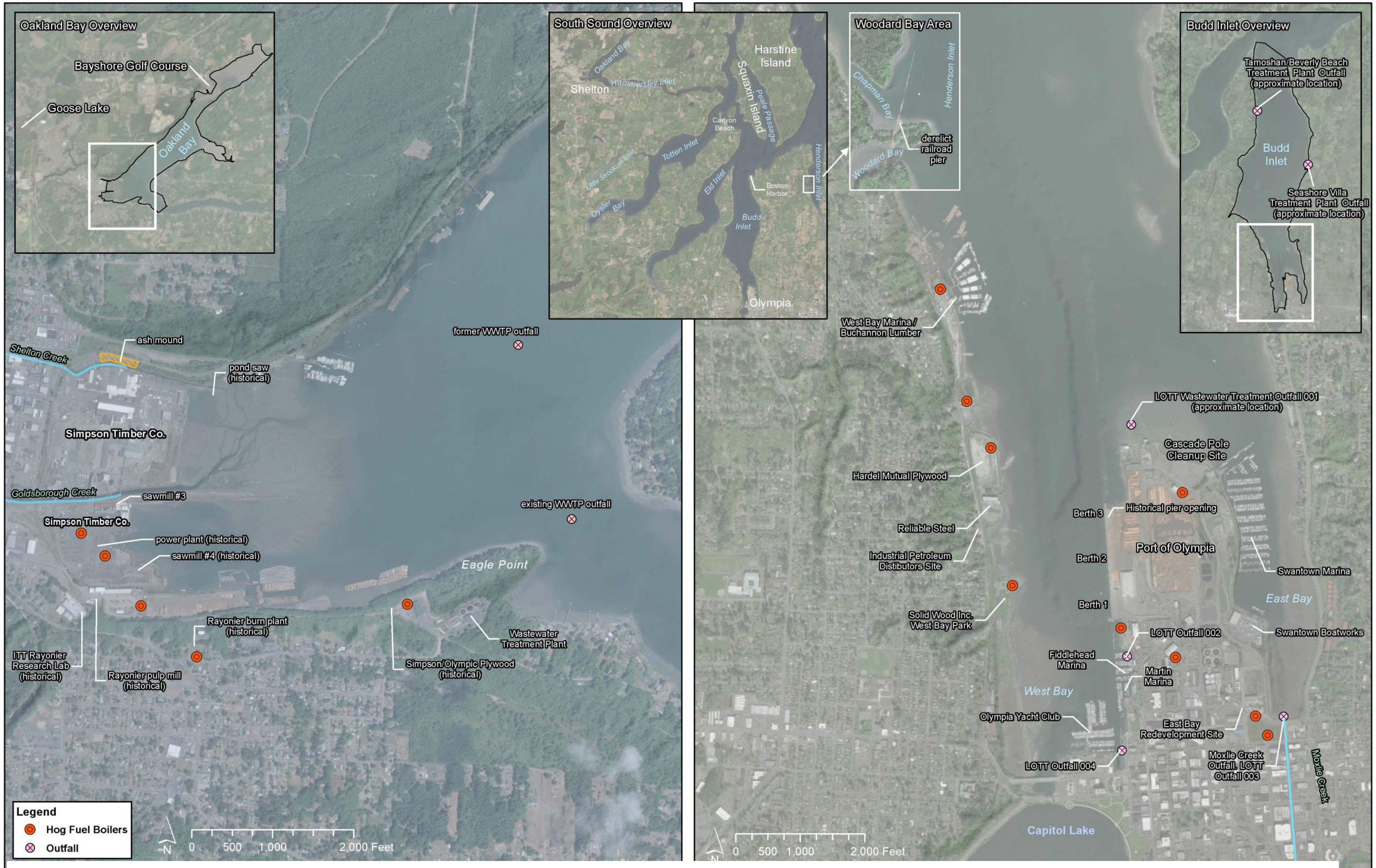

Figure 5. Sites and Sources

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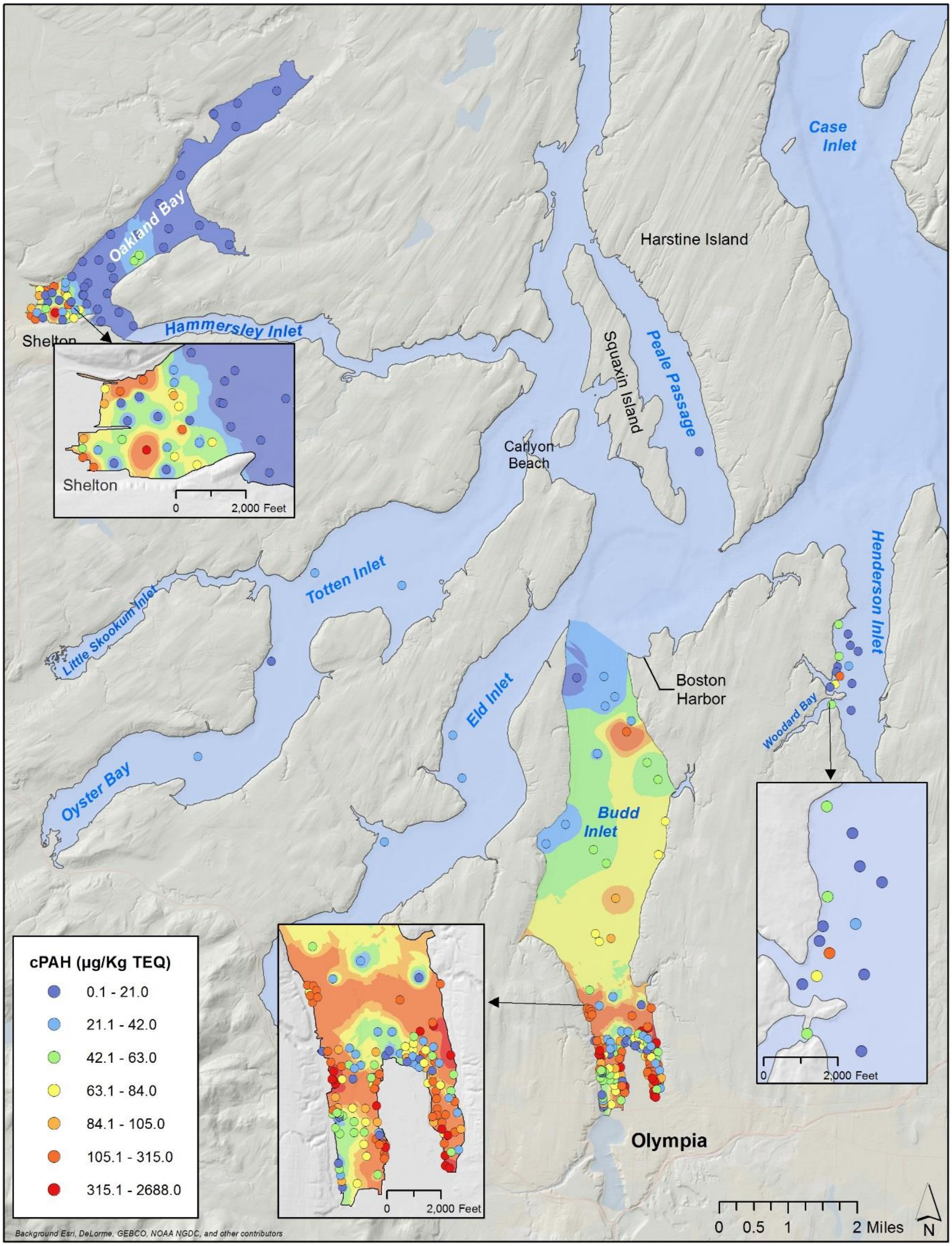

