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This is Appendix D-8 for the report:

Control of Toxic Chemicals in Puget Sound: Assessment of Selected Toxic Chemicals in the Puget Sound Basin, 2007-2011. www.ecy.wa.gov/biblio/1103055.html

Appendix D-8. Hazard Evaluation – Summary Statistics for Environmental (Observed) Data

Table 1. Observed Surface Water Data

Table 2. Observed Sediment Data

Table 3. Observed Tissue Residue Data Used to Compare to Tissue Residue Effects

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Appendix D-8. Table 1. Summary of surface water chemistry data and summary statistics

Chemical	Freshwater							Nearshore Water						Offshore Water					
	Units	Min	Max	Mean	Median	% FOD	N	Min	Max	Mean	Median	% FOD	N	Min	Max	Mean	Median	% FOD	N
Arsenic - dissolved	ug/L	0.007	50	1.52	0.757	85.1%	4528	0.5	2.0	1.113	1.1	93.0%	43	0.45	19.5	1.598	1.383	91.4%	58
Cadmium - dissolved	ug/L	0.002	3600	0.96	0.02	7.1%	4166	0.036	0.067	0.055	0.057	100%	32	0.067	0.111	0.083	0.081	100%	42
Copper - dissolved	ug/L	0.02	68.4	1.77	1.02	92.2%	5378	0.28	12.0	1.86	1.07	100%	107	0.16	76.6	1.817	0.347	100%	71
Lead - dissolved	ug/L	0.006	1400	0.92	0.144	32.9%	4427	0.007	1.0	0.087	0.014	68.1%	44	0.006	0.5	0.069	0.044	71.6%	74
Mercury - dissolved	ug/L	3E-05	0.5	0.045	0.005	52.9%	3284	No Data						No Data					
Mercury - total	ug/L	0.0002	0.46	0.0088	0.0016	63.0%	4313	0.009	0.02	0.015	0.017	100%	7	0.005	0.061	0.21	0.014	92.8%	14
Zinc - dissolved	ug/L	0.15	3150	8.75	1.9	87.5%	4844	0.39	5.0	1.14	0.94	100%	33	0.23	2.64	0.71	0.61	94.7%	57
PCB Aroclors - Total	ug/L	1E-05	0.0795	0.0109	0.0016	3.5%	1248	No Detects						No Detects					
PCB Congeners - Total	ug/L	3E-06	0.0273	0.0012	1.3E-04	79.7%	177	No Data						6.1E-06	8.3E-05	2.9E-05	2.6E-05	100%	84
PBDE Congeners -total ^a	ug/L	1E-06	0.2715	0.0068	4.2E-05	58.8%	255	No Data						1E-05	0.03385	0.00316	0.00042	19.8%	126
1,2,3,4,7,8-HxCDD	ug/L	1.5E-04	1.9E-04	1.7E-04	1.7E-04	28.5%	7	No Data						No Data					
1,2,3,7,8-PeCDD	ug/L	5.3E-05	6.4E-05	5.9E-05	5.9E-05	28.5%	7	No Data						No Data					
2,3,7,8-TCDD	ug/L	7.4E-06	7.4E-06	7.4E-06	7.4E-06	14.2%	7	No Data						No Data					
DDT/DDE/DDDs - Total	ug/L	0.0012	7.97	0.44	0.12	4.0%	2179	No Detects						No Detects					
