4.0 Data Validation

All chemistry data generated for this report underwent an independent quality assurance review and data validation by EcoChem, Inc. of Seattle, WA. A QA2 data review was conducted to examine the complete analytical process, and a QA1 data review was conducted to evaluate the acceptability of test results. Data validation results and the completeness of the dataset are summarized in Table 9. The full data validation reports are provided in Appendix C.

Completeness refers to the amount of data collected relative to that needed to assess the project's objectives. The completeness of data for the second round of analysis of the 2007 Fidalgo Bay Sediment Investigation has been summarized three ways: field sampling, analytical, and technical. Both sediment and tissue data are included in Table 9.

Field sampling completeness is the number of samples collected divided by the amount of results reported. For this study, field sampling completeness is the number of archive samples requested for analysis, versus the number analyzed.

All requested samples were sent to Axys, but one sample was compromised during extraction and not reported. All but two samples requested for analysis were sent to CAS. Tissue volumes for A3R2-macoma and A2R1-RR-hepato were low, and all available samples were sent to Axys. Field sampling completeness was 98 percent for samples submitted to Axys for dioxin/furan analysis, and 97 percent for samples submitted to CAS metals and PCB Aroclor analysis.

The number of samples that have not been qualified by either the analytical laboratory or EcoChem divided by the number of results reported is the analytical completeness. Analytical completeness was highest for the metals (29 to 91 percent) and lowest for the phthalates and miscellaneous extractables (0 percent) (Table 9). Analytical completeness for the dioxin/furan congeners ranged from 0 to 71 percent.

The most important measure of completeness is the number of usable results divided by the total number of results reported. Though referred to as technical completeness, this is a direct measure of the percent usable results. Analytes that were flagged either rejected or do not report are not usable results. Benzoic acid was rejected in all 21 sediment samples, giving it a technical completeness of 0 percent. All other data are considered valid and usable as qualified for the purposes of this investigation.

Table 9. Sediment Chemistry Analytes and Completeness Determination

Parameters	Samples Collected and Analyzed	Qualified Samples			Completeness		
		Total	Rejected	Do Not Report	Field Sampling	Analytical	Technical
Conventionals							
TOC (% dw)	21	21			100%	0%	100%
Total Solids (%)	21	21			100%	0%	100%
Metals in mg/kg dw							
Arsenic	58	5			97%	91%	100%
Cadmium	58	20			97%	66%	100%
Chromium	58	7			97%	88%	100%
Copper	58	23			97%	60%	100%
Lead	58	17			97%	71%	100%
Mercury	58	21			97%	64%	100%
Silver	58	26			97%	55%	100%
Zinc	58	41			97%	29%	100%
LPAH in µg/kg dw							
Naphthalene	21	19			100%	10%	100%
Acenaphthylene	21	21			100%	0%	100%
Acenaphthene	21	21			100%	0%	100%
Fluorene	21	21			100%	0%	100%
Phenanthrene	21	10			100%	52%	100%
Anthracene	21	17			100%	19%	100%
2-Methylnaphthalene	21	21			100%	0%	100%
HPAH in µg/kg dw							
Fluoranthene	21	3			100%	86%	100%
Pyrene	21	3			100%	86%	100%
Benzo(a)anthracene	21	14			100%	33%	100%
Chrysene	21	7			100%	67%	100%
Benzofluoranthenes*	21	17			100%	19%	100%
Benzo(a)pyrene	21	15			100%	29%	100%
Indeno(1,2,3-cd)pyrene	21	15			100%	29%	100%
Dibenz(a,h)anthracene	21	21			100%	0%	100%
Benzo(g,h,i)perylene	21	19			100%	10%	100%
Chlorinated Aromatics in µg/kg dw							
1,4-Dichlorobenzene	21	21			100%	0%	100%
1,2-Dichlorobenzene	21	21			100%	0%	100%
1,2,4-Trichlorobenzene	21	21			100%	0%	100%
Hexachlorobenzene	21	21			100%	0%	100%
Phthalate Esters in µg/kg dw							
Dimethylphthalate	21	21			100%	0%	100%
Diethylphthalate	21	21			100%	0%	100%
Di-n-Butylphthalate	21	21			100%	0%	100%
Butylbenzylphthalate	21	21			100%	0%	100%
bis(2-Ethylhexyl)phthalate	21	21			100%	0%	100%