Figure 6. Initial cPAH Data Set

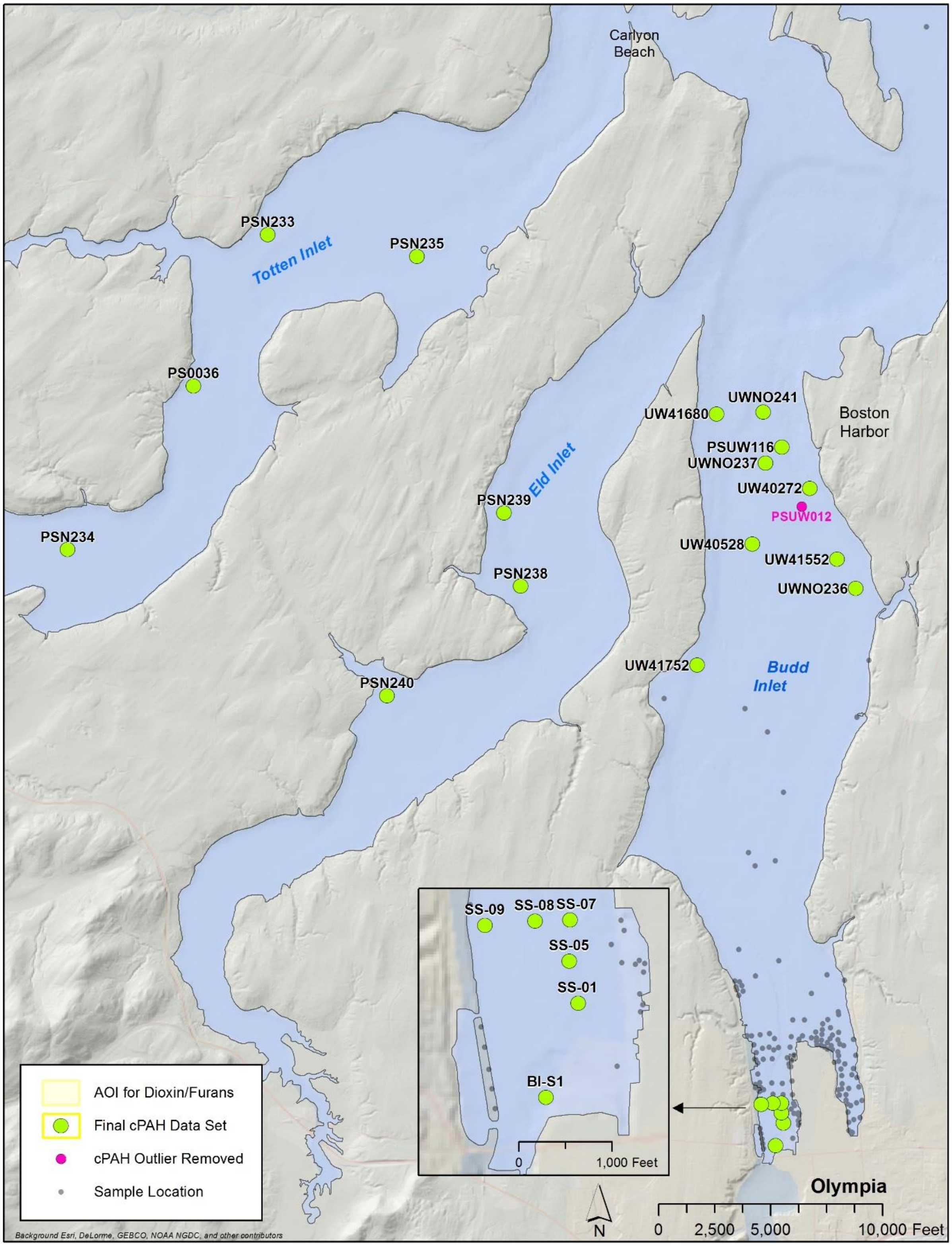

Figure 7. Final cPAH Data Set

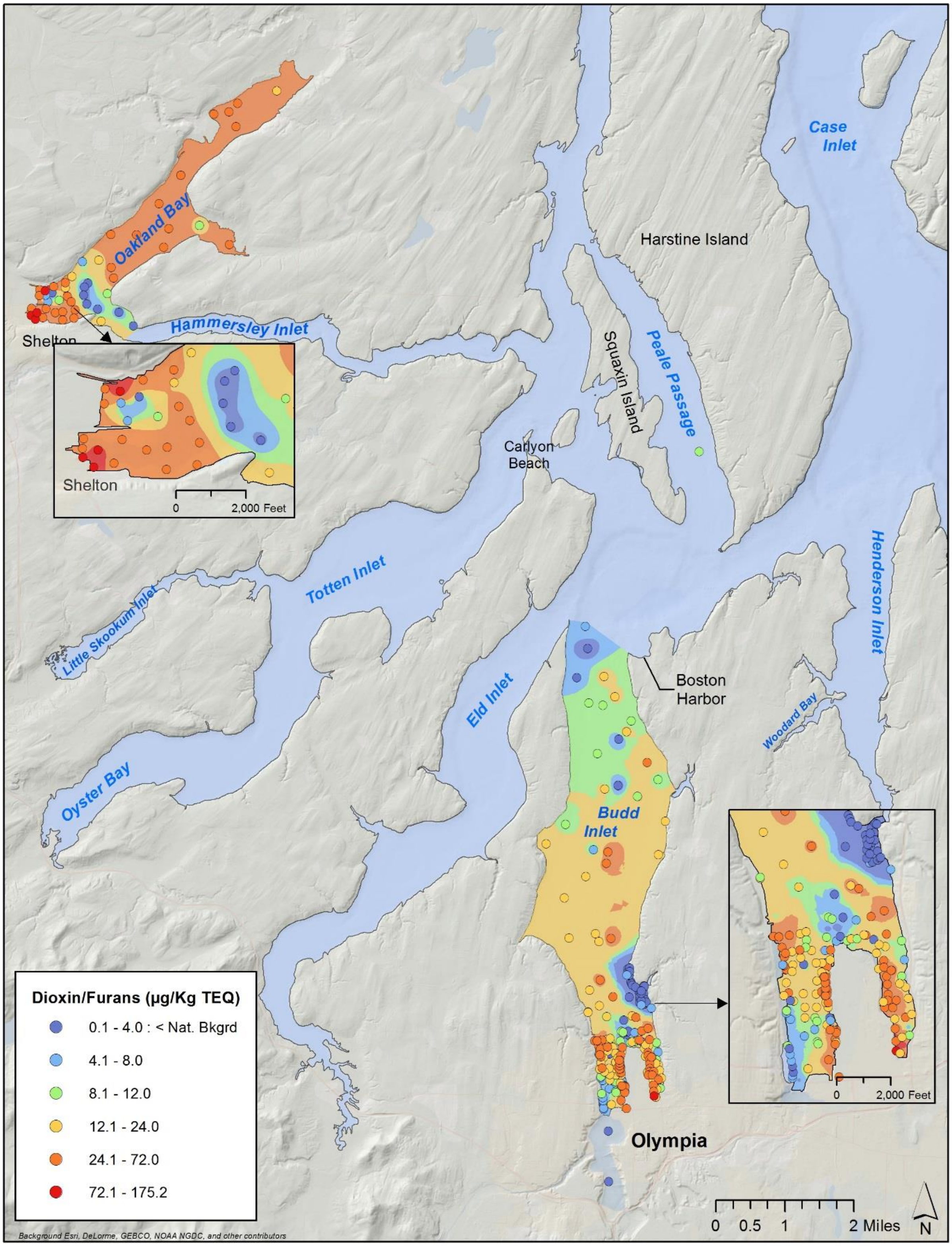

Figure 8. Initial Dioxin/Furan Data Set

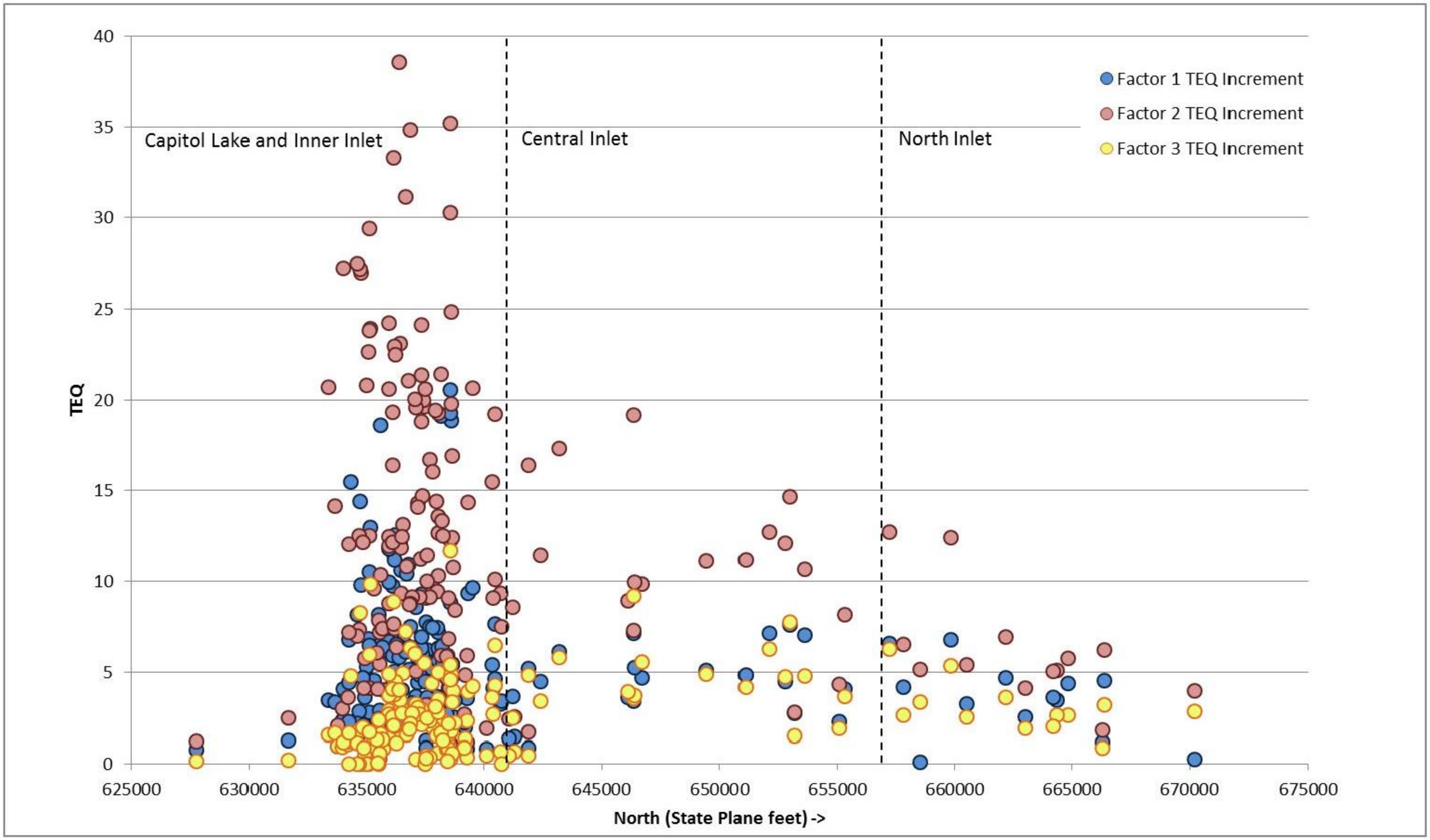

Figure 9. Dioxin/Furan Concentrations

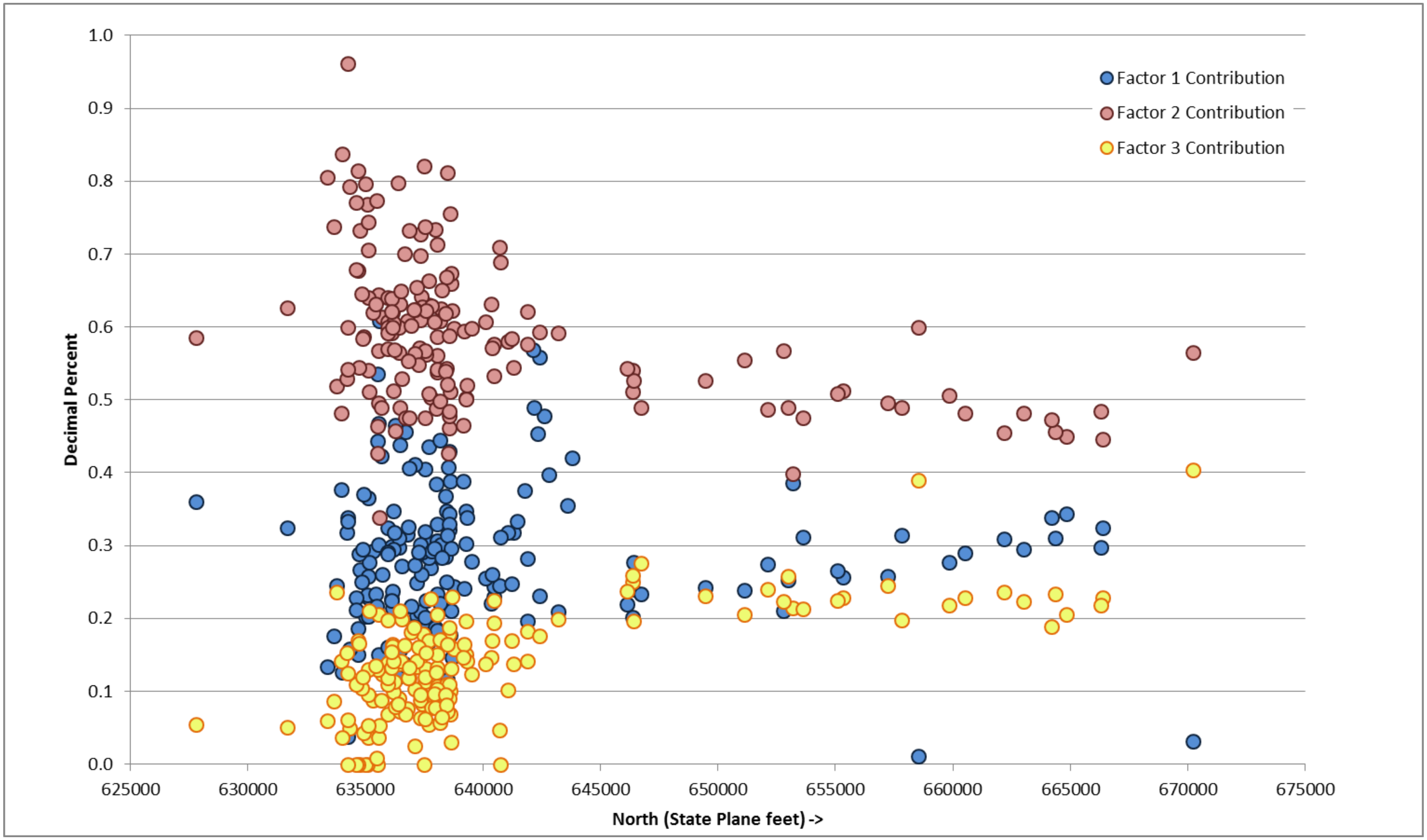

Figure 10. Dioxin/Furan Factor Relative Percentages

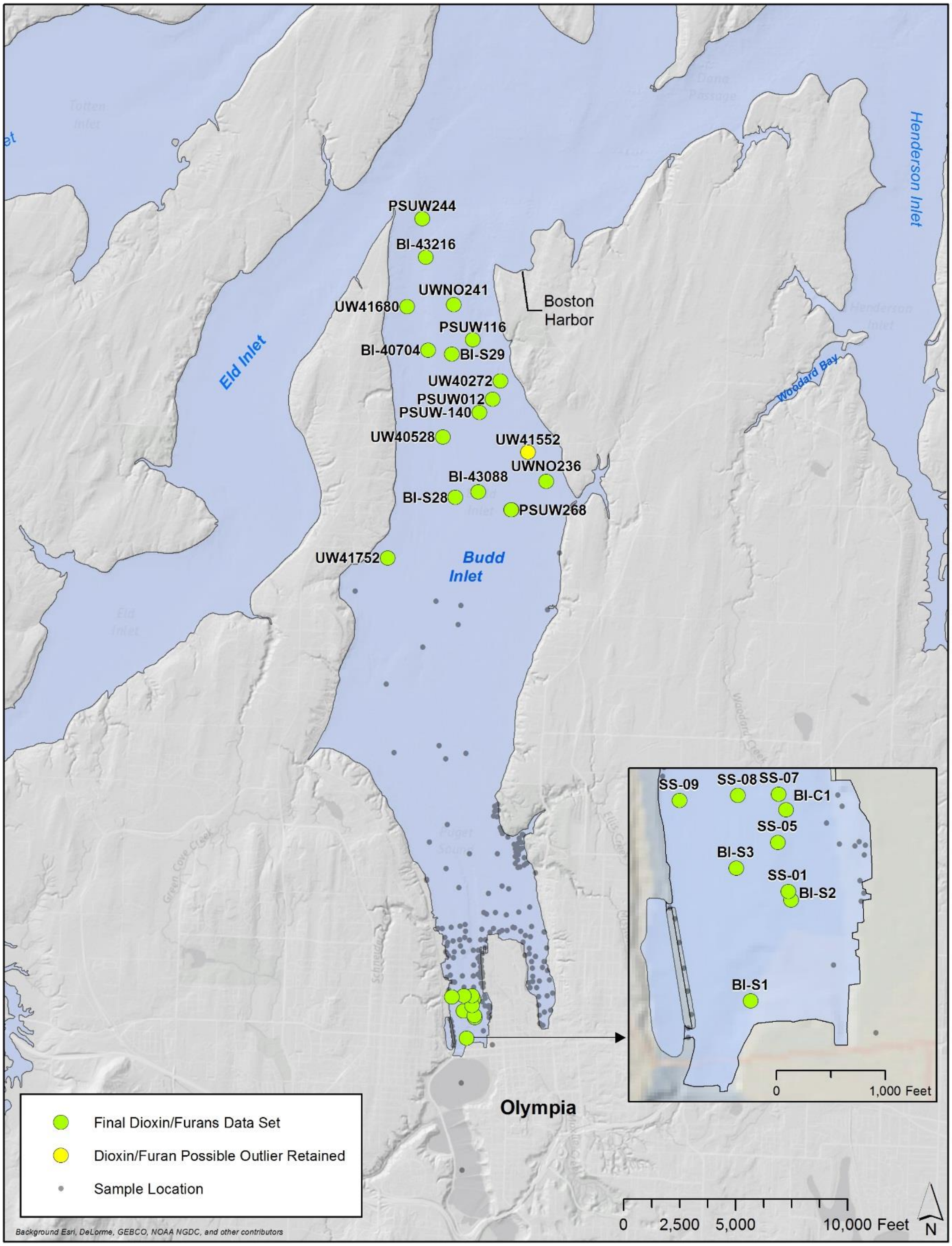

Figure 11. Final Dioxin/Furan Data Set

Appendix A. Data Tables

Table A-1: Screening of EIM data set for cPAHs and dioxins/furans in South Puget Sound.

Table A-2: Summary of dioxin/furan congener and cPAH data used to calculate South Puget Sound Regional Background.

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Table A-1 – Screening of EIM data set for cPAHs and dioxins/furans in South Puget Sound. Grey cells indicate data that were retained for the regional background data sets. Reasons for exclusion of the remaining data are provided in Column K.

Study_ID	Location_ID	Study_Specific_Location_ID	Location_Name	Sample_ID	Year Collected	Upper Depth	Lower Depth	Dioxin/Furan Congeners	cPAH Compounds	Reason for Exclusion
G1300053	G1300053-SS-01	POBI-SS-01_20130312	POBI-SS-01_20130312	POBI-SS-01-0-10-130312	2013	0	10	X	X	
G1300053	G1300053-SS-02	POBI-SS-02_20130312	POBI-SS-02_20130312	POBI-SS-02-0-10-130312	2013	0	10	X	X	Impacted by sites and sources in Budd Inlet
G1300053	G1300053-SS-03	POBI-SS-03_20130312	POBI-SS-03_20130312	POBI-SS-03-0-10-130312	2013	0	10	X	X	Impacted by sites and sources in Budd Inlet
G1300053	G1300053-SS-04	POBI-SS-04_20130312	POBI-SS-04_20130312	POBI-SS-04-0-10-130312	2013	0	10	X	X	Impacted by sites and sources in Budd Inlet
G1300053	G1300053-SS-05	POBI-SS-05_20130312	POBI-SS-05_20130312	POBI-SS-05-0-10-130312	2013	0	10	X	X	
G1300053	G1300053-SS-06	POBI-SS-06_20130312	POBI-SS-06_20130312	POBI-SS-06-0-10-130312	2013	0	10	X	X	Impacted by sites and sources in Budd Inlet
G1300053	G1300053-SS-07	POBI-SS-07_20130312	POBI-SS-07_20130312	POBI-SS-07-0-10-130312	2013	0	10	X	X	
G1300053	G1300053-SS-08	POBI-SS-08_20130313	POBI-SS-08_20130313	POBI-SS-08-0-10-130313	2013	0	10	X	X	
G1300053	G1300053-SS-09	POBI-SS-09_20130312	POBI-SS-09_20130312	POBI-SS-09-0-10-130312	2013	0	10	X	X	
G1300053	G1300053-SS-10	POBI-SS-10_20130311	POBI-SS-10_20130311	POBI-SS-10-0-10-130311	2013	0	10	X	X	Impacted by sites and sources in Budd Inlet
G1300053	G1300053-SS-11	POBI-SS-11_20130312	POBI-SS-11_20130312	POBI-SS-11-0-10-130312	2013	0	10	X	X	Impacted by sites and sources in Budd Inlet
G1300053	G1300053-SS-12	POBI-SS-12_20130313	POBI-SS-12_20130313	POBI-SS-12-0-10-130313	2013	0	10	X	X	Impacted by sites and sources in Budd Inlet
G1300053	G1300053-SS-13	POBI-SS-13_20130312	POBI-SS-13_20130312	POBI-SS-13-0-10-130312	2013	0	10	X	X	Impacted by sites and sources in Budd Inlet
G1300053	G1300053-SS-14	POBI-SS-14_20130312	POBI-SS-14_20130312	POBI-SS-14-0-10-130312	2013	0	10	X	X	Impacted by sites and sources in Budd Inlet
G1300053	G1300053-SS-15	POBI-SS-15_20130313	POBI-SS-15_20130313	POBI-SS-15-0-10-130313	2013	0	10	X	X	Impacted by sites and sources in Budd Inlet
G1300053	G1300053-SS-16	POBI-SS-16_20130312	POBI-SS-16_20130312	POBI-SS-16-0-10-130312	2013	0	10	X	X	Impacted by sites and sources in Budd Inlet
G1300053	G1300053-SS-17	POBI-SS-17_20130319	POBI-SS-17_20130319	POBI-SS-17-0-10-130313	2013	0	10	X	X	Impacted by sites and sources in Budd Inlet
G1300053	G1300053-SS-18	POBI-SS-18_20130312	POBI-SS-18_20130312	POBI-SS-18-0-10-130312	2013	0	10	X	X	Impacted by sites and sources in Budd Inlet

Table A-1 – Screening of EIM data set for cPAHs and dioxins/furans in South Puget Sound. Grey cells indicate data that were retained for the regional background data sets. Reasons for exclusion of the remaining data are provided in Column K.

Study_ID	Location_ID	Study_Specific_Location_ID	Location_Name	Sample_ID	Year Collected	Upper Depth	Lower Depth	Dioxin/Furan Congeners	cPAH Compounds	Reason for Exclusion
G1300053	G1300053-SS-19	POBI-SS-19_20130311	POBI-SS-19_20130311	POBI-SS-19-0-10-130311	2013	0	10	X	X	Impacted by sites and sources in Budd Inlet
G1300053	G1300053-SS-20	POBI-SS-20_20130311	POBI-SS-20_20130311	POBI-SS-20-0-10-130311	2013	0	10	X	X	Impacted by sites and sources in Budd Inlet
G1300053	G1300053-SS-21	POBI-SS-21_20130306	POBI-SS-21_20130306	POBI-SS-21-0-10-130306	2013	0	10	X	X	Impacted by sites and sources in Budd Inlet
G1300053	G1300053-SS-22	POBI-SS-22_20130306	POBI-SS-22_20130306	POBI-SS-22-0-10-130306	2013	0	10	X	X	Impacted by sites and sources in Budd Inlet
G1300053	G1300053-SS-23	POBI-SS-23_20130311	POBI-SS-23_20130311	POBI-SS-23-0-10-130311	2013	0	10	X	X	Impacted by sites and sources in Budd Inlet
G1300053	G1300053-SS-24	POBI-SS-24_20130311	POBI-SS-24_20130311	POBI-SS-24-0-10-130311	2013	0	10	X	X	Impacted by sites and sources in Budd Inlet
G1300053	G1300053-SS-25	POBI-SS-25_20130311	POBI-SS-25_20130311	POBI-SS-25-0-10-130311	2013	0	10	X	X	Impacted by sites and sources in Budd Inlet
G1300053	G1300053-SS-26	POBI-SS-26_20130306	POBI-SS-26_20130306	POBI-SS-26-0-10-130306	2013	0	10	X	X	Impacted by sites and sources in Budd Inlet
G1300053	G1300053-SS-27	POBI-SS-27_20130306	POBI-SS-27_20130306	POBI-SS-27-0-10-130306	2013	0	10	X	X	Impacted by sites and sources in Budd Inlet
G1300053	G1300053-SS-28	POBI-SS-28_20130311	POBI-SS-28_20130311	POBI-SS-28-0-10-130311	2013	0	10	X	X	Impacted by sites and sources in Budd Inlet
G1300053	G1300053-SS-29	POBI-SS-29_20130311	POBI-SS-29_20130311	POBI-SS-29-0-10-130311	2013	0	10	X	X	Impacted by sites and sources in Budd Inlet
G1300053	G1300053-SS-30	POBI-SS-30_20130311	POBI-SS-30_20130311	POBI-SS-30-0-10-130311	2013	0	10	X	X	Collected from low concentration area in the vicinity of the LOTT outfall in Budd Inlet
G1300053	G1300053-SS-31	POBI-SS-31_20130306	POBI-SS-31_20130306	POBI-SS-31-0-10-130306	2013	0	10	X	X	Collected from low concentration area in the vicinity of the LOTT outfall in Budd Inlet
G1300053	G1300053-SS-32	POBI-SS-32_20130308	POBI-SS-32_20130308	POBI-SS-32-0-10-130308	2013	0	10	X	X	Collected from low concentration area in the vicinity of the LOTT outfall in Budd Inlet
G1300053	G1300053-SS-33	POBI-SS-33_20130308	POBI-SS-33_20130308	POBI-SS-33-0-10-130308	2013	0	10	X	X	Collected from low concentration area in the vicinity of the LOTT outfall in Budd Inlet
G1300053	G1300053-SS-34	POBI-SS-34_20130311	POBI-SS-34_20130311	POBI-SS-34-0-10-130311	2013	0	10	X	X	Collected from low concentration area in the vicinity of the LOTT outfall in Budd Inlet
G1300053	G1300053-SS-35	POBI-SS-35_20130311	POBI-SS-35_20130311	POBI-SS-35-0-10-130311	2013	0	10	X	X	Impacted by sites and sources in Budd Inlet
G1300053	G1300053-SS-36	POBI-SS-36_20130307	POBI-SS-36_20130307	POBI-SS-36-0-10-130307	2013	0	10	X	X	Impacted by sites and sources in Budd Inlet

Table A-1 – Screening of EIM data set for cPAHs and dioxins/furans in South Puget Sound. Grey cells indicate data that were retained for the regional background data sets. Reasons for exclusion of the remaining data are provided in Column K.