Acenaphthene	ug/L	0.0006	1.2	0.0350	0.0095	7.8%	1540	0.009	1.0	0.099	0.012	58.3%	12	0.009	0.018	0.01	0.01	1.2%	84
Acenaphthylene	ug/L	0.0005	1	0.0389	0.0095	5.6%	1534	No Detects						No Detects					
Anthracene	ug/L	0.0005	1.7	0.0352	0.0095	5.9%	1539	0.009	1.0	0.093	0.009	8.3%	12	No Detects					
Benzo(a)anthracene	ug/L	0.0005	14.5	0.043	0.024	11.3%	1447	0.024	0.041	0.026	0.024	9.1%	11	No Detects					
Benzo(a)pyrene	ug/L	4E-06	20.4	0.062	0.0095	11.2%	1558	0.009	1.0	0.092	0.009	8.3%	12	No Detects					
Benzo(b)fluoranthene ^a	ug/L	9E-06	31.6	0.078	0.0095	14.3%	1558	0.009	1.0	0.097	0.009	16.7%	12	No Detects					
Benzo(ghi)perylene ^a	ug/L	6E-06	21.9	0.094	0.047	11.4%	1559	No Detects						No Detects					
Benzo(k)fluoranthene	ug/L	8E-06	25.1	0.068	0.0095	12.5%	1558	0.009	1.0	0.094	0.009	8.3%	12	No Detects					
Chrysene	ug/L	3E-05	29.3	0.078	0.024	15.5%	1557	0.024	1.0	0.109	0.024	8.3%	12	No Detects					
Dibenzo(a,h)anthracene	ug/L	3E-06	6.25	0.075	0.047	4.7%	1557	No Detects						No Detects					
Fluoranthene	ug/L	0.001	47.5	0.095	0.0096	21.9%	1539	0.009	1.00	0.106	0.02	75.0%	12	0.009	0.018	0.01	0.01	3.6%	84
Fluorene	ug/L	0.0005	3.4	0.041	0.0095	8.3%	1539	0.009	1.00	0.094	0.009	16.7%	12	0.009	0.012	0.01	0.01	1.2%	84
Indeno(1,2,3-cd)pyrene ^a	ug/L	3E-06	19.4	0.090	0.047	10.0%	1555	No Detects						No Detects					
Naphthalene	ug/L	0.0048	18	0.12	0.024	21.2%	1577	0.024	1.0	0.116	0.024	25.0%	12	0.01	0.088	0.018	0.018	2.4%	84
Phenanthrene	ug/L	0.0015	17	0.064	0.0096	23.2%	1538	0.01	1.0	0.10	0.01	66.7%	12	0.0094	0.0249	0.00996071	0.0098	3.6%	84
Pyrene	ug/L	0.001	38.7	0.090	0.0096	24.4%	1536	0.01	1.0	0.10	0.01	50.0%	12	No Detects					
Bis(2-Ethylhexyl) Phthalate	ug/L	0.0547	148	2.48	0.756	84.1%	1484	0.255	1.71	0.756	0.621	91.7%	12	0.012	40.5	0.966	0.18	53.6%	84
Total Nonylphenol	ug/L	0.019	44.2	0.64	0.12	25.6%	539	0.05	0.19	0.08	0.09	27.3%	11	0.032	0.36	0.202	0.282	16.7%	84
Triclopyr	ug/L	0.0028	1.3	0.073	0.063	33.2%	1632	No Data						No Data					
Petroleum - Heavy oils	ug/L	149	750	387	347	100%	17	No Data						No Data					
Petroleum - Diesel	ug/L	130	1020	355	285	95.6%	295	No Data						No Data					
Petroleum - Gasoline	ug/L	22	93000	6587	2750	26.5%	359	No Data						No Data					
Petroleum - Lube Oil	ug/L	30	11000	1166	210	8.3%	894	No Data						No Data					

