



PORTLAND HARBOR RI

APPENDIX G
BASELINE ECOLOGICAL RISK ASSESSMENT
ATTACHMENT 11
EVALUATION OF BACKGROUND AND UPRIVER REACH
CONCENTRATIONS

DRAFT

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Prepared for
The Lower Willamette Group

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1.0 COMPARISON OF BACKGROUND CONCENTRATIONS TO STUDY AREA CONCENTRATIONS

The following presents a comparison of ecological chemical of concern (COC) concentrations from the Study Area to background concentrations. Background concentrations in sediment and surface water are defined in Section 7.0 of the draft remedial investigation (RI). The 95th upper confidence limit on the mean (UCL) concentrations and the 95th upper percentile limit (UPL) of sediment and surface water data from background were compared to the UCL of sediment and surface water data from the Study Area. For those COPCs for which background concentrations were not available from Section 7.0 of the draft RI, background concentrations were calculated only as a UCL concentration.

For all ecological COCs, background sediment concentrations were compared to Study Area sediment concentrations (Table 1-1). For all ecological COCs identified through the surface water line of evidence (LOE), background surface water concentrations were compared to Study Area sediment concentrations (Table 1-2).

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Table 1-1. Comparison of Study Area and Background Sediment Concentrations

Sediment/Tissue/Diet COC	Units (dw)	Sediment Concentration				
		Study Area UCL	Background (all data)		Background (excluding outliers)	
			UCL	UPL	UCL	UPL
Metals						
Aluminum	mg/kg	24,375	24,877	33842	24,877	33,842
Antimony	mg/kg	1.013	0.206, 0.208	NA	NA	NA
Arsenic	mg/kg	4.655	3.018	3.973	3.007	3.973
Cadmium	mg/kg	0.45	0.127	NA	NA	NA
Chromium	mg/kg	33.41	23.75	32.13	23.75	32.13
Copper	mg/kg	69.08	25.91	37.3	25.91	37.3
Lead	mg/kg	64.33	9.205, 9.241	NA	NA	NA
Mercury	mg/kg	0.242	0.0337	0.0532	0.0337	0.0532
Zinc	mg/kg	163.6	79.02	110.2	79.02	110.2
Butyltins						
Tributyltin	µg/kg	2,078	n < 6 detects ^a	n < 6 detects ^a	n < 6 detects ^a	n < 6 detects ^a
Butyltin	µg/kg	34.19	n < 6 detects ^a	n < 6 detects ^a	n < 6 detects ^a	n < 6 detects ^a
PAHs						
Benzo(a)pyrene	µg/kg	4,008	8.254	19.75	7.087	15.32
Benzo(a)anthracene	µg/kg	3,445	8.116	19.87	6.936	15.72
Naphthalene	µg/kg	1,243	3.38	NA	NA	NA
Total HPAHs	µg/kg	44,888	85.95	NA	NA	NA
Total LPAHs	µg/kg	25,032	17.6	NA	NA	NA
Phthalates						
BEHP	µg/kg	2,191	209.6	499.4	67.17	118.4
Di(n)butyl phthalate	µg/kg	27.87	42.44	NA	NA	NA
PCBs and Dioxins						
Total PCBs	µg/kg	276.6	14.256 ^b (10.340 ^c)	23.592 ^b (23.45 ^c)	10.627 ^b (10.35;7.006 ^{c,d})	16.917 ^b (23.45, 11.34 ^{c,d})
PCB TEQ-bird	ng/kg	189.9	1.462	NA	NA	NA
Dioxin TEQ-bird	ng/kg	1,188	3.229	NA	NA	NA
Total TEQ-bird	ng/kg	2,158	3.831	NA	NA	NA
PCB TEQ-mammal	ng/kg	13.04	0.401	0.646	0.376	0.606
Dioxin TEQ-mammal	ng/kg	475.8	3.503	5.692	1.253	2.157
Total TEQ-mammal	ng/kg	856.5	3.314	NA	NA	NA
SVOCs						
Benzyl alcohol	µg/kg	5.863, 5.97 ^c	14.76	NA	NA	NA
Carbazole	µg/kg	417.6	10.69	NA	NA	NA
TPH						
PYO-PTO	mg/kg	NA	NA	NA	NA	NA
Phenols						
4-Methylphenol	µg/kg	98.52	17.83	NA	NA	NA

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Table 1-1. Comparison of Study Area and Background Sediment Concentrations