Study_ID	Location_ID	Study_Specific_Location_ID	Location_Name	Sample_ID	Year Collected	Upper Depth	Lower Depth	Dioxin/Furan Congeners	cPAH Compounds	Reason for Exclusion
G1300053	G1300053-SS-37	POBI-SS-37_20130311	POBI-SS-37_20130311	POBI-SS-37-0-10-130311	2013	0	10	X	X	Impacted by sites and sources in Budd Inlet
G1300053	G1300053-SS-38	POBI-SS-38_20130307	POBI-SS-38_20130307	POBI-SS-38-0-10-130307	2013	0	10	X	X	Impacted by sites and sources in Budd Inlet
G1300053	G1300053-SS-39	POBI-SS-39_20130307	POBI-SS-39_20130307	POBI-SS-39-0-10-130307	2013	0	10	X	X	Impacted by sites and sources in Budd Inlet
G1300053	G1300053-SS-40	POBI-SS-40_20130307	POBI-SS-40_20130307	POBI-SS-40-0-10-130307	2013	0	10	X	X	Impacted by sites and sources in Budd Inlet
G1300053	G1300053-SS-41	POBI-SS-41_20130307	POBI-SS-41_20130307	POBI-SS-41-0-10-130307	2013	0	10	X	X	Impacted by sites and sources in Budd Inlet
G1300053	G1300053-SS-42	POBI-SS-42_20130307	POBI-SS-42_20130307	POBI-SS-42-0-10-130307	2013	0	10	X	X	Impacted by sites and sources in Budd Inlet
G1300053	G1300053-SS-43	POBI-SS-43_20130307	POBI-SS-43_20130307	POBI-SS-43-0-10-130307	2013	0	10	X	X	Impacted by sites and sources in Budd Inlet
G1300053	G1300053-SS-44	POBI-SS-44_20130306	POBI-SS-44_20130306	POBI-SS-44-0-10-130306	2013	0	10	X	X	Impacted by sites and sources in Budd Inlet
G1300053	G1300053-SS-45	POBI-SS-45_20130308	POBI-SS-45_20130308	POBI-SS-45-0-10-130308	2013	0	10	X	X	Impacted by sites and sources in Budd Inlet
G1300053	G1300053-SS-46	POBI-SS-46_20130307	POBI-SS-46_20130307	POBI-SS-46-0-10-130307	2013	0	10	X	X	Impacted by sites and sources in Budd Inlet
G1300053	G1300053-SS-47	POBI-SS-47_20130308	POBI-SS-47_20130308	POBI-SS-47-0-10-130308	2013	0	10	X	X	Impacted by sites and sources in Budd Inlet
G1300053	G1300053-SS-48	POBI-SS-48_20130308	POBI-SS-48_20130308	POBI-SS-48-0-10-130308	2013	0	10	X	X	Impacted by sites and sources in Budd Inlet
G1300053	G1300053-SS-49	POBI-SS-49_20130308	POBI-SS-49_20130308	POBI-SS-49-0-10-130308	2013	0	10	X	X	Impacted by sites and sources in Budd Inlet
G1300053	G1300053-SS-50	POBI-SS-50_20130307	POBI-SS-50_20130307	POBI-SS-50-0-10-130307	2013	0	10	X	X	Impacted by sites and sources in Budd Inlet
G1300053	G1300053-SS-51	POBI-SS-51_20130311	POBI-SS-51_20130311	POBI-SS-51-0-10-130311	2013	0	10	X	X	Impacted by sites and sources in Budd Inlet
G1300053	G1300053-SS-52	POBI-SS-52_20130311	POBI-SS-52_20130311	POBI-SS-52-0-10-130311	2013	0	10	X	X	Impacted by sites and sources in Budd Inlet
G1300053	G1300053-SS-53	POBI-SS-53_20130308	POBI-SS-53_20130308	POBI-SS-53-0-10-130308	2013	0	10	X	X	Impacted by sites and sources in Budd Inlet
G1300053	G1300053-SS-54	POBI-SS-54_20130308	POBI-SS-54_20130308	POBI-SS-54-0-10-130308	2013	0	10	X	X	Impacted by sites and sources in Budd Inlet

Table A-1 – Screening of EIM data set for cPAHs and dioxins/furans in South Puget Sound. Grey cells indicate data that were retained for the regional background data sets. Reasons for exclusion of the remaining data are provided in Column K.

Study_ID	Location_ID	Study_Specific_Location_ID	Location_Name	Sample_ID	Year Collected	Upper Depth	Lower Depth	Dioxin/Furan Congeners	cPAH Compounds	Reason for Exclusion
G1300053	G1300053-SS-55	POBI-SS-55_20130307	POBI-SS-55_20130307	POBI-SS-55-0-10-130307	2013	0	10	X	X	Impacted by sites and sources in Budd Inlet
G1300053	G1300053-SS-56	POBI-SS-56_20130311	POBI-SS-56_20130311	POBI-SS-56-0-10-130311	2013	0	10	X	X	Impacted by sites and sources in Budd Inlet
G1300053	G1300053-SS-57	POBI-SS-57_20130307	POBI-SS-57_20130307	POBI-SS-57-0-10-130307	2013	0	10	X	X	Impacted by sites and sources in Budd Inlet
G1300053	G1300053-SS-58	POBI-SS-58_20130312	POBI-SS-58_20130312	POBI-SS-58-0-10-130312	2013	0	10	X	X	Impacted by sites and sources in Budd Inlet
G1300053	G1300053-SS-59	POBI-SS-59_20130307	POBI-SS-59_20130307	POBI-SS-59-0-10-130307	2013	0	10	X	X	Impacted by sites and sources in Budd Inlet
G1300053	G1300053-SS-60	POBI-SS-60_20130307	POBI-SS-60_20130307	POBI-SS-60-0-10-130307	2013	0	10	X	X	Impacted by sites and sources in Budd Inlet
G1300053	G1300053-SS-61	POBI-SS-61_20130522	POBI-SS-61_20130522	POBI-SS-61-0-10-130522	2013	0	10	X	X	Impacted by sites and sources in Budd Inlet
G1300053	G1300053-SS-62	POBI-SS-62_20130522	POBI-SS-62_20130522	POBI-SS-62-0-10-130522	2013	0	10	X	X	Impacted by sites and sources in Budd Inlet
G1300053	G1300053-SS-63	POBI-SS-63_20130522	POBI-SS-63_20130522	POBI-SS-63-0-10-130522	2013	0	10	X	X	Impacted by sites and sources in Budd Inlet
G1300053	G1300053-SS-64	POBI-SS-64_20130522	POBI-SS-64_20130522	POBI-SS-64-0-10-130522	2013	0	10	X	X	Impacted by sites and sources in Budd Inlet
G1300053	G1300053-SS-65	POBI-SS-65_20130522	POBI-SS-65_20130522	POBI-SS-65-0-10-130522	2013	0	10	X	X	Impacted by sites and sources in Budd Inlet
AODE5272	HC-WB-SS-001	HC-Westbay-SS-001	HC-WESTBAY-SS-001	HC-WB-SS-001	2011	0	10	X	X	Impacted by sites and sources in Budd Inlet
AODE5272	HC-WB-SS-002	HC-Westbay-SS-002	HC-WESTBAY-SS-002	HC-WB-SS-002	2011	0	10	X	X	Impacted by sites and sources in Budd Inlet
AODE5272	HC-WB-SS-003	HC-Westbay-SS-003	HC-WESTBAY-SS-003	HC-WB-SS-003	2011	0	10	X	X	Impacted by sites and sources in Budd Inlet
AODE5272	HC-WB-SS-004	HC-Westbay-SS-004	HC-WESTBAY-SS-004	HC-WB-SS-004	2011	0	10	X	X	Impacted by sites and sources in Budd Inlet
AODE5272	HC-WB-SS-005	HC-Westbay-SS-005	HC-WESTBAY-SS-005	HC-WB-SS-005	2011	0	10	X	X	Impacted by sites and sources in Budd Inlet
AODE5272	HC-WB-SS-006	HC-Westbay-SS-006	HC-WESTBAY-SS-006	HC-WB-SS-006	2011	0	10	X	X	Impacted by sites and sources in Budd Inlet
AODE5272	HC-WB-SS-007	HC-Westbay-SS-007	HC-WESTBAY-SS-007	HC-WB-SS-007	2011	0	10	X	X	Impacted by sites and sources in Budd Inlet

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Study_ID	Location_ID	Study_Specific_Location_ID	Location_Name	Sample_ID	Year Collected	Upper Depth	Lower Depth	Dioxin/Furan Congeners	cPAH Compounds	Reason for Exclusion
AODE5272	HC-WB-SS-008	HC-Westbay-SS-008	HC-WESTBAY-SS-008	HC-WB-SS-008	2011	0	10	X	X	Impacted by sites and sources in Budd Inlet
AJOH0049	SWANTOWN2	SWANTOWN2	SWANTOWN BOATWORKS	6080402	2006	0	2		X	Impacted by sites and sources in Budd Inlet
BOLD 2008	SS_0	SS_0	SS_0	SS_0	2008	0	14	X	X	Impacted by sites and sources in Budd Inlet
Budd Inlet Hardel 07	C396_HRDL_GS-01	GS-1	Station GS-01 off Hardel	GS-1	2007	0	10	X	X	Impacted by sites and sources in Budd Inlet
Budd Inlet Hardel 07	C396_HRDL_GS-02	GS-2	Station GS-02 off Hardel	GS-2	2007	0	10	X	X	Impacted by sites and sources in Budd Inlet
Budd Inlet Hardel 07	C396_HRDL_GS0-3	GS-4	Station GS-03 off Hardel	GS-4	2007	0	10	X		Impacted by sites and sources in Budd Inlet
BUDD07	BI-C10-0-10cm	BI-C10-0-10cm SBI, EB	BI-C10-0-10cm SBI, EB	BI-C10	2007	0	10	X	X	Impacted by sites and sources in Budd Inlet
BUDD07	BI-C1-0-10cm	BI-C1-0-10cm SBI, turning basin	BI-C1-0-10cm SBI, turning basin	BI-C1	2007	0	10	X		
BUDD07	BI-C12-0-10cm	BI-C12-0-10cm NBI	BI-C12-0-10cm NBI	BI-C12	2007	0	10	X		Impacted by sites and sources in Budd Inlet
BUDD07	BI-C13-0-10cm	BI-C13-0-10cm SBI, near Cascade Pole	BI-C13-0-10cm SBI, near Cascade Pole	BI-C13	2007	0	10	X		Impacted by sites and sources in Budd Inlet
BUDD07	BI-C14-0-10cm	BI-C14-0-10cm SBI, PO	BI-C14-0-10cm SBI, PO	BI-C14	2007	0	10	X	X	Impacted by sites and sources in Budd Inlet
BUDD07	BI-C15-0-10cm	BI-C15-0-10cm SBI, PO berth	BI-C15-0-10cm SBI, PO berth	BI-C15	2007	0	10	X		Impacted by sites and sources in Budd Inlet
BUDD07	BI-C16-0-10cm	BI-C16-0-10cm SBI, PO berth	BI-C16-0-10cm SBI, PO berth	BI-C16	2007	0	10	X		Impacted by sites and sources in Budd Inlet
BUDD07	BI-C17-0-10cm	BI-C17-0-10cm SBI	BI-C17-0-10cm SBI	BI-C17	2007	0	10	X		Impacted by sites and sources in Budd Inlet
BUDD07	BI-C18-0-10cm	BI-C18-0-10cm SBI, inner EB	BI-C18-0-10cm SBI, inner EB	BI-C18	2007	0	10	X	X	Impacted by sites and sources in Budd Inlet
BUDD07	BI-C2-0-10cm	BI-C2-0-10cm SBI, WB	BI-C2-0-10cm SBI, WB	BI-C2	2007	0	10	X		Impacted by sites and sources in Budd Inlet
BUDD07	BI-C5-0-10cm	BI-C5-0-10cm SBI, PO berth	BI-C5-0-10cm SBI, PO berth	BI-C5	2007	0	10	X		Impacted by sites and sources in Budd Inlet
BUDD07	BI-C6-0-10cm	BI-C6-0-10cm SBI, mouth of WB	BI-C6-0-10cm SBI, mouth of WB	BI-C6	2007	0	10	X		Impacted by sites and sources in Budd Inlet
BUDD07	BI-C7-0-10cm	BI-C7-0-10cm SBI, north of peninsula	BI-C7-0-10cm SBI, north of peninsula	BI-C7	2007	0	10	X		Collected from low concentration area in the vicinity of the LOTT outfall in Budd Inlet

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Study_ID	Location_ID	Study_Specific_Location_ID	Location_Name	Sample_ID	Year Collected	Upper Depth	Lower Depth	Dioxin/Furan Congeners	cPAH Compounds	Reason for Exclusion
BUDD07	BI-C8-0-10cm	BI-C8-0-10cm SBI, north of peninsula	BI-C8-0-10cm SBI, north of peninsula	BI-C8	2007	0	10	X		Collected from low concentration area in the vicinity of the LOTT outfall in Budd Inlet
BUDD07	BI-C9-0-10cm	BI-C9-0-10cm SBI, mouth of EB	BI-C9-0-10cm SBI, mouth of EB	BI-C9	2007	0	10	X		Impacted by sites and sources in Budd Inlet
BUDD07	BI-S1-0-10cm	BI-S1-0-10cm SBI, inner WB	BI-S1-0-10cm SBI, inner WB	BI-S1	2007	0	10	X	X	
BUDD07	BI-S11-0-10cm	BI-S11-0-10cm SBI, inner WB	BI-S11-0-10cm SBI, inner WB	BI-S11	2007	0	10	X	X	Impacted by sites and sources in Budd Inlet
BUDD07	BI-S12-0-10cm	BI-S12-0-10cm SBI, north of Cascade Pole	BI-S12-0-10cm SBI, north of Cascade Pole	BI-S12	2007	0	10	X	X	Impacted by sites and sources in Budd Inlet
BUDD07	BI-S13-0-10cm	BI-S13-0-10cm SBI, north of peninsula	BI-S13-0-10cm SBI, north of peninsula	BI-S13	2007	0	10	X		Impacted by sites and sources in Budd Inlet
BUDD07	BI-S14-0-10cm	BI-S14-0-10cm SBI, north of peninsula	BI-S14-0-10cm SBI, north of peninsula	BI-S14	2007	0	10	X		Collected from low concentration area in the vicinity of the LOTT outfall in Budd Inlet
BUDD07	BI-S15-0-10cm	BI-S15-0-10cm SBI, near Priest Pt Park	BI-S15-0-10cm SBI, near Priest Pt Park	BI-S15	2007	0	10	X	X	Impacted by sites and sources in Budd Inlet
BUDD07	BI-S16-0-10cm	BI-S16-0-10cm SBI, near WB Marina	BI-S16-0-10cm SBI, near WB Marina	BI-S16	2007	0	10	X		Impacted by sites and sources in Budd Inlet
BUDD07	BI-S17-0-10cm	BI-S17-0-10cm SBI, near WB Marina	BI-S17-0-10cm SBI, near WB Marina	BI-S17	2007	0	10	X	X	Impacted by sites and sources in Budd Inlet
BUDD07	BI-S18-0-10cm	BI-S18-0-10cm SBI	BI-S18-0-10cm SBI	BI-S18	2007	0	10	X	X	Impacted by sites and sources in Budd Inlet
BUDD07	BI-S19-0-10cm	BI-S19-0-10cm SBI, near Priest Pt Park	BI-S19-0-10cm SBI, near Priest Pt Park	BI-S19	2007	0	10	X		Impacted by sites and sources in Budd Inlet
BUDD07	BI-S2-0-10cm	BI-S2-0-10cm SBI, inner WB	BI-S2-0-10cm SBI, inner WB	BI-S2	2007	0	10	X		
BUDD07	BI-S21-0-10cm	BI-S21-0-10cm SBI, near WB Marina	BI-S21-0-10cm SBI, near WB Marina	BI-S21	2007	0	10	X	X	Impacted by sites and sources in Budd Inlet
BUDD07	BI-S23-0-10cm	BI-S23-0-10cm NBI	BI-S23-0-10cm NBI	BI-S23	2007	0	10	X		Impacted by sites and sources in Budd Inlet
BUDD07	BI-S26-0-10cm	BI-S26-0-10cm NBI	BI-S26-0-10cm NBI	BI-S26	2007	0	10	X		Impacted by sites and sources in Budd Inlet
BUDD07	BI-S28-0-10cm	BI-S28-0-10cm NBI	BI-S28-0-10cm NBI	BI-S28	2007	0	10	X		
BUDD07	BI-S29-0-10cm	BI-S29-0-10cm NBI	BI-S29-0-10cm NBI	BI-S29	2007	0	10	X		