Table 9. Sediment Chemistry Analytes and Completeness Determination (continued)

	Samples Collected and Analyzed	Qualified Samples			Completeness		
		Total	Rejected	Do Not Report	Field Sampling	Analytical	Technical
Di-n-Octylphthalate	21	21			100%	0%	100%
Phenols in µg/kg dw							
Phenol	21	15			100%	29%	100%
2-Methylphenol	21	21			100%	0%	100%
4-Methylphenol	21	10			100%	52%	100%
2,4-Dimethylphenol	21	21			100%	0%	100%
Pentachlorophenol	21	21			100%	0%	100%
Miscellaneous Extractables in µg/kg dw							
Benzyl Alcohol (µg/kg dw)	21	21			100%	0%	100%
Benzoic Acid (µg/kg dw)	21	21	21		100%	0%	0%
Dibenzofuran	21	21			100%	0%	100%
Hexachloroethane	21	21			100%	0%	100%
Hexachlorobutadiene	21	21			100%	0%	100%
N-Nitrosodiphenylamine	21	21			100%	0%	100%
PCBs in µg/kg dw							
Aroclor-1221	58	58			97%	0%	100%
Aroclor-1232	58	58			97%	0%	100%
Aroclor-1242	58	58			97%	0%	100%
Aroclor-1016	58	58			97%	0%	100%
Aroclor-1248	58	58			97%	0%	100%
Aroclor-1254	58	56			97%	3%	100%
Aroclor-1260	58	56			97%	3%	100%
Dioxin/Furan in pg/g							
2,3,7,8-TCDD	55	47			98%	15%	100%
1,2,3,7,8-PECDD	55	49			98%	11%	100%
1,2,3,4,7,8-HXCDD	55	47			98%	15%	100%
1,2,3,6,7,8-HXCDD	55	37			98%	33%	100%
1,2,3,7,8,9-HXCDD	55	44			98%	20%	100%
1,2,3,4,6,7,8-HPCDD	55	19			98%	65%	100%
OCDD	55	16			98%	71%	100%
2,3,7,8-TCDF	55	25			98%	55%	100%
1,2,3,7,8-PECDF	55	53			98%	4%	100%
2,3,4,7,8-PECDF	55	50			98%	9%	100%
1,2,3,4,7,8-HXCDF	55	49			98%	11%	100%
1,2,3,6,7,8-HXCDF	55	52			98%	5%	100%
1,2,3,7,8,9-HXCDF	55	55			98%	0%	100%
2,3,4,6,7,8-HXCDF	55	53			98%	4%	100%
1,2,3,4,6,7,8-HPCDF	55	35			98%	36%	100%
1,2,3,4,7,8,9-HPCDF	55	53			98%	4%	100%
OCDF	55	42			98%	24%	100%

HPAH = high molecular weight polycyclic aromatic hydrocarbons; LPAH = low molecular weight polycyclic aromatic hydrocarbons

5.0 Data Summary

The second round of chemical analysis for the Fidalgo Bay Sediment Investigation was conducted to further define the nature and extent of sediment contamination in Fidalgo Bay. Towards this goal, archived sediment samples were analyzed for SMS chemistry and dioxin/furan congeners, and archived tissue samples were analyzed for metals, PCB Aroclors, and dioxin/furan congeners.

Of the 21 sediment samples analyzed for SMS chemistry, four samples from DUA 3 exceeded either SQS or CSL criteria for phenol or 4-methylphenol. Neither of these compounds exceeded SMS criteria in the first round of analysis. Dioxin/furan congeners were measured in 11 sediment samples from DUAs 3 and 4, with concentrations ranging from 0.289 and 8.91 pg TEQ/g. The highest measured concentration was on the western side of DUA 3, in the vicinity of the elevated concentrations found in the first round of analysis (Figure 5).

Clam, crab, and flatfish were analyzed for PCB Aroclors and metals. Metals were detected in all samples, with variability in concentration between species and sampling location. PCBs were only detected in three clam and one crab samples. All tissue samples were analyzed for dioxin/furan congeners. For the clams, flatfish, and polychaetes, the highest dioxin/furan concentration was 0.76 pg TEQ/g for A4R1-bentnose. Tissue concentrations were higher for the crab, but this was primarily due to the higher lipid content of the hepatopancreas. Lipid normalized concentrations for the three crab tissue types were similar.

6.0 References

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