Sediment/Tissue/Diet COC	Units (dw)	Sediment Concentration				
		Study Area UCL	Background (all data)		Background (excluding outliers)	
			UCL	UPL	UCL	UPL
VOCs						
Trichloroethene	µg/kg	0.121; 0.288 ^c	n < 6 detects ^a	n < 6 detects ^a	n < 6 detects ^a	n < 6 detects ^a
Ethylbenzene	µg/kg	21.68	n < 6 detects ^a	n < 6 detects ^a	n < 6 detects ^a	n < 6 detects ^a
Pesticides						
Aldrin	µg/kg	4.294	0.267	0.339	0.267	0.339
cis-Chlordane	µg/kg	1.245	0.112	NA	NA	NA
Total chlordane	µg/kg	8.642	0.38	0.698	0.38	0.698
Endrin	µg/kg	1.018	n < 6 detects ^a	n < 6 detects ^a	n < 6 detects ^a	n < 6 detects ^a
Endrin ketone	µg/kg	0.529	0.093, 0.11	NA	NA	NA
Sum DDE	µg/kg	26.39	0.953	1.719	0.951	1.719
Total DDx	µg/kg	276	1.847	3.592	1.847; 1.637 ^d	3.592, 3.025 ^d
Dieldrin	µg/kg	1.598	0.137	0.215	0.137	0.215
alpha-Endosulfan	µg/kg	0.182	0.181, 0.187	NA	NA	NA
beta-HCH	µg/kg	1.238	0.446	1.049	0.446	1.049

NA – not available; background concentrations are not available for these COPCs in Section 7.0 of the draft RI.

^a Background concentrations were not calculated for analytes with < 6 detected concentrations.

^b UCL based on total PCB congeners.

^c UCL based on total PCB Aroclors.

^d UCL based on LWG and EPA case, respectively.

^e Two UCLs recommended from ProUCL.

BEHP – bis(2-ethylhexyl) phthalate

COC – chemical of concern

DDD – dichlorodiphenyldichloroethane

DDE – dichlorodiphenyldichloroethylene

DDT – dichlorodiphenyltrichloroethane

dw – dry weight

HCH – hexachlorocyclohexane

HPAP – high-molecular-weight polycyclic aromatic hydrocarbon

LPAH – low-molecular-weight polycyclic aromatic hydrocarbon

NA – not available

PAH – polycyclic aromatic hydrocarbon

PTO – petrogenic

PYO – pyrogenic

TEQ – toxic equivalent

Total DDx – sum of all six DDT isomers (2,4'-DDD; 4,4'-DDD; 2,4'-DDE; 4,4'-DDE; 2,4'-DDT; and 4,4'-DDT)

UCL – upper confidence limit on the mean

UPL – upper percentile limit

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Table 1-2. Comparison of Surface Water Study Area and Background UCLs

Surface Water COC	Units (dw)	Study Area UCL	Surface Water Concentration			
			Background (all data)		Background (excluding outliers)	
			UCL	UPL	UCL	UPL
Metals						
Aluminum	µg/L	460	1,276	1485.0	1,278	1485
Zinc	µg/L	2.5	n < 6 detects ^b	n < 6 detects ^b	n < 6 detects ^b	n < 6 detects ^b
Butyltins						
Butyltin ion	ng/L	4.3	n < 6 detects ^b	n < 6 detects ^b	n < 6 detects ^b	n < 6 detects ^b
PAHs						
Benzo(a)anthracene	ng/L	8.1	0.9302	NA	NA	NA
Benzo(a)pyrene	ng/L	6.7	0.3601	NA	NA	NA
Naphthalene	ng/L	31,000	n < 6 detects ^b	n < 6 detects ^b	n < 6 detects ^b	n < 6 detects ^b
Phthalates						
BEHP	ng/L	480	n < 6 detects ^b	n < 6 detects ^b	n < 6 detects ^b	n < 6 detects ^b
VOCs						
Ethylbenzene	µg/L	2.3	ND	ND	ND	ND
Trichloroethene	µg/L	194 ^a	ND	ND	ND	ND
PCBs						
Total PCBs	ng/L	1.8	0.4511	0.6168	0.2363	0.3887
Pesticides						
2,4'-DDD	ng/L	0.15	0.01234	NA	NA	NA
2,4'-DDT	ng/L	0.62	0.03171	NA	NA	NA
4,4'-DDD	ng/L	0.32	0.0465	0.0785	0.0463	0.0785
4,4'-DDT	ng/L	0.69	0.32	0.272	0.32	0.272
Total DDx	ng/L	1.6	0.428	0.592	0.428	0.593

NA – not available; background concentrations are not available for these COPCs in Section 7.0 of the draft RI.

^a Exposure concentration and HQ based on maximum value; UCL could not be calculated (n=2 detected values).

^b Background concentrations were not calculated for analytes with < 6 detected concentrations.