FOD - Frequency of Detection

^aNo figure for these COCs due to a lack of toxicity data with which to compare

Appendix D-8. Table 3 - Summary of freshwater and marine (near- and offshore) tissue residue data used in the in the direct effects to aquatic life assessment.

Chemical of Concern	Units	Tissue Types																		
		Non-decapod invertebrates						Decapods (crabs and shrimps)						Fish						
		min	max	mean	median	% FOD	N	min	max	mean	median	% FOD	N	min	max	mean	median	% FOD	N	
Freshwater Tissue Residue - Environmental Data Summary																				
PCB congeners	ug/Kg	6.94	4309	266	85.0	1	123	No Environmental Data Available				N/A	0	13.1	67.2	41.2	44.2	100%	12	
Aroclor	ug/Kg	11.0	3228	186	60.8	88%	142	No Environmental Data Available				N/A	0	3.1	3.1	3.1	3.1	9.1%	11	
Dioxins	ug/Kg-TEQ	2.38E-07	4.49E-01	6.65E-03	0.000727761	57%	175	No Environmental Data Available				N/A	0	No Environmental Data Available				N/A	0	
DDT	ug/Kg	No Environmental Data Available					N/A	0	No Environmental Data Available				N/A	0	1.8	173	62.3	55.9	91.6%	83
Mercury	ug/Kg	No Environmental Data Available					N/A	0	No Environmental Data Available				N/A	0	23.1	160	49.3	42.5	100%	16
Marine Nearshore Tissue Residue - Environmental Data Summary																				
Aroclor	ug/Kg	3.00	580	71.1	24	33.3%	99	6.5	1400	266	110	70.4%	27	5.9	18400	1606	845	100%	96	
DDT	ug/Kg	0.31	33.0	7.74	5.34	31.0%	84	1.1	167	38.0	16.9	100%	20	1.4	1020	91.4	51.2	97.7%	131	
Dioxins	ug/Kg-TEQ	8.9E-08	0.0098	0.000298	1.35245E-05	97.3%	76	9.8E-08	0.0047	0.00124	0.00032	100.0%	13	No detections				0.0%	1	
Mercury	ug/Kg	1.20	42.0	8.37	6.83	95.9%	169	2	100	31.9	24.5	95.2%	42	5	183	34.9	30	1	104	
PCB congeners	ug/Kg	0.01	930	47.59	4.26	100%	57	0.67	1346	120	24.33	100%	28	2.38	12228	736	115	97.1%	70	
Marine Offshore Tissue Residue - Environmental Data Summary																				
Aroclor	ug/Kg	3.50	300.0	98.59	81	53.1%	32	100	240	170	170	40.0%	5	5.70	4200	882	14.7	84.6%	26	
DDT	ug/Kg	0.58	3.40	1.98	1.82	18.2%	33	16.0	81.4	48.7	48.7	40.0%	5	0.69	286	19.1	14.9	99.8%	543	
Dioxins	ug/Kg-TEQ	4.91E-08	0.000984	0.000203	5.8153E-06	85.7%	28	1.37E-07	0.00935	0.00278	0.00252	100.0%	9	9.05E-08	0.00169	0.000579	9.8E-06	90.0%	10	
Mercury	ug/Kg	10.0	82.0	21.29	17.5	100%	48	9.00	50.0	32.2	45.0	100%	5	10.0	523	71.3	50.2	100%	190	
PCB congeners	ug/Kg	0.04	2.15	0.69	0.147	100%	11	213	213	213	213	100%	1	0.95	2481	58.4	23.5	99.1%	324	

Appendix D-8. Table 4 - Summary of freshwater and marine concentrations used to calculate daily doses for wildlife.

Statistic	Media	Chemical of Concern				
		Mercury	Total PCBs **	DDTs	Dioxins as TEQs	Total PBDEs
Freshwater 95% UCL on the mean	Fish (mg/kg dry) **	2.5	1.1	0.31	5.0E-06	0.089
	Sediment (mg/kg dry)	0.0033	16	2.4	0.0033	0.11
	Water (mg/L)	7.8E-06	2.2E-06	0.0011	6.2E-07	NA
Marine 95% UCL on the mean	Fish (mg/kg dry) **	1.3	28	0.41	2.7E-06	0.12
	Sediment (mg/kg dry)	0.77	0.34	0.63	0.000064	0.0046
	Water (mg/L)	0.000022	3.7E-08	3.9E-07	NA	NA

*Tissue data were corrected to dry weight assuming 20% solids

** Fish and sediment concentrations are total PCBs as Aroclors. Water concentrations are total PCBs as congeners.

NA - no data available

Appendix D-8. Table 5. Summary of Human Health Tissue chemistry data and summary statistics