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BUDD07	BI-S3-0-10cm	BI-S3-0-10cm SBI, inner WB	BI-S3-0-10cm SBI, inner WB	BI-S3	2007	0	10	X		
BUDD07	BI-S31-0-10cm	BI-S31-0-10cm SBI, boat launch	BI-S31-0-10cm SBI, boat launch	BI-S31	2007	0	10	X	X	Impacted by sites and sources in Budd Inlet
BUDD07	BI-S32-0-10cm	BI-S32-0-10cm SBI, Reliable Steel	BI-S32-0-10cm SBI, Reliable Steel	BI-S32	2007	0	10	X	X	Impacted by sites and sources in Budd Inlet
BUDD07	BI-S33-0-10cm	BI-S33-0-10cm SBI, Reliable Steel	BI-S33-0-10cm SBI, Reliable Steel	BI-S33	2007	0	10	X		Impacted by sites and sources in Budd Inlet
BUDD07	BI-S34	BI-S34 SBI, Park south of PO	BI-S34 SBI, Park south of PO	BI-S34	2007	0	10	X	X	Impacted by sites and sources in Budd Inlet
BUDD07	BI-S35-0-10cm	BI-S35-0-10cm SBI, mouth of WB	BI-S35-0-10cm SBI, mouth of WB	BI-S35	2007	0	10	X		Impacted by sites and sources in Budd Inlet
BUDD07	BI-S36-0-10cm	BI-S36-0-10cm SBI, PO berth	BI-S36-0-10cm SBI, PO berth	BI-S36	2007	0	10	X		Impacted by sites and sources in Budd Inlet
BUDD07	BI-S37-0-10cm	BI-S37-0-10cm SBI, PO berth	BI-S37-0-10cm SBI, PO berth	BI-S37	2007	0	10	X		Impacted by sites and sources in Budd Inlet
BUDD07	BI-S38-0-10cm	BI-S38-0-10cm SBI, PO	BI-S38-0-10cm SBI, PO	BI-S38	2007	0	10	X		Impacted by sites and sources in Budd Inlet
BUDD07	BI-S4-0-10cm	BI-S4-0-10cm SBI, inner WB	BI-S4-0-10cm SBI, inner WB	BI-S4	2007	0	10	X	X	Impacted by sites and sources in Budd Inlet
BUDD07	BI-S5-0-10cm	BI-S5-0-10cm SBI, near Reliable Steel	BI-S5-0-10cm SBI, near Reliable Steel	BI-S5	2007	0	10	X	X	Impacted by sites and sources in Budd Inlet
BUDD07	BI-S6-0-10cm	BI-S6-0-10cm SBI, near Hardel	BI-S6-0-10cm SBI, near Hardel	BI-S6	2007	0	10	X		Impacted by sites and sources in Budd Inlet
BUDD07	BI-S7-0-10cm	BI-S7-0-10cm SBI, near Hardel	BI-S7-0-10cm SBI, near Hardel	BI-S7	2007	0	10	X	X	Impacted by sites and sources in Budd Inlet
BUDD07	BI-S9-0-10cm	BI-S9-0-10cm SBI, EB	BI-S9-0-10cm SBI, EB	BI-S9	2007	0	10	X	X	Impacted by sites and sources in Budd Inlet
BUDD07	BI-TISSUE1	BI-TISSUE1 SBI, Reliable Steel	BI-TISSUE1 SBI, Reliable Steel	BI-TISSUE1-SEDIMENT	2007	0	10	X	X	Impacted by sites and sources in Budd Inlet
BUDD07	BI-TISSUE1B	BI-TISSUE1B SBI, Reliable Steel	BI-TISSUE1B SBI, Reliable Steel	BI-TISSUE1B-SEDIMENT	2007	0	10	X	X	Impacted by sites and sources in Budd Inlet
BUDD07	BI-TISSUE2	BI-TISSUE2 SBI, near Priest Pt Park	BI-TISSUE2 SBI, near Priest Pt Park	BI-TISSUE2-SEDIMENT	2007	0	10	X	X	Impacted by sites and sources in Budd Inlet
BUDD07	BI-TISSUE3	BI-TISSUE3 SBI, near Cascade Pole	BI-TISSUE3 SBI, near Cascade Pole	BI-TISSUE3-SEDIMENT	2007	0	10	X		Impacted by sites and sources in Budd Inlet
BUDD07	CL-S2	CL-S2 Capitol Lake	CL-S2 Capitol Lake	CL-S2	2007	0	10	X	X	Impacted by sites and sources in Budd Inlet
BUDD07	CL-S5	CL-S5 Capitol Lake	CL-S5 Capitol Lake	CL-S5	2007	0	10	X	X	Impacted by sites and sources in Budd Inlet

Table A-1 – Screening of EIM data set for cPAHs and dioxins/furans in South Puget Sound. Grey cells indicate data that were retained for the regional background data sets. Reasons for exclusion of the remaining data are provided in Column K.

Study_ID	Location_ID	Study_Specific_Location_ID	Location_Name	Sample_ID	Year Collected	Upper Depth	Lower Depth	Dioxin/Furan Congeners	cPAH Compounds	Reason for Exclusion
BuddOakDioxins	UWI2011-UW40272	BI-40272	UWI2011-UW40272	1106045-16	2011	0	10	X		Impacted by sites and sources in Budd Inlet
BuddOakDioxins	BI-42704	BI-42704	BI-42704	1106045-25	2011	0	10	X		
BuddOakDioxins	BI-42776	BI-42776	BI-42776	1106045-26	2011	0	10	X		Impacted by sites and sources in Budd Inlet
BuddOakDioxins	BI-43088	BI-43088	BI-43088	1106045-27	2011	0	10	X		
BuddOakDioxins	BI-43216	BI-43216	BI-43216	1106045-28	2011	0	10	X		
BuddOakDioxins	BI-S30	BI-S30	BI-S30 SBI, Moxlie Creek	1106045-29	2011	0	10	X	X	Impacted by sites and sources in Budd Inlet
BuddOakDioxins	BI-S7-0-10cm	BI-S7	BI-S7-0-10cm SBI, near Hardel	1106045-30	2011	0	10	X		Impacted by sites and sources in Budd Inlet
BuddOakDioxins	OAKBAY-OB-10-SC	OB-10S	OAKBAY-OB-10-SC	1106045-38	2011	0	10	X		Impacted by sites and sources in Oakland Bay
BuddOakDioxins	OB-12.5S	OB-12.5S	OB-12.5S	1106045-40	2011	0	10	X		Impacted by sites and sources in Oakland Bay
BuddOakDioxins	UWI2011-PSUW012	BI-12	UWI2011-PSUW012	1106045-01	2011	0	10	X		
BuddOakDioxins	UWI2011-PSUW020	BI-20	UWI2011-PSUW020	1106045-02	2011	0	10	X	X	Impacted by sites and sources in Budd Inlet
BuddOakDioxins	UWI2011-PSUW084	BI-84	UWI2011-PSUW084	1106045-03	2011	0	10	X	X	Impacted by sites and sources in Budd Inlet
BuddOakDioxins	UWI2011-PSUW116	BI-116	UWI2011-PSUW116	1106045-04	2011	0	10	X		
BuddOakDioxins	UWI2011-PSUW140	BI-140	UWI2011-PSUW140	1106045-05	2011	0	10	X		
BuddOakDioxins	UWI2011-PSUW148	BI-148	UWI2011-PSUW148	1106045-06	2011	0	10	X		Impacted by sites and sources in Budd Inlet
BuddOakDioxins	UWI2011-PSUW244	BI-244	UWI2011-PSUW244	1106045-10	2011	0	10	X		
BuddOakDioxins	UWI2011-PSUW268	BI-268	UWI2011-PSUW268	1106045-11	2011	0	10	X		
BuddOakDioxins	UWI2011-PSUW268	BI-268	UWI2011-PSUW268	--	2011	0	2	X		Removed in favor of 0 to 10 cm interval from the same location

Table A-1 – Screening of EIM data set for cPAHs and dioxins/furans in South Puget Sound. Grey cells indicate data that were retained for the regional background data sets. Reasons for exclusion of the remaining data are provided in Column K.

Study_ID	Location_ID	Study_Specific_Location_ID	Location_Name	Sample_ID	Year Collected	Upper Depth	Lower Depth	Dioxin/Furan Congeners	cPAH Compounds	Reason for Exclusion
BuddOakDioxins	UWI2011-PSUW300	BI-300	UWI2011-PSUW300	1106045-12	2011	0	10	X		Impacted by sites and sources in Budd Inlet
BuddOakDioxins	UWI2011-PSUW556	BI-556	UWI2011-PSUW556	1106046-60	2011	0	10	X		Impacted by sites and sources in Budd Inlet
BuddOakDioxins	UWI2011-UW40056	BI-40056	UWI2011-UW40056	1106046-62	2011	0	10	X	X	Impacted by sites and sources in Budd Inlet
BuddOakDioxins	UWI2011-UW40216	BI-40216	UWI2011-UW40216	1106045-15	2011	0	10	X	X	Impacted by sites and sources in Budd Inlet
BuddOakDioxins	UWI2011-UW40272	BI-40272	UWI2011-UW40272	1106045-16	2011	0	10	X	X	
BuddOakDioxins	UWI2011-UW40528	BI-40528	UWI2011-UW40528	1106045-17	2011	0	10	X		
BuddOakDioxins	UWI2011-UW40984	BI-40984	UWI2011-UW40984	1106045-18	2011	0	10	X	X	Impacted by sites and sources in Budd Inlet
BuddOakDioxins	UWI2011-UW41040	BI-41040	UWI2011-UW41040	1106045-19	2011	0	10	X	X	Impacted by sites and sources in Budd Inlet
BuddOakDioxins	UWI2011-UW41240	BI-41240	UWI2011-UW41240	1106045-20	2011	0	10	X	X	Impacted by sites and sources in Budd Inlet
BuddOakDioxins	UWI2011-UW41296	BI-41296	UWI2011-UW41296	1106045-21	2011	0	10	X	X	Impacted by sites and sources in Budd Inlet
BuddOakDioxins	UWI2011-UW41552	BI-41552	UWI2011-UW41552	1106045-22	2011	0	10	X		
BuddOakDioxins	UWI2011-UW41680	BI-41680	UWI2011-UW41680	1106045-23	2011	0	10	X		
BuddOakDioxins	UWI2011-UW41752	BI-41752	UWI2011-UW41752	1106045-24	2011	0	10	X		
BuddOakDioxins	UWI2011-UWNO236	BI-236	UWI2011-UWNO236	1106045-07	2011	0	10	X		
BuddOakDioxins	UWI2011-UWNO241	BI-241	UWI2011-UWNO241	1106045-08	2011	0	10	X		
BuddOakDioxins	UWI2011-UWNO242	BI-242	UWI2011-UWNO242	1106046-45	2011	0	10	X	X	Impacted by sites and sources in Budd Inlet
FS1385	TCPSR753-CP-16	CP-16-M2	CP-16-M2	VO23L	2012	0	10	X	X	Impacted by sites and sources in Budd Inlet
FS1385	TCPSR753-CP-17	CP-17-M2	CP-17-M2	VO23M	2012	0	10	X	X	Impacted by sites and sources in Budd Inlet

Table A-1 – Screening of EIM data set for cPAHs and dioxins/furans in South Puget Sound. Grey cells indicate data that were retained for the regional background data sets. Reasons for exclusion of the remaining data are provided in Column K.

Study_ID	Location_ID	Study_Specific_Location_ID	Location_Name	Sample_ID	Year Collected	Upper Depth	Lower Depth	Dioxin/Furan Congeners	cPAH Compounds	Reason for Exclusion
FS1385	TCPSR753-CP-18	CP-18-M2	CP-18-M2	VO23P	2012	0	10	X	X	Impacted by sites and sources in Budd Inlet
FS1385	TCPSR753-CP-19	CP-19-M2	CP-19-M2	VO23O	2012	0	10	X	X	Impacted by sites and sources in Budd Inlet
FS1385	TCPSR753-CP-20	CP-20-M2	CP-20-M2	VO23K	2012	0	10	X		Impacted by sites and sources in Budd Inlet
FS1385	TCPSR753-CP-21	CP-21	CP-21	VY94J	2013	0	10		X	Impacted by sites and sources in Budd Inlet
FS1385	TCPSR753-CP-22	CP-22	CP-22	VY94I	2013	0	10		X	Impacted by sites and sources in Budd Inlet
FS1385	TCPSR753-CP-23	CP-23	CP-23	VY94H	2013	0	10		X	Impacted by sites and sources in Budd Inlet
FS1385	TCPSR753-CP-24	CP-24	CP-24	VY94G	2013	0	10		X	Impacted by sites and sources in Budd Inlet
FS1385	TCPSR753-CP-25	CP-25	CP-25	VY94F	2013	0	10		X	Impacted by sites and sources in Budd Inlet
FS1385	TCPSR753-CP-26	CP-26	CP-26	VY94A	2013	0	10		X	Impacted by sites and sources in Budd Inlet
FS1385	TCPSR753-CP-27	CP-27	CP-27	VY94B	2013	0	10		X	Impacted by sites and sources in Budd Inlet
FS1385	TCPSR753-CP-28	CP-28	CP-28	VY94K	2013	0	10		X	Impacted by sites and sources in Budd Inlet
FS1385	TCPSR753-CP-29	CP-29	CP-29	VY94D	2013	0	10		X	Impacted by sites and sources in Budd Inlet
FS1385	TCPSR753-CP-30	CP-30	CP-30	VY94L	2013	0	10		X	Impacted by sites and sources in Budd Inlet
FS1385	TCPSR753-CP-31	CP-31	CP-31	VY94M	2013	0	10		X	Impacted by sites and sources in Budd Inlet
FS1385	TCPSR753-CP-32	CP-32	CP-32	VY94N	2013	0	10		X	Impacted by sites and sources in Budd Inlet
FS1385	TCPSR753-CP-33	CP-33	CP-33	VY94O	2013	0	10		X	Impacted by sites and sources in Budd Inlet
FS1385	TCPSR753-CP-34	CP-34	CP-34	VY94E	2013	0	10		X	Impacted by sites and sources in Budd Inlet
FS1385	TCPSR753-CP-35	CP-35	CP-35	VY94P	2013	0	10		X	Impacted by sites and sources in Budd Inlet

Table A-1 – Screening of EIM data set for cPAHs and dioxins/furans in South Puget Sound. Grey cells indicate data that were retained for the regional background data sets. Reasons for exclusion of the remaining data are provided in Column K.

Study_ID	Location_ID	Study_Specific_Location_ID	Location_Name	Sample_ID	Year Collected	Upper Depth	Lower Depth	Dioxin/Furan Congeners	cPAH Compounds	Reason for Exclusion
FS1385	TCPSR753-CP-36	CP-36	CP-36	VY94Q	2013	0	10		X	Impacted by sites and sources in Budd Inlet
FS1385	TCPSR753-CP-37	CP-37	CP-37	VY94R	2013	0	10		X	Impacted by sites and sources in Budd Inlet
FS94656838Ph2	WB1577SD01	SD01	SD01	SD-01	2007	0	0	X		Intertidal sample collected from fill in south West Bay
FS94656838Ph2	WB1577SD02	SD02	SD02	SD-02	2007	0	0	X		Intertidal sample collected from fill in south West Bay
FS94656838Ph2	WB1577SD03	SD03	SD03	SD-03	2007	0	0	X		Intertidal sample collected from fill in south West Bay
FS94656838Ph2	WB1577SD04	SD04	SD04	SD-04	2007	0	0	X		Intertidal sample collected from fill in south West Bay
FS94656838Ph2	WB1577SD05	SD05	SD05	SD-05	2007	0	0	X		Impacted by sites and sources in Budd Inlet
FS94656838Ph2	WB1577SD06	SD06	SD06	SD-06	2007	0	0	X		Impacted by sites and sources in Budd Inlet
OAKSED08	OAKBAY-HI-02-SS	HI-02-SS	OAKBAY-HI-02-SS	HI-02-SS-00	2008	0	10	X	X	Scoured by currents of Hammersly Inlet
OAKSED08	OAKBAY-HI-03-SS	HI-03-SS	OAKBAY-HI-03-SS	HI-03-SS-00	2008	0	10	X	X	Scoured by currents of Hammersly Inlet
OAKSED08	OAKBAY-HI-04-SS	HI-04-SS	OAKBAY-HI-04-SS	HI-04-SS-00	2008	0	10	X	X	Scoured by currents of Hammersly Inlet
OAKSED08	OAKBAY-HI-05-SS	HI-05-SS	OAKBAY-HI-05-SS	HI-05-SS-00	2008	0	10	X	X	Scoured by currents of Hammersly Inlet
OAKSED08	OAKBAY-HI-06-SS	HI-06-SS	OAKBAY-HI-06-SS	HI-06-SS-00	2008	0	10	X	X	Scoured by currents of Hammersly Inlet
OAKSED08	OAKBAY-HI-07-SS	HI-07-SS	OAKBAY-HI-07-SS	HI-07-SS-00	2008	0	10	X	X	Scoured by currents of Hammersly Inlet
OAKSED08	OAKBAY-OB-01-SS	OB-01-SS	OAKBAY-OB-01-SS	OB-01-SS-00	2008	0	10	X	X	Scoured by currents of Hammersly Inlet
OAKSED08	OAKBAY-OB-02-SS	OB-02-SS	OAKBAY-OB-02-SS	OB-02-SS-00	2008	0	10	X	X	Dioxins impacted by elevated sources, cPAH below natural background - Oakland Bay
OAKSED08	OAKBAY-OB-03-SS	OB-03-SS	OAKBAY-OB-03-SS	OB-03-SS-00	2008	0	10	X	X	Dioxins impacted by elevated sources, cPAH below natural background - Oakland Bay
OAKSED08	OAKBAY-OB-04-SS	OB-04-SS	OAKBAY-OB-04-SS	OB-04-SS-00	2008	0	10	X	X	Dioxins impacted by elevated sources, cPAH below natural background - Oakland Bay
OAKSED08	OAKBAY-OB-05-SS	OB-05-SS	OAKBAY-OB-05-SS	OB-05-SS-00	2008	0	10	X	X	Dioxins impacted by elevated sources, cPAH below natural background - Oakland Bay
OAKSED08	OAKBAY-OB-06-SS	OB-06-SS	OAKBAY-OB-06-SS	OB-06-SS-00	2008	0	10	X	X	Dioxins impacted by elevated sources, cPAH below natural background - Oakland Bay
OAKSED08	OAKBAY-OB-07-SS	OB-07-SS	OAKBAY-OB-07-SS	OB-07-SS-00	2008	0	10	X	X	Dioxins impacted by elevated sources, cPAH below natural background - Oakland Bay

Table A-1 – Screening of EIM data set for cPAHs and dioxins/furans in South Puget Sound. Grey cells indicate data that were retained for the regional background data sets. Reasons for exclusion of the remaining data are provided in Column K.

