APPENDIX E
DATA MANAGEMENT

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BUDD INLET CLEANUP EVALUATION

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LIST OF ACRONYMS AND ABBREVIATIONS

C	chemical concentration
cPAHs	carcinogenic polycyclic aromatic hydrocarbons
HPAHs	high molecular weight polycyclic aromatic hydrocarbons
LPAHs	low molecular weight polycyclic aromatic hydrocarbons
mg/kg	milligrams per kilogram
OC	organic carbon
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
QC	quality control
RL	reporting limit
SIM	selected ion monitoring
SMS	Sediment Management Standards
SVOC	semivolatile organic compound
TEF	toxic equivalency factor
TEQ	toxicity equivalency quotient
TOC	total organic carbon
VOC	volatile organic compound
WHO	World Health Organization
µg/kg	micrograms per kilogram

1 SIGNIFICANT FIGURES AND CALCULATIONS

Analytical laboratories reported results with various numbers of significant figures depending on the laboratory's standard operating procedures, the instrument, the chemical, and the reported chemical concentration relative to the reporting limit (RL). The reported (or assessed) precision of each result is explicitly stored in the project database by recording the number of significant figures. Tracking of significant figures is used when calculating averages and performing other data summaries. When a calculation involves addition, such as totaling polychlorinated biphenyls (PCBs), the calculation can only be as precise as the least precise number that went into the calculation. For example:

> 210 + 19 = 229 would be reported as 230 because although 19 is reported to 2 significant digits, the trailing zero in the number 210 is not significant.

When a calculation involves multiplication or division, the final result is rounded at the end of the calculation to reflect the value used in the calculation with the fewest significant figures. For example:

> $59.9 \times 1.2 = 71.88$ would be reported as 72 because there are two significant figures in the number 1.2.

When rounding, if the number following the last significant figure is less than 5, the digit is left unchanged. If the number following the last significant figure is equal to or greater than 5, the digit is increased by 1.

Many of the Washington State Sediment Management Standards (SMS) chemical criteria are in units normalized to the total organic carbon (TOC) content in the sediment sample (i.e., milligrams per kilogram [mg/kg] organic carbon [OC]). Only samples with TOC concentrations greater than or equal to 0.5 percent or less than or equal to 4.0 percent are considered appropriate for OC normalization. Samples with TOC concentrations less than 0.5 percent or greater than 4.0 percent are compared to dry weight chemical criteria.

Chemical concentrations originally in units of micrograms per kilogram (µg/kg) dry weight were converted to mg/kg OC using the following equation:

$$\frac{(C_{\mu g/kg\ dry\ weight}) \times (0.001\ mg/\mu g)}{TOC}$$

Where:

C = the chemical concentration

TOC = the percent total organic carbon on a dry weight basis, expressed as a decimal (e.g., 1% = 0.01)

2 BEST RESULT SELECTION FOR MULTIPLE RESULTS

In some instances, the laboratory generates more than one result for a chemical for a given sample. Multiple results can occur for several reasons, including: 1) the original result did not meet the laboratory's internal quality control (QC) guidelines, and a reanalysis was performed; 2) the original result did not meet other project data quality objectives, such as a sufficiently low RL, and a reanalysis was performed; or 3) two different analytical methods were used for that chemical. In each case, a single best result was selected for use. The procedures for selecting the best result differed depending on whether a single or multiple analytical methods were used for that chemical. For the same analytical method, if the results were:

- Detected and not qualified, then the result from the lowest dilution was selected.
- A combination of detected and undetected results, then the detected result was selected. If there was more than one detected result, the applicable rules for multiple results (as discussed above) were followed.
- All undetected results, then the lowest RL was selected.
- The best result selection for historical datasets that may have followed alternate rules. For example, the highest detected concentration may have been preferentially selected regardless of dilution, in the interest of protecting the environment.

For semivolatile organic compounds (SVOC) the following data selection process was used:

- For full-scan and selected ion monitoring (SIM) methods the highest detected concentration was selected.
- If the result by full-scan SVOC was detected and the result by SIM method was not detected, then the detected result was selected for reporting, regardless of the method.
- If results were reported as non-detected by SIM and full-scan SVOC methods, the undetected result with the lowest RL was selected. The SIM method is more analytically sensitive than the full-scan SVOC method, and the undetected results were generally reported at a lower RL by the SIM method than by the full-scan method. Therefore, the SIM method was selected for non-detected results unless an analytical dilution or analytical interferences elevated the SIM RL above the SVOC full-scan RL.

3 CALCULATED TOTALS

Total PCBs and total polycyclic aromatic hydrocarbons (PAHs) were calculated by summing the detected values for the individual components available for each sample. For individual samples in which none of the individual components was detected, the total value was given a value equal to the highest RL of an individual component, and assigned the same qualifier (U or UJ), indicating an undetected result. Concentrations for the analyte sums are calculated as follows:

- Total PCBs are calculated, in accordance with the methods of the SMS, using only detected values for seven Aroclor mixtures (Aroclors 1016, 1221, 1232, 1242, 1248, 1254, and 1260.) For individual samples in which none of the seven Aroclor mixtures is detected, total PCBs are given a value equal to the highest RL of the seven Aroclors and assigned a U-qualifier indicating the lack of detected concentrations.
- Total low-molecular-weight PAHs (LPAHs), high-molecular-weight PAHs (HPAHs), , and benzofluoranthenes are also calculated in accordance with the methods of the SMS. Total LPAHs are the sum of detected concentrations for naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene, and anthracene. Total HPAHs are the sum of detected concentrations for fluoranthene, pyrene, benzo(a)anthracene, chrysene, total benzofluoranthenes, benzo(a)pyrene, indeno(1,2,3,-c,d)pyrene, dibenzo(a,h)anthracene, and benzo(g,h,i)perylene. Total benzofluoranthenes are the sum of the b (i.e., benzo(b)fluoranthene), j, and k isomers. Because the j isomer is rarely quantified, this sum is typically calculated with only the b and k isomers. For samples in which all individual compounds within any of the three groups described above are undetected, the single highest RL for that sample represents the sum.

4 CALCULATION OF DIOXIN/FURAN CONGENER TEQS

Dioxin/furan congener TEQs are calculated using the WHO consensus TEF values (Van den Berg et al. 2006) for mammals as presented in Table E-1. The TEQ is calculated as the sum of each congener concentration multiplied by the corresponding TEF value. When the congener concentration is reported as undetected, then the TEF is multiplied by half the RL.

Table E-1
Dioxin/Furan Congener TEF Values for Mammals

Dioxin/Furan Congener	TEF Value
1,2,3,4,6,7,8-Heptachlorodibenzofuran	0.01
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	0.01
1,2,3,4,7,8,9-Heptachlorodibenzofuran	0.01
1,2,3,4,7,8-Hexachlorodibenzofuran	0.1
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	0.1
1,2,3,6,7,8-Hexachlorodibenzofuran	0.1
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	0.1
1,2,3,7,8,9-Hexachlorodibenzofuran	0.1
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	0.1
1,2,3,7,8-Pentachlorodibenzofuran	0.03
1,2,3,7,8-Pentachlorodibenzo-p-dioxin	1
2,3,4,6,7,8-Hexachlorodibenzofuran	0.1
2,3,4,7,8-Pentachlorodibenzofuran	0.3
2,3,7,8-Tetrachlorodibenzofuran	0.1
2,3,7,8-Tetrachlorodibenzo-p-dioxin	1
Octachlorodibenzofuran	0.0003
Octachlorodibenzo-p-dioxin	0.0003

Notes:
TEF – toxic equivalency factor

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