Chemical	Freshwater							Nearshore Water						Offshore Water						
	Units	Min	Max	Mean	Median	% FOD	N	Min	Max	Mean	Median	% FOD	N	Min	Max	Mean	Median	% FOD	N	
Arsenic, inorganic - bivalves	µg/Kg	No Data							16	33	22.54545	23	100	11	18	28	23	23	100	2
Arsenic, inorganic - fish	µg/Kg	No Detects						4	No Data						No Data					
Arsenic, inorganic - other invertebrate	µg/Kg	No Data							10	11	10.5	10.5	100	2	No Data					
Mercury - bivalves	µg/Kg	5	43.8	13.1	10	100	69	3.2	42.0	8.3	7	100	153	10	82	24.1	18	100	37	
Mercury - fish	µg/Kg	1.2	1840	155.3	71	100	776	5.0	182.5	37.2	30	100	197	10	1250	132	62.6	100	346	
Mercury - other invertebrate	µg/Kg	3	10.5	5.4	4.85	100	34	1.2	136.0	34.2	30	100	107	9	543	63.4	45	100	154	
PCB Aroclors - bivalves	µg/Kg	11	1471	82.3	39.4	85.7	91	3	580	71.1	24	33.3	99	3.5	150	57.9	72	100	10	
PCB Aroclors - fish	µg/Kg	1.2	1339	39.3	14.8	92.9	864	5.5	18400	548	21	97.6	335	1.6	4200	132	77	97.5	477	
PCB Aroclors - other invertebrate	µg/Kg	29.8	3228	358	114	92.2	51	2.3	5520	549	180	69.1	68	13.4	4000	356	198	66.7	45	
PCB Congeners - bivalves	µg/Kg	10.6	2655	133	61.3	92.3	155	0.01	930	21.3	1.7	100	161	0.04	2.1	0.77	0.64	92.3	155	
PCB Congeners - fish	µg/Kg	0.397	974	46.9	18	77.0	918	0.69	12228	231	51.7	100	344	0.03	4333	93.9	39	98.2	727	
PCB Congeners - other invertebrates	µg/Kg	6.9	4309	550	166	87.1	93	0.13	5800	362	20.2	100	225	0.11	372	35.2	9.68	100	12	
2,3,7,8 TCDD - bivalves	µg/Kg	5E-05	0.015	4.3E-04	1.5E-04	25	64	4E-06	2.7E-04	5.65E-05	2.48E-05	19	129	5E-06	2.8E-04	8.4E-05	5.0E-05	0.05	40	
2,3,7,8 TCDD - fish	µg/Kg	8E-06	1.9E-03	1.6E-04	6.4E-05	62.5	72	No Detects					8	3E-05	5.3E-04	1.1E-04	8.6E-05	0.3208	53	
2,3,7,8 TCDD - other invertebrates	µg/Kg	0.0002	0.163	5.3E-03	4.5E-04	74.2	35	9E-06	3.8E-03	3.8E-04	8.9E-05	62	82	1E-05	5.4E-04	1.7E-04	1.3E-04	0.4688	32	