Study_ID	Location_ID	Study_Specific_Location_ID	Location_Name	Sample_ID	Year Collected	Upper Depth	Lower Depth	Dioxin/Furan Congeners	cPAH Compounds	Reason for Exclusion
OAKSED08	OAKBAY-OB-08-SS	OB-08-SS	OAKBAY-OB-08-SS	OB-08-SS-00	2008	0	10	X	X	Dioxins impacted by elevated sources, cPAH below natural background - Oakland Bay
OAKSED08	OAKBAY-OB-09-SS	OB-09-SS	OAKBAY-OB-09-SS	OB-09-SS-00	2008	0	10	X	X	Dioxins impacted by elevated sources, cPAH below natural background - Oakland Bay
OAKSED08	OAKBAY-OB-10-SS	OB-10-SS	OAKBAY-OB-10-SS	OB-10-SS-00	2008	0	10	X	X	Dioxins impacted by elevated sources, cPAH below natural background - Oakland Bay
OAKSED08	OAKBAY-OB-11-SS	OB-11-SS	OAKBAY-OB-11-SS	OB-11-SS-00	2008	0	10	X	X	Dioxins impacted by elevated sources, cPAH below natural background - Oakland Bay
OAKSED08	OAKBAY-OB-12-SS	OB-12-SS	OAKBAY-OB-12-SS	OB-12-SS-00	2008	0	10	X	X	Dioxins impacted by elevated sources, cPAH below natural background - Oakland Bay
OAKSED08	OAKBAY-OB-13-SS	OB-13-SS	OAKBAY-OB-13-SS	OB-13-SS-00	2008	0	10	X	X	Dioxins impacted by elevated sources, cPAH below natural background - Oakland Bay
OAKSED08	OAKBAY-OB-14-SS	OB-14-SS	OAKBAY-OB-14-SS	OB-14-SS-00	2008	0	10	X	X	Dioxins impacted by elevated sources, cPAH below natural background - Oakland Bay
OAKSED08	OAKBAY-OB-17-WS	OB-17-WS	OAKBAY-OB-17-WS	OB-17-WS-00	2008	0	10	X	X	Dioxins impacted by elevated sources, cPAH below natural background - Oakland Bay
OAKSED08	OAKBAY-OB-18-WS	OB-18-WS	OAKBAY-OB-18-WS	OB-18-WS-00	2008	0	10	X	X	Dioxins impacted by elevated sources, cPAH below natural background - Oakland Bay
OAKSED08	OAKBAY-OB-19-WS	OB-19-WS	OAKBAY-OB-19-WS	OB-19-WS-00	2008	0	10	X	X	Dioxins and cPAH impacted by elevated sources - Oakland Bay
OAKSED08	OAKBAY-SH-01-SS	SH-01-SS	OAKBAY-SH-01-SS	SH-01-SS-00	2008	0	10	X	X	Dioxins and cPAH impacted by elevated sources - Oakland Bay
OAKSED08	OAKBAY-SH-02-SS	SH-02-SS	OAKBAY-SH-02-SS	SH-02-SS-00	2008	0	10	X	X	Dioxins and cPAH impacted by elevated sources - Oakland Bay
OAKSED08	OAKBAY-SH-03-SS	SH-03-SS	OAKBAY-SH-03-SS	SH-03-SS-00	2008	0	10	X	X	Dioxins and cPAH impacted by elevated sources - Oakland Bay
OAKSED08	OAKBAY-SH-04-SS	SH-04-SS	OAKBAY-SH-04-SS	SH-04-SS-00	2008	0	10	X	X	Dioxins and cPAH impacted by elevated sources - Oakland Bay
OAKSED08	OAKBAY-SH-05-SS	SH-05-SS	OAKBAY-SH-05-SS	SH-05-SS-00	2008	0	10	X	X	Dioxins and cPAH impacted by elevated sources - Oakland Bay
OAKSED08	OAKBAY-SH-07-SS	SH-07-SS	OAKBAY-SH-07-SS	SH-07-SS-00	2008	0	10	X	X	Dioxins and cPAH impacted by elevated sources - Oakland Bay
OAKSED08	OAKBAY-SH-09-SS	SH-09-SS	OAKBAY-SH-09-SS	SH-09-SS-00	2008	0	10	X	X	Dioxins and cPAH impacted by elevated sources - Oakland Bay
OAKSED08	OAKBAY-SH-10-SS	SH-10-SS	OAKBAY-SH-10-SS	SH-10-SS-00	2008	0	10	X	X	Dioxins and cPAH impacted by elevated sources - Oakland Bay

Table A-1 – Screening of EIM data set for cPAHs and dioxins/furans in South Puget Sound. Grey cells indicate data that were retained for the regional background data sets. Reasons for exclusion of the remaining data are provided in Column K.

Study_ID	Location_ID	Study_Specific_Location_ID	Location_Name	Sample_ID	Year Collected	Upper Depth	Lower Depth	Dioxin/Furan Congeners	cPAH Compounds	Reason for Exclusion
OAKSED08	OAKBAY-SH-11-SS	SH-11-SS	OAKBAY-SH-11-SS	SH-11-SS-00	2008	0	10	X	X	Dioxins and cPAH impacted by elevated sources - Oakland Bay
OAKSED08	OAKBAY-SH-12-SS	SH-12-SS	OAKBAY-SH-12-SS	SH-12-SS-00	2008	0	10	X	X	Dioxins and cPAH impacted by elevated sources - Oakland Bay
OAKSED08	OAKBAY-SH-13-SS	SH-13-SS	OAKBAY-SH-13-SS	SH-13-SS-00	2008	0	10	X	X	Dioxins and cPAH impacted by elevated sources - Oakland Bay
OAKSED08	OAKBAY-SH-14-SS	SH-14-SS	OAKBAY-SH-14-SS	SH-14-SS-00	2008	0	10	X	X	Dioxins and cPAH impacted by elevated sources - Oakland Bay
OAKSED08	OAKBAY-SH-15-SS	SH-15-SS	OAKBAY-SH-15-SS	SH-15-SS-00	2008	0	10	X	X	Scoured by currents of Hammersly Inlet
OAKSED08	OAKBAY-SH-16-SS	SH-16-SS	OAKBAY-SH-16-SS	SH-16-SS-00	2008	0	10	X	X	Scoured by currents of Hammersly Inlet
OAKSED08	OAKBAY-SH-18-WS	SH-18-WS	OAKBAY-SH-18-WS	SH-18-WS-00	2008	0	10	X	X	Dioxins and cPAH impacted by elevated sources - Oakland Bay
OAKSED08	OAKBAY-SH-19-WS	SH-19-WS	OAKBAY-SH-19-WS	SH-19-WS-00	2008	0	10	X	X	Dioxins and cPAH impacted by elevated sources - Oakland Bay
OAKSED08	OAKBAY-SH-20-WS	SH-20-WS	OAKBAY-SH-20-WS	SH-20-WS-00	2008	0	10	X	X	Dioxins and cPAH impacted by elevated sources - Oakland Bay
OAKSED08	OAKBAY-SH-21-WS	SH-21-WS	OAKBAY-SH-21-WS	SH-21-WS-00	2008	0	10	X	X	Dioxins and cPAH impacted by elevated sources - Oakland Bay
OAKSED08	OAKBAY-SH-22-WS	SH-22-WS	OAKBAY-SH-22-WS	SH-22-WS-00	2008	0	10	X	X	Dioxins and cPAH impacted by elevated sources - Oakland Bay
OAKSED08	OAKBAY-SH-23-WS	SH-23-WS	OAKBAY-SH-23-WS	SH-23-WS-00	2008	0	10	X	X	Dioxins and cPAH impacted by elevated sources - Oakland Bay
OAKSED08	OAKBAY-SH-24-WS	SH-24-WS	OAKBAY-SH-24-WS	SH-24-WS-00	2008	0	10	X	X	Dioxins and cPAH impacted by elevated sources - Oakland Bay
OAKSED08	OAKBAY-SH-25-WS	SH-25-WS	OAKBAY-SH-25-WS	SH-25-WS-00	2008	0	10	X	X	Dioxins and cPAH impacted by elevated sources - Oakland Bay
OAKSED08	OAKBAY-SH-26-WS	SH-26-WS	OAKBAY-SH-26-WS	SH-26-WS-00	2008	0	10	X	X	Dioxins and cPAH impacted by elevated sources - Oakland Bay
OAKSED08	OAKBAY-SH-27-WS	SH-27-WS	OAKBAY-SH-27-WS	SH-27-WS-00	2008	0	10	X	X	Dioxins and cPAH impacted by elevated sources - Oakland Bay
OAKSED08	OAKBAY-SH-28-WS	SH-28-WS	OAKBAY-SH-28-WS	SH-28-WS-00	2008	0	10	X	X	Dioxins and cPAH impacted by elevated sources - Oakland Bay
OAKSED08	OAKBAY-SH-29-WS	SH-29-WS	OAKBAY-SH-29-WS	SH-29-WS-00	2008	0	10	X	X	Scoured by currents of Hammersly Inlet

Table A-1 – Screening of EIM data set for cPAHs and dioxins/furans in South Puget Sound. Grey cells indicate data that were retained for the regional background data sets. Reasons for exclusion of the remaining data are provided in Column K.

Study_ID	Location_ID	Study_Specific_Location_ID	Location_Name	Sample_ID	Year Collected	Upper Depth	Lower Depth	Dioxin/Furan Congeners	cPAH Compounds	Reason for Exclusion
OAKSED08	OAKBAY-SH-30-WS	SH-30-WS	OAKBAY-SH-30-WS	SH-30-WS-00	2008	0	10	X	X	Dioxins and cPAH impacted by elevated sources - Oakland Bay
OHPSD06	OHPSD0224-S12	DMMP-OHPSD-AF-0224-S12	DMMP-OHPSD-AF-0224-S12	CORE 20	2006	0	10	X		Impacted by sites and sources in Budd Inlet
OHPSD06	OHPSD0224-S13	DMMP-OHPSD-AF-0224-S13	DMMP-OHPSD-AF-0224-S13	CORE 21	2006	0	10	X		Impacted by sites and sources in Budd Inlet
OlyMarineTerminal08	AM-28-090313	Post-Cover_PO-AM-28-090313	Post-Cover_PO-AM-28-090313	PO-AM-28-SS-A-090313	2009	0	10	X		Impacted by sites and sources in Budd Inlet
OlyMarineTerminal08	BA-24-090226	Post-Dredge_PO-BA-24-090226	Post-Dredge_PO-BA-24-090226	PO-BA-24-SS-A-090226	2009	0	10	X		Impacted by sites and sources in Budd Inlet
OlyMarineTerminal08	BA-24-090313	Post-Cover_PO-BA-24-090313	Post-Cover_PO-BA-24-090313	PO-BA-24-SS-A-090313	2009	0	10	X		Impacted by sites and sources in Budd Inlet
OlyMarineTerminal08	BA-25-090226	Post-Dredge_PO-BA-25-090226	Post-Dredge_PO-BA-25-090226	PO-BA-25-SS-A-090226	2009	0	10	X		Impacted by sites and sources in Budd Inlet
OlyMarineTerminal08	BA-25-090316	Post-Cover_PO-BA-25-090316	Post-Cover_PO-BA-25-090316	PO-BA-25-SS-A-090316	2009	0	10	X		Impacted by sites and sources in Budd Inlet
OlyMarineTerminal08	BA-26-090226	Post-Dredge_PO-BA-26-090226	Post-Dredge_PO-BA-26-090226	PO-BA-26-SS-A-090226	2009	0	10	X		Impacted by sites and sources in Budd Inlet
OlyMarineTerminal08	BA-26-090316	Post-Cover_PO-BA-26-090316	Post-Cover_PO-BA-26-090316	PO-BA-26-SS-A-090316	2009	0	10	X		Impacted by sites and sources in Budd Inlet
OlyMarineTerminal08	BA-27B-090226	Post-Dredge_PO-BA-27B-090226	Post-Dredge_PO-BA-27B-090226	PO-BA-27B-SS-A-090226	2009	0	10	X		Impacted by sites and sources in Budd Inlet
OlyMarineTerminal08	BA-27B-090313	Post-Cover_PO-BA-27B-090313	Post-Cover_PO-BA-27B-090313	PO-BA-27B-SS-A-090313	2009	0	10	X		Impacted by sites and sources in Budd Inlet
OlyMarineTerminal08	BI-C16-090313	Post-Cover_BI-C16-090313	Post-Cover_BI-C16-090313	B1-C16-SS-A-090313	2009	0	10	X		Impacted by sites and sources in Budd Inlet
OlyMarineTerminal08	BI-S37-090313	Post-Cover_BI-S37-090313	Post-Cover_BI-S37-090313	B1-S37-SS-A-090313	2009	0	10	X		Impacted by sites and sources in Budd Inlet
OlyMarineTerminal08	UP-20-090313	Post-Cover_PO-UP-20-090313	Post-Cover_PO-UP-20-090313	PO-UP-20-SS-A-090313	2009	0	10	X		Impacted by sites and sources in Budd Inlet
OlyMarineTerminal08	UP-21-090313	Post-Cover_PO-UP-21-090313	Post-Cover_PO-UP-21-090313	PO-UP-21-SS-A-090313	2009	0	10	X		Impacted by sites and sources in Budd Inlet
OlyMarineTerminal08	UP-22-090313	Post-Cover_PO-UP-22-090313	Post-Cover_PO-UP-22-090313	PO-UP-22-SS-A-090313	2009	0	10	X		Impacted by sites and sources in Budd Inlet
OlyMarineTerminal08	UP-23B-090313	Post-Cover_PO-UP-23B-090313	Post-Cover_PO-UP-23B-090313	PO-UP-23B-SS-A-090313	2009	0	10	X		Impacted by sites and sources in Budd Inlet
PriestPoint	AAAA175	NA	NA	NA	2010	0	10	X		Result below natural background for dioxin

Table A-1 – Screening of EIM data set for cPAHs and dioxins/furans in South Puget Sound. Grey cells indicate data that were retained for the regional background data sets. Reasons for exclusion of the remaining data are provided in Column K.

Study_ID	Location_ID	Study_Specific_Location_ID	Location_Name	Sample_ID	Year Collected	Upper Depth	Lower Depth	Dioxin/Furan Congeners	cPAH Compounds	Reason for Exclusion
PriestPoint	CC102	NA	NA	NA	2010	0	10	X		Result below natural background for dioxin
PriestPoint	CCCC131	NA	NA	NA	2010	0	10	X		Result below natural background for dioxin
PriestPoint	CCCC165	NA	NA	NA	2010	0	10	X		Result below natural background for dioxin
PriestPoint	FF110	NA	NA	NA	2010	0	10	X		Result below natural background for dioxin
PriestPoint	FFF209	NA	NA	NA	2010	0	10	X		Result below natural background for dioxin
PriestPoint	II118	NA	NA	NA	2010	0	10	X		Result below natural background for dioxin
PriestPoint	IIII142	NA	NA	NA	2010	0	10	X		Result below natural background for dioxin
PriestPoint	KKKK159	NA	NA	NA	2010	0	10	X		Result below natural background for dioxin
PriestPoint	LLLL121	NA	NA	NA	2010	0	10	X		Result below natural background for dioxin
PriestPoint	N44	NA	NA	NA	2010	0	10	X		Result below natural background for dioxin
PriestPoint	N57	NA	NA	NA	2010	0	10	X		Result below natural background for dioxin
PriestPoint	OOO148	NA	NA	NA	2010	0	10	X		Result below natural background for dioxin
PriestPoint	OOOO123	NA	NA	NA	2010	0	10	X		Result below natural background for dioxin
PriestPoint	QQQQ184	NA	NA	NA	2010	0	10	X		Result below natural background for dioxin
PriestPoint	QQQQ204	NA	NA	NA	2010	0	10	X		Result below natural background for dioxin
PriestPoint	RRR159	NA	NA	NA	2010	0	10	X		Result below natural background for dioxin
PriestPoint	RRR181	NA	NA	NA	2010	0	10	X		Result below natural background for dioxin
PriestPoint	RRR181	NA	NA	NA	2010	0	10	X		Result below natural background for dioxin
PriestPoint	RRR200	NA	NA	NA	2010	0	10	X		Result below natural background for dioxin
PriestPoint	U73	NA	NA	NA	2010	0	10	X		Result below natural background for dioxin
PriestPoint	U73	NA	NA	NA	2010	0	10	X		Result below natural background for dioxin
PriestPoint	UUU169	NA	NA	NA	2010	0	10	X		Result below natural background for dioxin
PriestPoint	V91	NA	NA	NA	2010	0	10	X		Result below natural background for dioxin
PriestPoint	VVVV200	NA	NA	NA	2010	0	10	X		Result below natural background for dioxin
PriestPoint	W38	NA	NA	NA	2010	0	10	X		Result below natural background for dioxin
PriestPoint	X55	NA	NA	NA	2010	0	10	X		Result below natural background for dioxin
PriestPoint	XX127	NA	NA	NA	2010	0	10	X		Result below natural background for dioxin
PriestPoint	XXXX198	NA	NA	NA	2010	0	10	X		Result below natural background for dioxin
PriestPoint	YYY190	NA	NA	NA	2010	0	10	X		Result below natural background for dioxin
PriestPoint	ZZZ157	NA	NA	NA	2010	0	10	X		Result below natural background for dioxin
PriestPoint	ZZZZ144	NA	NA	NA	2010	0	10	X		Result below natural background for dioxin
WB1577RIFS	WB1577SD08	SD08	SD08	WB-S0-SD-08-0000	2008	0	0		X	Impacted by sites and sources in Budd Inlet
WB1577RIFS	WB1577SD09	SD09	SD09	WB-S0-SD-09-0000	2008	0	0		X	Impacted by sites and sources in Budd Inlet

Table A-1 – Screening of EIM data set for cPAHs and dioxins/furans in South Puget Sound. Grey cells indicate data that were retained for the regional background data sets. Reasons for exclusion of the remaining data are provided in Column K.