4,4' DDD - bivalves	µg/Kg	0.38	702	13.2	1.6	79.8	104	0	1.9	0.71	0.85	40.8	120	No Detects					33	
4,4' DDD - fish	µg/Kg	0.23	73.3	2.6	1.2	79.8	620	0.1	20	1.73	0.75	62.4	437	0.1	18	1.81	0.85	74.8	1036	
4,4' DDD - other invertebrates	µg/Kg	0.94	1060	51.7	10.9	91.1	56	0.28	18	4.62	2.05	20	50	0.32	10	3.23	2.5	22.3	76	
4,4' DDE - bivalves	µg/Kg	0.12	63.7	5.6	1.2	86.5	104	0.20	3.5	0.94	1	38.3	120	0.33	5.6	3.07	2.5	6	33	
4,4' DDE - fish	µg/Kg	0.32	328	14.1	9.9	94.4	634	0.2	29	5.31	2.9	93.8	491	0.27	280	8.63	4.1	97.6	1209	
4,4' DDE - other invertebrates	µg/Kg	1.9	171	22.9	15.6	100	56	0.23	41	6.48	2.7	86.4	59	0.14	46	4.42	2.5	44.1	77	
4,4' DDT - bivalves	µg/Kg	0.07	87.1	2.5	1.2	79.8	104	0	12	1.27	1	50	120	0.58	5.6	3.24	2.5	18.1	33	
4,4' DDT - fish	µg/Kg	0.14	55	1.6	0.86	68.1	440	0.1	470	14.1	0.7	65	360	0	84	2.16	0.6	72.4	885	
4,4' DDT - other invertebrates	µg/Kg	0.05	37.9	3.04	0.90	76.7	56	0.42	180	20.27	7.8	93.7	48	0.2	160	7.76	4.8	40.8	76	
Anthracene - bivalves	µg/Kg	0.52	78	6.6	4.5	85.2	102	0.114	2000	121.6	16	33.3	111	0.12	2000	151	50	31	29	
Anthracene - fish	µg/Kg	No Detects						17	0.12	400	84.2	1.8	64.1	81	0.01	2000	309	0.15	33.3	27
Anthracene - other invertebrates	µg/Kg	0.65	650	32.6	6.7	100	56	0.09	110	6.4	0.72	76.4	51	0.12	58	27.2	49	23.4	47	
Fluorene - bivalves	µg/Kg	0.5	80	8	2.4	81.3	102	0.118	2000	137	16	33.3	111	0.152	2000	150	50	24.1	29	
Fluorene - fish	µg/Kg	No Detects						17	0.37	400	84	3.9	71.6	81	0.05	2000	309	0.37	33.3	27
Fluorene - other invertebrates	µg/Kg	0.72	300	30	4.8	100	56	0.08	57	4.0	0.72	82.3	51	0.11	58	26.7	49	21.3	47	
Benzo(a)pyrene - bivalves	µg/Kg	0.076	490	19.1	2.5	72.5	102	0.065	2000	114.6	26	31.6	117	0.079	2000	134.5	33.2	21.2	33	
Benzo(a)pyrene - fish	µg/Kg	No Detects						17	0.1	400	83.4	0.72	41.9	81	0.016	2000	308.3	0.1	18.5	27
Benzo(a)pyrene - other invertebrates	µg/Kg	0.82	1500	82.6	13	100	56	0.1	190	11.1	0.72	32	53	0.1	58	27.3	49	6.3	47	

Chemical	Freshwater							Nearshore Water						Offshore Water					
	Units	Min	Max	Mean	Median	% FOD	N	Min	Max	Mean	Median	% FOD	N	Min	Max	Mean	Median	% FOD	N
Benzo(b)fluoranthene - bivalves	µg/Kg	0.15	460	19.8	3.5	70.5	102	0.056	2000	117	27	38.4	117	0.078	2000	167.6	0.743	42.8	21
Benzo(b)fluoranthene - fish	µg/Kg	No Detects					17	0.15	400	83.5	0.72	54.3	81	0.0061	2000	308.5	0.15	18.5	27
Benzo(b)fluoranthene - other invertebrates	µg/Kg	2.3	1600	116	30.5	100	56	0.12	290	14.4	0.72	43.3	53	0.15	34	3.1	0.15	21.7	23
Benzo(k)fluoranthene - bivalves	µg/Kg	0.13	310	14.7	1.8	63.7	102	0.17	2000	127.6	27	33	106	0.17	2000	246	0.245	7.1	14
Benzo(k)fluoranthene - fish	µg/Kg	No Detects					17	0.17	400	83.5	0.72	53	81	0.17	2000	396	0.53	23.8	21
Benzo(k)fluoranthene - other invertebrates	µg/Kg	1.5	1500	85.4	19	100	56	0.16	220	11.0	0.72	39.6	53	0.17	25	2.2	0.17	21.7	23
Chrysene - bivalves	µg/Kg	1.6	560	33.6	11	78.4	102	0.17	2000	121.8	31	41	117	0.17	2000	134.9	38.2	30.3	33
Chrysene - fish	µg/Kg	No Detects					17	0.12	400	83.6	1.3	59	81	0.015	2000	308.6	0.17	25.9	27
Chrysene - other invertebrates	µg/Kg	4.3	3900	256.7	71.5	100	56	0.14	780	31.4	0.72	54.7	53	0.13	61	28.8	49	14.8	47
Benzo(a)anthracene - bivalves	µg/Kg	No Detects					9	No Detects					47	No Data					
Benzo(a)anthracene - fish	µg/Kg	No Data						No Data						No Data					
Benzo(a)anthracene - other invertebrates	µg/Kg	No Data						No Data						No Data					
Dibenzo(a,h)anthracene - bivalves	µg/Kg	0.11	80	8.8	0.17	21.5	102	0.0439	2000	124.8	5.1	20.5	117	0.0771	2000	132.3	5.25	9	33
Dibenzo(a,h)anthracene - fish	µg/Kg	No Detects					17	0.12	400	83.3	0.72	8.6	81	0.0234	2000	308.2	0.15	11.1	27
Dibenzo(a,h)anthracene - other invertebrates	µg/Kg	0.11	95	6.5	1.65	83.9	56	0.15	25	4.2	0.72	26.4	53	0.13	58	26.6	49	8.5	47
Fluoranthene - bivalves	µg/Kg	4.4	770	57.8	18.5	86.2	102	0.37	2000	149.3	49.75	51.7	114	0.519	2000	114.7	33	34.8	43
Fluoranthene - fish	µg/Kg	No Detects					17	0.37	400	85.8	5.1	62.9	81	0.038	2000	309.3	0.42	44.4	27
Fluoranthene - other invertebrates	µg/Kg	4.7	10000	589	91	100	56	0.18	680	52.4	0.99	78.4	51	0.26	71	27.9	25	28.3	74
Indeno(1,2,3-cd)pyrene - bivalves	µg/Kg	0.16	170	12.2	0.685	42.1	102	0.066	2000	135.5	27	28.2	117	0.073	2000	133	20.5	15.1	33
Indeno(1,2,3-cd)pyrene - fish	µg/Kg	No Detects					17	0.11	400	83.3	0.5	34.5	81	0.0295	2000	308	0.18	14.8	27
Indeno(1,2,3-cd)pyrene - other invertebrates	µg/Kg	0.71	670	38.3	6.45	100	56	0.18	87	5.9	0.72	37.7	53	0.14	58	26.9	49	10.6	47
Pyrene - bivalves	µg/Kg	3.6	850	73.5	16	83.3	102	0.334	2000	133.4	40	46.4	114	0.32	2000	109.0	11	25.5	43
Pyrene - fish	µg/Kg	No Detects					17	0.33	400	84.5	2.5	61.7	81	0.038	2000	308.9	0.39	18.5	27
Pyrene - other invertebrates	µg/Kg	4.5	11000	638.5	110	100	56	0.16	570	53.5	0.78	78	50	0.19	120	28.9	25	28.3	74
Bis(2-Ethylhexyl) Phthalate - bivalves	µg/Kg	12	8600	180.5	81	57.5	99	16	2000	267	120	32.8	73	65	2000	287	99.5	25	16
Bis(2-Ethylhexyl) Phthalate - fish	µg/Kg	No Detects					9	66	7200	2014	720	10.1	79	No Detects					16
Bis(2-Ethylhexyl) Phthalate - other invertebrates	µg/Kg	53	530	111.6	105	60.8	46	16	7200	1212	180	9.5	42	50	7200	417	57	24.2	33

FOD - Frequency of Detection