Study_ID	Location_ID	Study_Specific_Location_ID	Location_Name	Sample_ID	Year Collected	Upper Depth	Lower Depth	Dioxin/Furan Congeners	cPAH Compounds	Reason for Exclusion
WB1577RIFS	WB1577SD07	SD07	SD07	WB-S0-SD-07-0000	2008	0	0		X	Impacted by sites and sources in Budd Inlet
WB1577RIFS	WB1577SD10	SD10	SD10	WB-S0-SD-10-0000	2008	0	0		X	Impacted by sites and sources in Budd Inlet
WB1577RIFS	WB1577SD11	SD11	SD11	WB-S0-SD-11-0000	2008	0	0		X	Impacted by sites and sources in Budd Inlet
WB1577RIFS	WB1577SD14	SD14	SD14	WB-S0-SD-14-0000	2008	0	0		X	Impacted by sites and sources in Budd Inlet
WB1577RIFS	WB1577SD16	SD16	SD16	WB-S0-SD-16-0000	2008	0	0		X	Impacted by sites and sources in Budd Inlet
WB1577RIFS	WB1577SD17	SD17	SD17	WB-S0-SD-17-0000	2008	0	0		X	Impacted by sites and sources in Budd Inlet
WB1577RIFS	WB1577SD18	SD18	SD18	WB-S0-SD-18-0000	2008	0	0	X	X	Intertidal sample collected from fill in south West Bay
WB1577RIFS	WB1577SD19	SD19	SD19	WB-S0-SD-19-0000	2008	0	0	X	X	Intertidal sample collected from fill in south West Bay
WB1577RIFS	WB1577SD20	SD20	SD20	WB-S0-SD-20-0000	2008	0	0	X	X	Intertidal sample collected from fill in south West Bay
WB1577RIFS	WB1577SD21	SD21	SD21	WB-S0-SD-21-0000	2008	0	0	X	X	Intertidal sample collected from fill in south West Bay
WB1577RIFS	WB1577SD22	SD22	SD22	WB-S0-SD-22-0000	2008	0	0	X	X	Intertidal sample collected from fill in south West Bay
WB1577RIFS	WB1577SD23	SD23	SD23	WB-S0-SD-23-0000	2008	0	0	X	X	Intertidal sample collected from fill in south West Bay
WB1577RIFS	WB1577SD24	SD24	SD24	WB-S0-SD-24-0000	2008	0	0	X		Intertidal sample collected from fill in south West Bay
PSAMP_SP	PSAMP_SP-PS0164	PSAMP_SP-PS00164	PSAMP_SP-PS0164	1106046-03	2011	0	3		X	cPAH below natural background in Oakland Bay
PSAMP_SP	PSAMP_SP-PS0036	PSAMP_SP-PS00036	PSAMP_SP-PS0036	1106046-07	2011	0	3		X	
PSAMP_SP	PSAMP-OB-PSN227	PSAMP_SP-PSNO227	Oakland Bay-PSN227	1106046-28	2011	0	3		X	Impacted by sites and sources in Oakland Bay
PSAMP_SP	PSAMP-OB-PSN228	PSAMP_SP-PSNO228	Oakland Bay-PSN228	1106046-29	2011	0	3		X	Impacted by sites and sources in Oakland Bay
PSAMP_SP	PSAMP-OB-PSN229	PSAMP_SP-PSNO229	Oakland Bay-PSN229	1106046-31	2011	0	3		X	Impacted by sites and sources in Oakland Bay

Table A-1 – Screening of EIM data set for cPAHs and dioxins/furans in South Puget Sound. Grey cells indicate data that were retained for the regional background data sets. Reasons for exclusion of the remaining data are provided in Column K.

Study_ID	Location_ID	Study_Specific_Location_ID	Location_Name	Sample_ID	Year Collected	Upper Depth	Lower Depth	Dioxin/Furan Congeners	cPAH Compounds	Reason for Exclusion
PSAMP_SP	PSAMP-OB-PSN230	PSAMP_SP-PSNO230	Oakland Bay-PSN230	1106046-32	2011	0	3		X	Impacted by sites and sources in Oakland Bay
PSAMP_SP	PSAMP-OB-PSN231	PSAMP_SP-PSNO231	Oakland Bay-PSN231	1106046-33	2011	0	3		X	cPAH below natural background in Oakland Bay
PSAMP_SP	PSAMP-OB-PSN232	PSAMP_SP-PSNO232	Oakland Bay-PSN232	1106046-34	2011	0	3		X	cPAH below natural background in Oakland Bay
PSAMP_SP	PSAMP-TI-PSN233	PSAMP_SP-PSNO233	Totten Inlet-PSN233	1106046-35	2011	0	3		X	
PSAMP_SP	PSAMP-TI-PSN234	PSAMP_SP-PSNO234	Totten Inlet-PSN234	1106046-36	2011	0	3		X	
PSAMP_SP	PSAMP-TI-PSN235	PSAMP_SP-PSNO235	Totten Inlet-PSN235	1106046-37	2011	0	3		X	
PSAMP_SP	PSAMP-EI-PSN238	PSAMP_SP-PSNO238	Eld Inlet-PSN238	1106046-40	2011	0	3		X	
PSAMP_SP	PSAMP-EI-PSN239	PSAMP_SP-PSNO239	Eld Inlet-PSN239	1106046-42	2011	0	3		X	
PSAMP_SP	PSAMP-EI-PSN240	PSAMP_SP-PSNO240	Eld Inlet-PSN240	1106046-43	2011	0	3		X	
PSAMP_SP	PSAMP_SP-PS0508	PSAMP_SP-PS00508	PSAMP_SP-PS0508	1106046-59	2011	0	3		X	cPAH below natural background in Oakland Bay
PSAMP_SP	PSAMP_SP-PS0636	PSAMP_SP-PS00636	PSAMP_SP-PS0636	1106046-61	2011	0	3		X	Impacted by sites and sources in Oakland Bay
UWI2011	UWI2011-UW40272	UWI2011-UW40272	UWI2011-UW40272	1106046-64	2011	0	3		X	
UWI2011	UWI2011-PSUW012	UWI2011-PSUW012	UWI2011-PSUW012	1106046-02	2011	0	3		X	cPAH TEQ identified as an outlier
UWI2011	UWI2011-PSUW116	UWI2011-PSUW116	UWI2011-PSUW116	1106046-48	2011	0	3		X	
UWI2011	UWI2011-UW40528	UWI2011-UW40528	UWI2011-UW40528	1106046-65	2011	0	3		X	
UWI2011	UWI2011-UW41552	UWI2011-UW41552	UWI2011-UW41552	1106046-71	2011	0	3		X	
UWI2011	UWI2011-UW41680	UWI2011-UW41680	UWI2011-UW41680	1106046-72	2011	0	3		X	
UWI2011	UWI2011-UW41752	UWI2011-UW41752	UWI2011-UW41752	1106046-73	2011	0	3		X	

Table A-1 – Screening of EIM data set for cPAHs and dioxins/furans in South Puget Sound. Grey cells indicate data that were retained for the regional background data sets. Reasons for exclusion of the remaining data are provided in Column K.

Study_ID	Location_ID	Study_Specific_Location_ID	Location_Name	Sample_ID	Year Collected	Upper Depth	Lower Depth	Dioxin/Furan Congeners	cPAH Compounds	Reason for Exclusion
UWI2011	UWI-BI-UWNO236	UWI2011-UWNO236	Budd Inlet-UWNO236	1106046-38	2011	0	3		X	
UWI2011	UWI-BI-UWNO241	UWI2011-UWNO241	Budd Inlet-UWNO241	1106046-44	2011	0	3		X	
UWI2011	UWI-BI-UWNO237	UWI2011-UWNO237	Budd Inlet-UWNO237	1106046-39	2011	0	3		X	
UWI2011	UWI2011-UW40728	UWI2011-UW40728	UWI2011-UW40728	1106046-66	2011	0	3		X	Impacted by sites and sources in Budd Inlet
UWI2011	UWI2011-PSUW100	UWI2011-PSUW100	UWI2011-PSUW100	1106046-16	2011	0	3		X	Impacted by sites and sources in Budd Inlet
UWI2011	UWI-WB-UWNO244	UWI2011-UWNO244	Olympia West Bay-UWNO244	1106046-47	2011	0	3		X	Impacted by sites and sources in Budd Inlet
UWI2011	UWI-EB-UWNO243	UWI2011-UWNO243	Olympia East Bay-UWNO243	1106046-46	2011	0	3		X	Impacted by sites and sources in Budd Inlet
WOODARD	WB-03	WB-03	WB-03	WB-03-S	2008	0	10		X	Possible direct influence from creosote pilings
WOODARD	WB-06	WB-06	WB-06	WB-06-S	2008	0	10		X	Possible direct influence from creosote pilings
WOODARD	WB-09	WB-09	WB-09	WB-09-S	2008	0	10		X	Possible direct influence from creosote pilings
WOODARD	WB-12	WB-12	WB-12	WB-12-S	2008	0	10		X	Possible direct influence from creosote pilings
WOODARD	WB-16	WB-16	WB-16	WB-16-S	2008	0	10		X	Possible direct influence from creosote pilings
WOODARD	WB-17	WB-17	WB-17	WB-17-S	2008	0	10		X	Possible direct influence from creosote pilings
WOODARD	WB-21	WB-21	WB-21	WB-21-S	2008	0	10		X	Possible direct influence from creosote pilings
WOODARD	WB-22	WB-22	WB-22	WB-22-S	2008	0	10		X	Possible direct influence from creosote pilings
WOODARD	WB-26	WB-26	WB-26	WB-26-S	2008	0	10		X	Possible direct influence from creosote pilings
WOODARD	WB-30	WB-30	WB-30	WB-30-S	2008	0	10		X	Possible direct influence from creosote pilings
WOODARD	WB-35	WB-35	WB-35	WB-35-S	2008	0	10		X	Possible direct influence from creosote pilings
WOODARD	WB-36	WB-36	WB-36	WB-36-S	2008	0	10		X	Possible direct influence from creosote pilings
WOODARD	WB-37	WB-37	WB-37	WB-37-S	2008	0	10		X	Possible direct influence from creosote pilings
WOODARD	WB-42	WB-42	WB-42	WB-42-S	2008	0	10		X	Possible direct influence from creosote pilings

Table A-2: Summary of dioxin/furan congener and cPAH data used to calculate South Puget Sound Regional Background.

Location ID EIM Study ID Collection Date Depth	BI-C1-0-10cm BUDD07 4/12/2007 0 to 10 cm		BI-S1-0-10cm BUDD07 4/11/2007 0 to 10 cm		BI-S2-0-10cm BUDD07 4/12/2007 0 to 10 cm		BI-S28-0-10cm BUDD07 4/12/2007 0 to 10 cm		BI-S29-0-10cm BUDD07 4/12/2007 0 to 10 cm		BI-S3-0-10cm BUDD07 4/12/2007 0 to 10 cm		BI-42704 BuddOakDioxins 6/6/2011 0 to 10 cm		BI-43088 BuddOakDioxins 6/3/2011 0 to 10 cm	
Percent Fines	79.1		81.7		66.8		63.9		43.8		53.9		79.2		89.1	
Total Organic Carbon	3.52		4.06		3.31		2.51		2.17		2.87		2.24		2.83	
cPAH TEQ (µg/kg)																
Benzo(a)pyrene	--		51		--		--		--		--		--		--	
Benz[a]anthracene	--		57		--		--		--		--		--		--	
Total Benzofluoranthenes	--		149		--		--		--		--		--		--	
Chrysene	--		100		--		--		--		--		--		--	
Dibenzo(a,h)anthracene	--		7.6	T	--		--		--		--		--		--	
Indeno(1,2,3-cd)pyrene	--		41		--		--		--		--		--		--	
cPAH TEQ (1/2 DL)	--		77		--		--		--		--		--		--	
cPAH TEQ (KM)	--		77		--		--		--		--		--		--	
Dioxin/Furan Congeners (ng/kg)																
2,3,7,8-TCDD	0.283	T	0.456	T	0.317	T	0.464	U	0.358	T	0.326	T	0.477	J	0.224	UJ
1,2,3,7,8-PeCDD	1.44	T	2.5	T	1.48	T	2.43	T	2.03	T	1.22	T	1.9	J	0.262	UJ
1,2,3,4,7,8-HxCDD	2.44	T	4.61	T	2.64	T	3.87	T	2.85	T	2.07	T	2.85	J	0.374	UJ
1,2,3,6,7,8-HxCDD	14		26.7		14.2		17.2	T	13.6	T	9.9		12.4	J	0.941	J
1,2,3,7,8,9-HxCDD	7.27		13.7		7.42		11.1	T	8.99	T	5.24		7.71	J	0.575	J
1,2,3,4,6,7,8-HpCDD	265		619		309		287	T	222	T	179		235	J	18.1	J
OCDD	1890		5410		2420		2210	T	1690	T	1210		1820	J	140	J
2,3,7,8-TCDF	0.631	T	1.49	U	0.897	T	2.42		2.02		0.828	U	2.83	J	0.609	UJ
1,2,3,7,8-PeCDF	1.02	T	1.83	T	1.12	T	1.95	T	1.36	T	0.782	T	1.38	J	0.27	UJ
2,3,4,7,8-PeCDF	1.28	T	2.17	T	1.34	T	2.53	T	2	T	1.02	T	2.76	J	0.272	UJ
1,2,3,4,7,8-HxCDF	4.79	T	8.38	T	4.94	T	10.1		7.46		3.03	T	7.68	J	0.649	J
1,2,3,6,7,8-HxCDF	2.42	T	4.04	T	2.38	T	3.45	T	2.65	T	1.74	T	2.93	J	0.358	UJ
1,2,3,7,8,9-HxCDF	0.253	U	0.38	T	0.23	T	0.285	T	0.24	T	0.171	T	1.36	J	0.374	UJ
2,3,4,6,7,8-HxCDF	2.23	T	3.88	T	2.09	T	3.22	T	2.59	T	1.8	T	4.52	J	0.465	J
1,2,3,4,6,7,8-HpCDF	75.5		133		73.5		97.7		78.5		52.3		77	J	6.59	J
1,2,3,4,7,8,9-HpCDF	3.16	T	6.02		3.49	T	4.86	T	3.67	T	2.04	T	4.19	J	0.547	UJ
OCDF	131		258		142		242	T	198	T	80.7		163	J	13.6	J
Dioxin/Furan TEQ (1/2 DL)	9.6		19		10		13		11		7		11		0.93	
Dioxin/Furan TEQ (KM)	9.6		19		10		13		11		7		11		0.93	L9

Table A-2: Summary of dioxin/furan congener and cPAH data used to calculate South Puget Sound Regional Background (cont.).

Location ID EIM Study ID Collection Date Depth	BI-43216 BuddOakDioxins 6/6/2011 0 to 10 cm		UWI2011-PSUW012 BuddOakDioxins[a] 6/3/2011 0 to 10 cm[a]		UWI2011-PSUW116 BuddOakDioxins[a] 6/21/2011 0 to 10 cm[a]		UWI2011-PSUW140 BuddOakDioxins 6/3/2011 0 to 10 cm		UWI2011-PSUW244 BuddOakDioxins 6/21/2011 0 to 10 cm		UWI2011-PSUW268 BuddOakDioxins 6/3/2011 0 to 10 cm	
Percent Fines	69.2		87.1		83.1		87		45.5		91	
Total Organic Carbon	2.3		2.49		2.12		2.52		2.78		2.93	
cPAH TEQ (µg/kg)												
Benzo(a)pyrene	--		--		20.7		--		--		--	
Benz[a]anthracene	--		--		16.9		--		--		--	
Total Benzofluoranthenes	--		--		52.7		--		--		--	
Chrysene	--		--		27.9		--		--		--	
Dibenzo(a,h)anthracene	--		--		4.1		--		--		--	
Indeno(1,2,3-cd)pyrene	--		--		28.3		--		--		--	
cPAH TEQ (1/2 DL)	--		--		31		--		--		--	
cPAH TEQ (KM)	--		--		31		--		--		--	
Dioxin/Furan Congeners (ng/kg)												
2,3,7,8-TCDD	0.0791	UJ	0.533	J	0.485	J	0.349	J	0.321	J	0.391	UJ
1,2,3,7,8-PeCDD	0.18	J	2.59	J	2.4	J	0.981	UJ	1.48	UJ	1	UJ
1,2,3,4,7,8-HxCDD	0.17	J	3.68	J	3.41	J	0.942	J	1.97	J	1.2	J
1,2,3,6,7,8-HxCDD	0.643	J	18.3	J	15.4	J	3.65	J	9.26	J	5.12	J
1,2,3,7,8,9-HxCDD	0.366	J	9.9	J	8	J	2.48	J	5.53	J	2.76	J
1,2,3,4,6,7,8-HpCDD	10	J	317	J	263	J	75.1	J	174	J	96.3	J
OCDD	78.8	J	2350	J	1940	J	559	J	1310	J	724	J
2,3,7,8-TCDF	0.441	J	3.43	J	3.12	J	1.61	J	2.07	J	1.67	J
1,2,3,7,8-PeCDF	2.47	UJ	2.22	J	2	J	2.45	UJ	2.49	UJ	0.934	UJ
2,3,4,7,8-PeCDF	0.182	UJ	4.02	J	3.25	J	1.41	J	2.27	J	1.16	UJ
1,2,3,4,7,8-HxCDF	0.406	J	10	J	7.84	J	2.71	J	5.51	J	3.25	J
1,2,3,6,7,8-HxCDF	0.164	UJ	3.75	J	2.94	J	2.45	UJ	1.92	J	2.5	UJ
1,2,3,7,8,9-HxCDF	0.224	UJ	2.17	J	1.68	J	0.636	UJ	1.25	J	0.523	UJ
2,3,4,6,7,8-HxCDF	0.239	J	6.12	J	4.8	J	1.55	UJ	3.25	J	1.85	J
1,2,3,4,6,7,8-HpCDF	3.44	J	105	J	83.9	J	23.9	J	57.2	J	30.6	J
1,2,3,4,7,8,9-HpCDF	0.241	J	5.51	J	4.59	J	2.45	UJ	3.23	J	1.58	J
OCDF	7.76	J	228	J	217	J	52.5	J	135	J	58.2	J
Dioxin/Furan TEQ (1/2 DL)	0.69		15		13		3.9		7.6		4.1	
Dioxin/Furan TEQ (KM)	0.65		15		13		4.2	L	7.2		4.5	L

Table A-2: Summary of dioxin/furan congener and cPAH data used to calculate South Puget Sound Regional Background (cont.).

Location ID EIM Study ID Collection Date Depth	UWI2011-UW40272 BuddOakDioxins[a] 6/6/2011 0 to 10 cm[a]		UWI2011-UW40528 BuddOakDioxins[a] 6/1/2011 0 to 10 cm[a]		UWI2011-UW41552 BuddOakDioxins[a] 6/1/2011 0 to 10 cm[a]		UWI2011-UW41680 BuddOakDioxins[a] 6/6/2011 0 to 10 cm[a]		UWI2011-UW41752 BuddOakDioxins[a] 6/6/2011 0 to 10 cm[a]		UWI2011-UWNO236 BuddOakDioxins[a] 6/1/2011 0 to 10 cm[a]	
Percent Fines	75.6		86.5		76		14.7		49.7		81.4	
Total Organic Carbon	2.05		2.34		2.69		1.12		1.62		2.95	
cPAH TEQ (ug/kg)												
Benzo(a)pyrene	24.3		24.6		32.6		7.03		17.5		34.3	
Benz[a]anthracene	19.6		20.4		24.4		5.27		13.2		25.7	
Total Benzofluoranthenes	59.8		63.4		83.4		16.3		44.9		86.7	
Chrysene	32.8		32.7		39.7		8.22		22.3		40.6	
Dibenzo(a,h)anthracene	4.41		4.89		6.17		1.44		3.22		6.15	
Indeno(1,2,3-cd)pyrene	31		35.4		42.9		9.27		25.5		45.6	
cPAH TEQ (1/2 DL)	36		37		49		10		26		51	
cPAH TEQ (KM)	36		37		49		10		26		51	
Dioxin/Furan Congeners (ng/kg)												
2,3,7,8-TCDD	0.307	J	0.438	J	0.766	J	0.0767	UJ	0.312	J	0.661	UJ
1,2,3,7,8-PeCDD	1.45	J	1.81	J	3.89	J	0.663	J	1.34	J	1.44	UJ
1,2,3,4,7,8-HxCDD	2.09	J	3.18	J	6.7	J	0.919	J	2.18	J	2.79	J
1,2,3,6,7,8-HxCDD	9.11	J	12.6	J	29.2	J	4.42	J	10.4	J	11.3	J
1,2,3,7,8,9-HxCDD	5.88	J	7.41	J	17	J	2.77	J	5.92	J	6.08	J
1,2,3,4,6,7,8-HpCDD	194	J	246	J	562	J	84.6	J	200	J	221	J
OCDD	1410	J	1920	J	4230	J	647	J	1550	J	1710	J
2,3,7,8-TCDF	1.93	J	2.54	J	4.93	J	0.798	J	1.56	J	2.87	J
1,2,3,7,8-PeCDF	1.07	J	1.54	J	3.11	J	0.482	J	1.06	J	1.84	J
2,3,4,7,8-PeCDF	2.02	J	2.74	J	5.85	J	0.961	J	2.04	J	2.71	J
1,2,3,4,7,8-HxCDF	5.68	J	7.02	J	16	J	2.4	J	5.82	J	6.17	J
1,2,3,6,7,8-HxCDF	2.13	J	2.79	J	5.92	J	0.999	J	2.15	UJ	2.53	J
1,2,3,7,8,9-HxCDF	1.11	J	1.4	J	3.46	J	0.501	J	1.04	J	1.5	J
2,3,4,6,7,8-HxCDF	3.34	J	4.36	J	9.47	J	1.52	J	3.51	J	3.71	J
1,2,3,4,6,7,8-HpCDF	63.6	J	81.1	J	168	J	28.5	J	64.6	J	69.5	J
1,2,3,4,7,8,9-HpCDF	3.39	J	4.38	J	8.44	J	1.65	J	3.52	J	3.22	J
OCDF	120	J	175	J	320	J	68.1	J	136	J	128	J
Dioxin/Furan TEQ (1/2 DL)	8.6		11		25		3.8		8.6		9.1	
Dioxin/Furan TEQ (KM)	8.6		11		25		3.8		8.6		8.8	

Table A-2: Summary of dioxin/furan congener and cPAH data used to calculate South Puget Sound Regional Background (cont.).

Location ID EIM Study ID Collection Date Depth	UWI-BI-UWNO237 6/7/2011 0 to 3 cm	UWI2011-UWNO241 BuddOakDioxins[a] 6/7/2011 0 to 10 cm[a]	G1300053-SS-01 G1300053 3/12/2013 0 to 10 cm	G1300053-SS-05 G1300053 3/12/2013 0 to 10 cm	G1300053-SS-07 G1300053 3/12/2013 0 to 10 cm	G1300053-SS-08 G1300053 3/13/2013 0 to 10 cm
Percent Fines	77.7	75.8	70.3	41.5	45.5	70.9
Total Organic Carbon	2.31	2.31	3.69	2.32	2.57	2.71
cPAH TEQ (ug/kg)						
Benzo(a)pyrene	19.1	20.8	45	55	44	38
Benz[a]anthracene	16.9	17.7	39	72	35	26
Total Benzofluoranthenes	48.4	52.3	110[b]	120[b]	100[b]	77[b]
Chrysene	27	31.1	60	160	61	43
Dibenzo(a,h)anthracene	3.7	4.14	4.1 U	4.1 U	4.2 U	4.1 U
Indeno(1,2,3-cd)pyrene	25.9	28.5	30	32	29	24
cPAH TEQ (1/2 DL)	29	31	64	79	61	51
cPAH TEQ (KM)	29	31	64	79	61	52
Dioxin/Furan Congeners (ng/kg)						
2,3,7,8-TCDD	--	0.547 J	0.457 U	0.335 U	0.404 U	0.547 U
1,2,3,7,8-PeCDD	--	2.46 J	2.36 J	1.69	1.8	3.93
1,2,3,4,7,8-HxCDD	--	3.91 J	3.03	1.87	2.37	3.36
1,2,3,6,7,8-HxCDD	--	14.6 J	15.5	9.35	12.6	21.9
1,2,3,7,8,9-HxCDD	--	9.94 J	7.09	4.26	5.76	10.1
1,2,3,4,6,7,8-HpCDD	--	291 J	315	188	246	305
OCDD	--	2180 J	2430	1360	1770	2160
2,3,7,8-TCDF	--	3.92 J	1.48	1.17 J	1.23	1.51
1,2,3,7,8-PeCDF	--	2.19 J	1.31 J	0.96 J	1.13	1.42
2,3,4,7,8-PeCDF	--	3.88 J	1.4	1.05	1.27	1.5
1,2,3,4,7,8-HxCDF	--	9.24 J	5.52	3.42	4.74	5.45
1,2,3,6,7,8-HxCDF	--	3.44 J	2.92	1.87	2.34	3.01
1,2,3,7,8,9-HxCDF	--	1.85 J	1.32	0.932 J	1.2	1.4 J
2,3,4,6,7,8-HxCDF	--	5.19 J	4.4	2.98	3.64	4.47
1,2,3,4,6,7,8-HpCDF	--	90.8 J	86.6	54.3	76.1	94.5
1,2,3,4,7,8,9-HpCDF	--	4.63 J	3.48	2.21	3.12 J	3.62
OCDF	--	224 J	155	87.6	129	149
Dioxin/Furan TEQ (1/2 DL)	--	14	12	7.7	9.6	15
Dioxin/Furan TEQ (KM)	--	14	12	7.6	9.6	15

Table A-2: Summary of dioxin/furan congener and cPAH data used to calculate South Puget Sound Regional Background (cont.).

Location ID EIM Study ID Collection Date Depth	G1300053-SS-09 G1300053 3/12/2013 0 to 10 cm		PSAMP_SP-PS0036 PSAMP_SP 6/20/2011 0 to 3 cm	PSAMP_SP-PSN233 PSAMP_SP 6/20/2011 0 to 3 cm	PSAMP_SP-PSN234 PSAMP_SP 6/20/2011 0 to 3 cm	PSAMP_SP-PSN235 PSAMP_SP 6/20/2011 0 to 3 cm	PSAMP_SP-PSN238 PSAMP_SP 6/21/2011 0 to 3 cm
Percent Fines	13.6		55.4	56	68.9	73.2	87.8
Total Organic Carbon	2.61		2.46	2.67	2.46	2.48	2.78
cPAH TEQ (ug/kg)							
Benzo(a)pyrene	34		13.6	20.7	21.3	20.9	25.1
Benz[a]anthracene	24		10.4	16.9	15.8	15.5	18.1
Total Benzofluoranthenes	94[b]		35.4	45.5	55.6	51.3	62.2
Chrysene	52		19	26.4	25.5	29.6	29.4
Dibenzo(a,h)anthracene	13		2.47	3.87	4.28	3.97	4.78
Indeno(1,2,3-cd)pyrene	34		18.6	24.5	28.3	26.6	36.2
cPAH TEQ (1/2 DL)	51		20	30	32	31	38
cPAH TEQ (KM)	51		20	30	32	31	38
Dioxin/Furan Congeners (ng/kg)							
2,3,7,8-TCDD	0.312	U	--	--	--	--	--
1,2,3,7,8-PeCDD	1.41		--	--	--	--	--
1,2,3,4,7,8-HxCDD	1.53		--	--	--	--	--
1,2,3,6,7,8-HxCDD	5.41		--	--	--	--	--
1,2,3,7,8,9-HxCDD	3.12		--	--	--	--	--
1,2,3,4,6,7,8-HpCDD	94.9		--	--	--	--	--
OCDD	596		--	--	--	--	--
2,3,7,8-TCDF	0.813	J	--	--	--	--	--
1,2,3,7,8-PeCDF	0.493	J	--	--	--	--	--
2,3,4,7,8-PeCDF	0.567	J	--	--	--	--	--
1,2,3,4,7,8-HxCDF	1.31	J	--	--	--	--	--
1,2,3,6,7,8-HxCDF	0.826	J	--	--	--	--	--
1,2,3,7,8,9-HxCDF	0.412	J	--	--	--	--	--
2,3,4,6,7,8-HxCDF	1.22		--	--	--	--	--
1,2,3,4,6,7,8-HpCDF	20.7		--	--	--	--	--
1,2,3,4,7,8,9-HpCDF	0.776	J	--	--	--	--	--
OCDF	32.5		--	--	--	--	--
Dioxin/Furan TEQ (1/2 DL)	4.6		--	--	--	--	--
Dioxin/Furan TEQ (KM)	4.5		--	--	--	--	--

Table A-2: Summary of dioxin/furan congener and cPAH data used to calculate South Puget Sound Regional Background (cont.).

Location ID **EIM Study ID** **Collection Date** **Depth**	**PSAMP_SP-PSN239** **PSAMP_SP** **6/21/2011** **0 to 3 cm**	**PSAMP_SP-PSN240** **PSAMP_SP** **6/21/2011** **0 to 3 cm**
Percent Fines	88.1	86
Total Organic Carbon	2.56	2.97
cPAH TEQ (ug/kg)		
Benzo(a)pyrene	20	18.2
Benz[a]anthracene	15.6	13
Total Benzofluoranthenes	52.8	47.5
Chrysene	29	21.3
Dibenzo(a,h)anthracene	4.54	3.92
Indeno(1,2,3-cd)pyrene	29.2	28.4
cPAH TEQ (1/2 DL)	31	28
cPAH TEQ (KM)	31	28
Dioxin/Furan Congeners (ng/kg)		
2,3,7,8-TCDD	--	--
1,2,3,7,8-PeCDD	--	--
1,2,3,4,7,8-HxCDD	--	--
1,2,3,6,7,8-HxCDD	--	--
1,2,3,7,8,9-HxCDD	--	--
1,2,3,4,6,7,8-HpCDD	--	--
OCDD	--	--
2,3,7,8-TCDF	--	--
1,2,3,7,8-PeCDF	--	--
2,3,4,7,8-PeCDF	--	--
1,2,3,4,7,8-HxCDF	--	--
1,2,3,6,7,8-HxCDF	--	--
1,2,3,7,8,9-HxCDF	--	--
2,3,4,6,7,8-HxCDF	--	--
1,2,3,4,6,7,8-HpCDF	--	--
1,2,3,4,7,8,9-HpCDF	--	--
OCDF	--	--
Dioxin/Furan TEQ (1/2 DL)	--	--
Dioxin/Furan TEQ (KM)	--	--

Notes:

[a] Dioxin data were reported in EIM StudyID BuddOakDioxins with a reported depth of 0 to 10 cm, while cPAH data were reported in StudyID UWI2011 with a reported depth of 0 to 3 cm.

[b] Results were reported as total benzofluoranthenes (b,j,k).

-- Not analyzed.

U = Below detection limit.

L = Less than the reported value (estimated TEQ is biased high).

J/T = Depending upon the study and laboratory, a J or T qualifier represents an estimated result present above the detection limit but below the reporting limit.

Appendix B. Statistical Methods and Analysis Used to Characterize the South Puget Sound Regional Background Data Set

B.1 Introduction

The South Puget Sound data set is a compilation of relatively recent studies with differing objectives and sampling designs. A data set consisting of multiple studies requires careful screening and spatial analysis to isolate those results that best represent the regional background concentration distribution before calculating summary statistics. Data that passed the quality assurance review (Section 3; Figures 7 and 11, Table A-2) were used in this analysis. As part of this process, the spatial relationships among samples were evaluated to identify independent samples, avoiding over-emphasis on areas with greater sampling intensity. The data set was then statistically evaluated to determine if it represented a single homogenous population or multiple overlapping subpopulations. This iterative process involved multiple steps listed below, summarized in Table B-1, and described in more detail in Section B.2 of this report:

Step 1. A spatial autocorrelation analysis was conducted to identify the autocorrelation distance, which is the minimum distance between samples required to consider them independent. Samples that were spatially isolated or clear outliers were temporarily removed for this analysis, to reduce variability that would disproportionately affect the model. Clusters of samples within the autocorrelation distance can be assumed to have been influenced by the same sources and can be expected to have similar concentrations. There did not appear to be detectable autocorrelation within this data set.

Step 2. A population separation analysis of finite mixture models (Benaglia et al. 2009) was used to identify whether a single homogeneous population or multiple subpopulations were present within the data set. In this step the specific subpopulation representing regional background was identified.

Step 3. Precision and 90/90 UTL estimates were calculated for the identified regional background subpopulation.

B.2 Methods

The following sections describe the above steps in greater detail, as well as the statistical methods that were used.

B.2.1 Outlier Analysis

Prior to trend analysis and estimating the autocorrelation distance, certain samples were excluded from the data set for each analyte. These samples were either spatially isolated and/or chemically distinct (i.e., samples with unusual concentrations that were dissimilar to neighboring samples). Such samples unduly influence the trend model and disrupt the pattern of the residuals in the area.

Identification of potential concentration outliers was conducted using boxplots and/or Quantile-Quantile (QQ) plots. These diagnostic tools generally assume independent and identically distributed (i.i.d.) data, an assumption that was not confirmed for this data set. However, the intent was to identify elevated values that might be indicative of an unsuspected source and exclude data points that could bias the autocorrelation analysis due to higher or spatially isolated values. Outliers were subsequently added back into the data set for the final population analysis, since they may not be elevated when viewed in the context of a homogenous subpopulation.

B.2.2 Autocorrelation Analysis

The autocorrelation distance is estimated based on data that do not exhibit a trend and have a zero mean, specifically the residuals from the best-fit model to the concentration surface. A simplified approach to evaluating trends was used. Multiple surface trend models were used to evaluate potential trends in concentrations, including least squares polynomial surface models of orders 0 to 5 (i.e., from no trend up to a 5th order polynomial). The six polynomial regression models were compared using the Aikake Information Criterion corrected for sample size (AICc, Burnham and Anderson 2002), and patterns in the residual diagnostic plots. The model with the lowest AICc and best fitting residuals plots was considered to be the best trend model.

Lacking a regularly spaced grid of samples, the autocorrelation boundary was estimated by evaluating the correlation among pairs of points within various distances of each other. Pairs of sample points were grouped into bins of similar distances. For example, using a test distance of 50 m between samples, all pairs of samples within 0 to 50 m, 50 to 100 m, 100 to 150 m, etc. were grouped. Pearson's linear correlation coefficient between residuals for all possible station pairs within each distance bin provided an estimate of autocorrelation.

The distance bins considered were required to have a minimum of six pairs per bin, considered the smallest number of pairs that can reasonably be used to test for autocorrelation (e.g., Journel and Huijbregts 1978). When the sample size was small ($n < 10$), a significance test of the autocorrelation within each distance bin was applied using $\alpha = 0.20$ to limit Type II errors (i.e., failure to reject the null hypothesis when autocorrelation is present). This binned hypothesis testing approach was useful given the data limitations (i.e., insufficient pairs of samples at sequentially increasing distances) and the objective of estimating the minimum distance between independent samples.

B.2.3 Population Separation

A statistical likelihood method was used to select the best description of each data set, choosing among finite mixture models of one or more normal or gamma distributions.

If the composite data sets used for this analysis included samples within natural background on the low end and portions of elevated populations on the high end, this process would identify the breakpoints that segregated the intermediate regional background subpopulation. These breakpoints between subpopulations were identified using an expectation-maximization (EM) algorithm implemented in the following functions in the *mixtools* package in R (Benaglia et al. 2009): *normalmixEM* for mixtures of *k* normal distributions and *gammamixEM* for mixtures of *k* gamma distributions (*k* = 1, 2, or 3). The breakpoints were readily confirmed by natural breaks or slope changes in the QQ plots. The appropriateness of a single normal or gamma distribution was also evaluated, using the *fitdistr* function in the *MASS* package in R (Venables and Ripley, 2002).

The single and mixture model alternatives were compared using Akaike Information Criterion with correction for small sample sizes (AICc; Burnham and Anderson 2002). The model with the smallest AICc was preferred, and any model with an AICc within 2 units of the minimum AICc was considered a reasonable alternative to the "best" model.

$$AICc = -2ln(\hat{L}) + 2k + 2k(k+1)/(n-k-1)$$

where:

> $ln(\hat{L})$ = the log-Likelihood for the specified model.
>
> k = number of parameters (2 for each gamma or normal distribution in the mixture, so a mixture of 2 gamma distributions would have k = 4).
>
> n = number of observations.

When more than one mixture model was considered appropriate, the models were reviewed to determine which was most suitable to identify regional background. For example, when comparable models differed only in how they differentiated concentrations at or below natural background, but the upper breakpoint which differentiated regional background was unchanged, both would be considered suitable.

Overall, the process was to:

- Evaluate the QQ plot and remove obvious outliers based on large jumps in the data distribution. Use the EM algorithm to identify maximum likelihood breakpoints between multiple normal or gamma subpopulations, and calculate the AICc associated with each mixture.

- The finite mixture with the lowest AICc was deemed the most appropriate description for the data set and the subpopulations (if any) were interpreted using available information.

B.3 Results

B.3.1 Outlier Identification

Identification of outliers, or highly influential samples, was conducted prior to performing the autocorrelation analysis. Samples that were spatially isolated or chemically distinct were removed prior to the autocorrelation step. Only one sample was excluded from the autocorrelation analysis for cPAHs:

- One station on the northeast side of Budd Inlet (Study = UWI2011, Location ID = PSUW012) had a cPAH TEQ value of 240 µg/kg, over three times the next highest value in the dataset. This station was surrounded by samples with TEQ values in the range of 29 to 49 µg/kg. This sample is clearly not correlated with its neighbors, and its inclusion in the trend surface model decreased the goodness of fit. Consequently, it was excluded from the autocorrelation analysis.

B.3.2 Autocorrelation Distance

In this data set there were relatively few occurrences of spatially clustered samples. These spatially clustered samples tended to be individual pairs of samples that were in close proximity in space (though separated by years) instead of large areas that were the subject of more intensive sampling efforts.

The residuals from the best fit model for each chemical (Table B-2) were grouped based on distance between sampling locations. For example, if the distance interval under evaluation was 50 m, then all sample pairs within 0 to 50 m, 50 to 100 m, 100 to 150 m, etc. were grouped, and the Pearson correlation was calculated between the values among all sample pairs within each distance bin.

For the cPAH TEQ data, there were very few clustered samples; only 8 sample pairs were within 300 m of one another, and 14 sample pairs were within 500 m. The Pearson correlation coefficients within each of these closest distance bins were near zero. With no evidence for autocorrelation within the cPAH data set, all data were treated as independent.

For the dioxin/furan TEQ data, there were more clustered samples on which to test the autocorrelation hypothesis (13 sample pairs within 200 m of one another, 26 sample pairs within 300 m, and 38 sample pairs within 500 m). The relationship between concentrations for sample pairs within these distance bins showed no correlation, with a single data point responsible for the overall negative Pearson correlation coefficients. Similar to the conclusion for cPAHs, there was no evidence for autocorrelation within the dioxin/furan data set and all data were treated as independent.

B.3.3 Population Separation

The following describes the results of the population separation analysis for the dioxin/furan and cPAH data sets.

B.3.3.1 cPAH TEQs

In the QQ plot for the full data set, one sample with a cPAH TEQ value of 240 µg/kg stood out as a clear outlier (Figure B-1a). The data (excluding the single elevated value) were then evaluated as a single population of either normal or a gamma distribution, or a mixture of two or more normal or gamma distributions using the *mixtools* package in R.

In a well-mixed environment, the sediment chemistry from the regional background signal may be expected to follow a normal distribution without excessive skewness. When the sediment chemistry data has a skewed probability distribution, this may be an indicator of an environmental setting that has multiple regional sources that are not well-mixed or of overlapping distributions with the upper concentrations representing very localized contaminant sources. A skewed distribution that is supported by a smooth QQ plot without large breaks in the distribution of values may reasonably be modeled as a gamma distribution.

The AICc values for five different mixture models are shown in Table B-3. Among these five competing mixture models, model selection based on the AICc showed comparable fit for a mixture of two normal distributions and a single gamma distribution. The mixture of two normal distributions identified a breakpoint at 65 ppb, placing the highest two values (77 and 79 ppb, both located in the West Bay) in a different subpopulation. The West Bay stations define the upper tail of the concentration distribution (Figure B-1b), with six values ranging from 51 to 79 ppb. However, the entire group of West Bay stations does not represent a separate and distinct subpopulation, and they are similar to values found just north of Gull Harbor. A comparison between the two models with the lowest AICcs (Figures B-1c and B-1d) indicates a slight preference for the single gamma distribution based on a slightly higher correlation coefficient for the QQ plot, and less overall deviation from the line. Therefore, all of the data were considered to be part of a single distribution.

B.3.3.2 Dioxin/Furan TEQs

QQ plots for the full data set for dioxin/furan TEQs are shown in Figures B-2a and b. There do not appear to be any distinct breaks in the distribution, although there appear to be one or two possible outliers. These data were evaluated as a single population of either a normal or gamma distribution, or a mixture of two or more normal or gamma distributions using the *mixtools* package in R.

The AICc values for five different mixture models are shown in Table B-3. Among these five competing mixture models, model selection based on the AICc showed a slight preference for a single normal distribution over a single gamma distribution (AICc of 165 versus 166). If a normal distribution is assumed, however, the highest concentration at 25 ng/kg TEQ appears to be a statistical outlier (Dixon's Outlier test, $p < .05$). The normal QQ plot for the data excluding this potential outlier (Figure B-2c) also appears to be a good fit to the data, with a correlation coefficient for the QQ plot of 0.99.

Table B-1: Stepwise approach to identify the regional background data set from the compiled data set.

Step	Data Set	Objective
1	All samples, excluding chemical/spatial outliers.	Identify autocorrelation distance.
2	Independent samples plus cluster averages (if any), including chemical/spatial outliers.	Identify regional background subpopulation.
3	Regional background subpopulation.	Calculate precision and 90/90 UTL.

Table B-2: Summary of the trend surface analysis for each analyte.

Analyte	Sample Size	Concentration Range of the Data Used to Fit the Trend Surface	Polynomial Order of the Best-Fit Trend Surface
cPAH TEQ	22	10 to 79 µg/kg TEQ	No trend
Dioxin/furan TEQ	26	0.65 to 25 ng/kg TEQ	No trend

Table B-3: AICc values and relative likelihoods for competing mixture models[1] for dioxin/furan and cPAH TEQ data sets.

Distribution of Mixtures	AICc for cPAH data	Difference from Min(AICc)	AICc for Dioxin/furan TEQ data (final)	Difference from Min(AICc)
1 Normal	193	3	165*	0
2 Normals	190*	0	169	4
3 Normals	194	4	173	8
1 Gamma	190*	0	166	1
2 Gammas	196	6	172	7

[1] Evaluated using *mixtools* package in R (Benaglia et al 2009).

* Mixture model preferred by smallest AICc value.

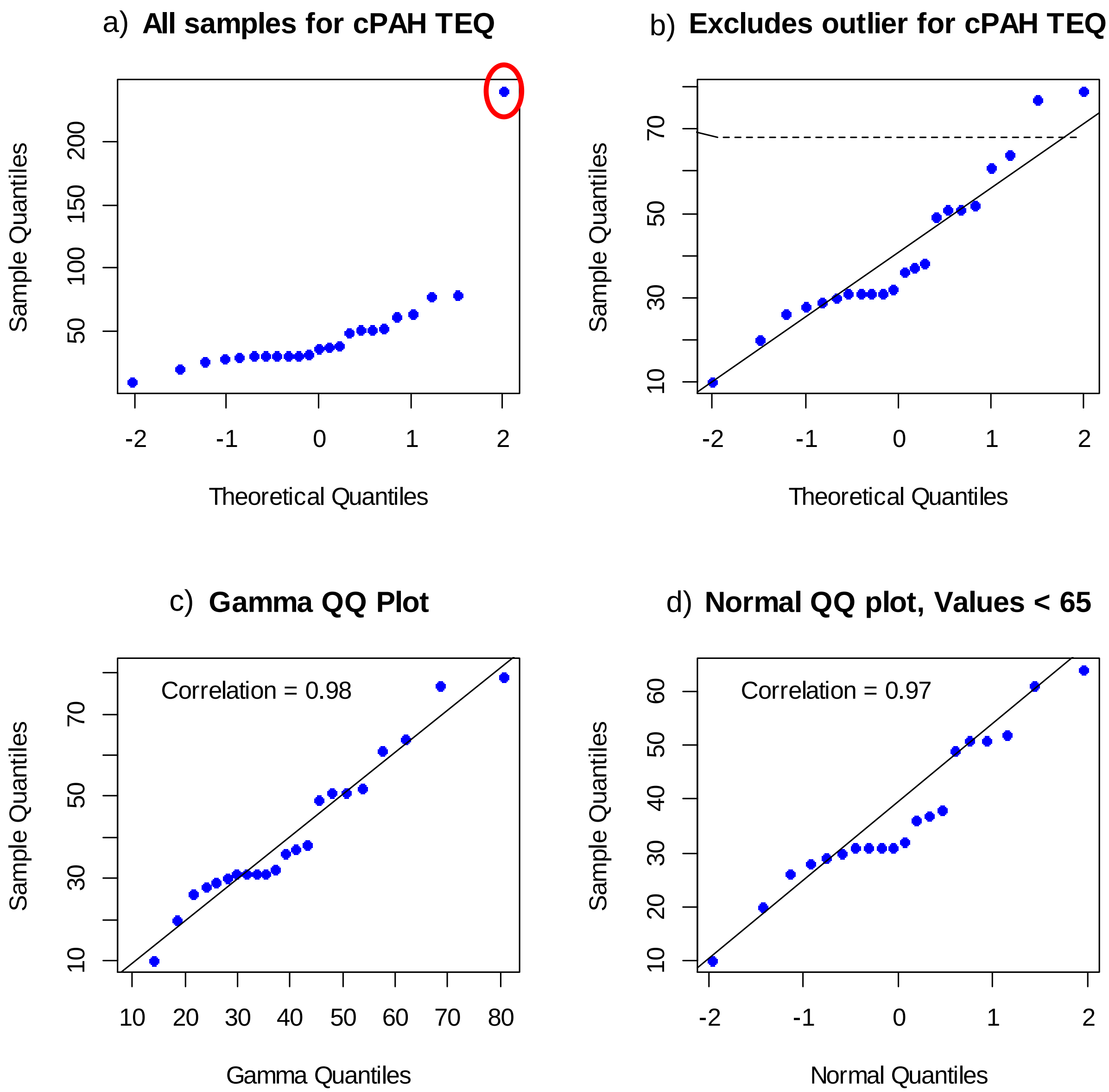

Figure B-1. QQ plots for the cPAH TEQ data (µg/kg, dry weight):

a) Normal QQ plot for all samples with one elevated value (circled in red).

b) Normal QQ plot for all data excluding the elevated value and showing possible breakpoint for a mixture model of two normal distributions.

c) Gamma QQ plot for all data excluding the single elevated value.

d) Normal QQ plot for all data below the breakpoint shown in panel b.

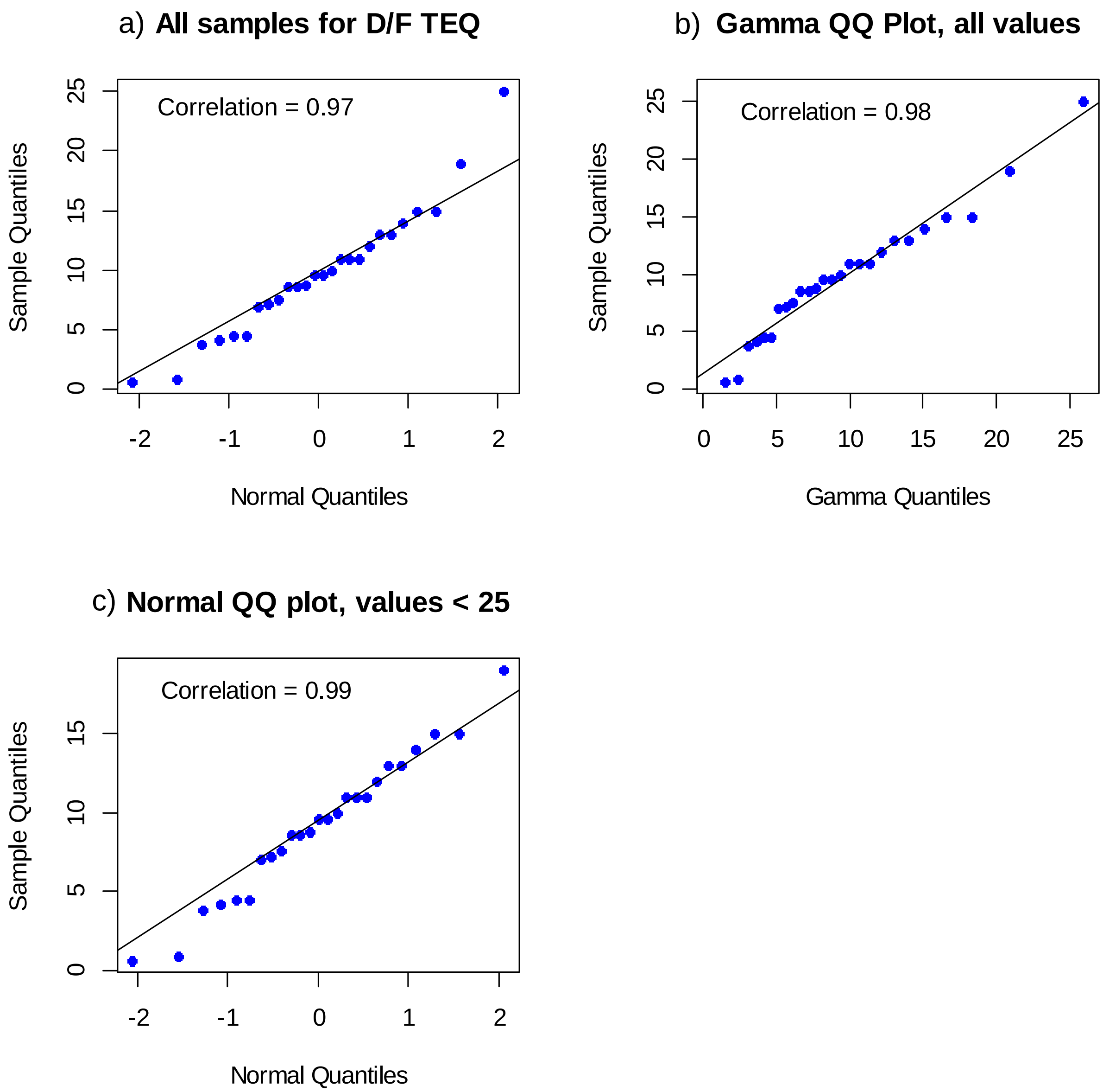

Figure B-2. QQ plots for the dioxin/furan TEQ data (ng/kg, dry weight):

a) Normal QQ plot for all samples with one elevated value.

b) Gamma QQ plot for all data.

c) Normal QQ plot for all data.