BEHP – Bis(2-ethylhexyl) phthalate

PAH – polycyclic aromatic hydrocarbon

COC – chemical of concern

PCB – polychlorinated biphenyl

DDD – dichlorodiphenyldichloroethane

Total DDx – sum of all six DDT isomers (2,4'-DDD; 4,4'-DDD; 2,4'-DDE; 4,4'-DDE; 2,4'-DDT; and 4,4'-DDT)

DDE – dichlorodiphenyldichloroethylene

UCL – upper confidence limit on the mean

DDT – dichlorodiphenyltrichloroethane

VOC – volatile organic compound

HQ – hazard quotient

ND – no data; not analyzed in background water

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2.0 EVALUATION OF UPRIVER TISSUE CONCENTRATIONS

Tissue data for four fish receptor species were available from the upriver reach (from RM 15.3 to RM 28.4). Four juvenile Chinook salmon, three brown bullhead, six smallmouth bass, and four lamprey ammocoete samples were collected by LWG from the upriver reach between June 2002 and September 2006. The non-Study Area sediment and tissue chemistry data from these reaches are presented in Attachment 4.

For all fish tissue COCs and fish-eating wildlife receptor COCs (i.e., hooded merganser, osprey, bald eagle, mink, and river otter), Study Area tissue chemical concentrations were compared to upriver tissue chemical concentrations. These COCs are presented in Table 2-1 and are discussed in the following subsections.

Table 2-1. Summary of Fish Tissue and Piscivorous Wildlife Receptor COCs

COC	Fish COC	Wildlife COC
Copper	X	
Lead	X	X
Mercury	X	X
Total PCBs	X	X
Total TEQ		X
BEHP	X	
Total DDx	X	X
Sum DDE		X

BEHP – bis(2-ethylhexyl) phthalate

COC – chemical of concern

DDD – dichlorodiphenyldichloroethane

DDE – dichlorodiphenyldichloroethylene

DDT – dichlorodiphenyltrichloroethane

PCB – polychlorinated biphenyl

TEQ – toxic equivalent

Total DDx – sum of all six DDT isomers (2,4'-DDD; 4,4'-DDD; 2,4'-DDE; 4,4'-DDE; 2,4'-DDT; and 4,4'-DDT)

2.1 COPPER

Copper was identified as a COC for lamprey ammocoetes and sculpin. Average copper concentrations in brown bullhead, juvenile Chinook salmon, lamprey ammocoetes, and smallmouth bass were similar in tissues collected from upriver reach and the Study Area (Figure 2-1). These data indicate that elevated concentrations of copper (i.e., greater than the 5th percentile and 10th percentile LOAELs of 2.8 and 3.1 mg/kg ww, respectively) are also in upriver reach lamprey and greater than those in lamprey in the Study Area.

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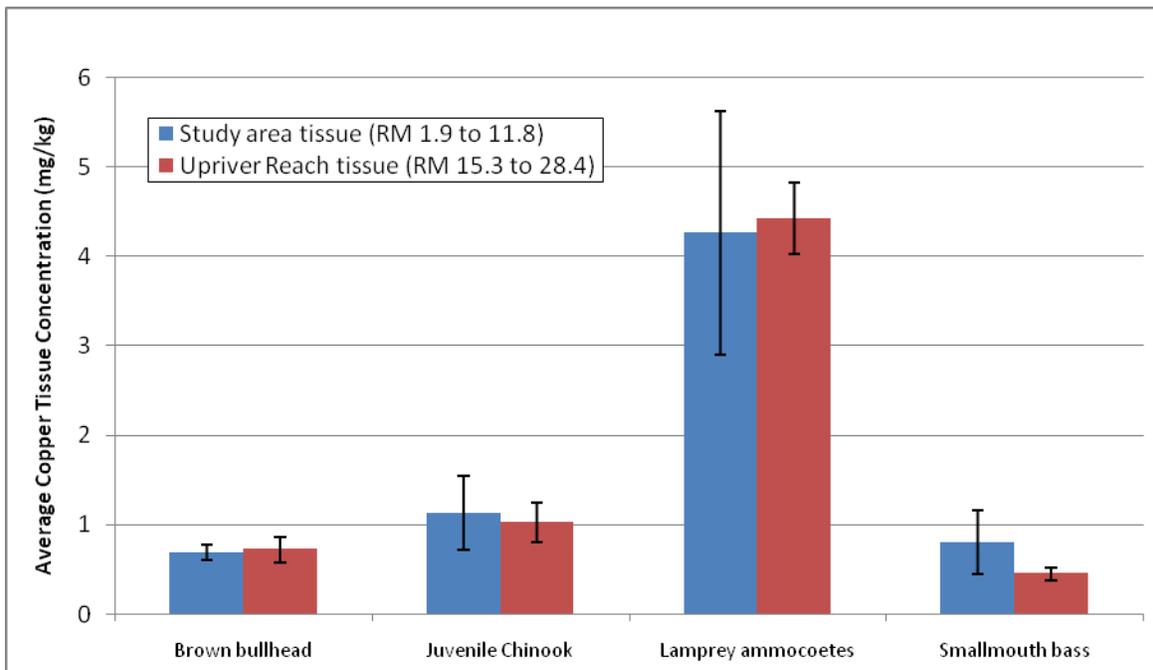


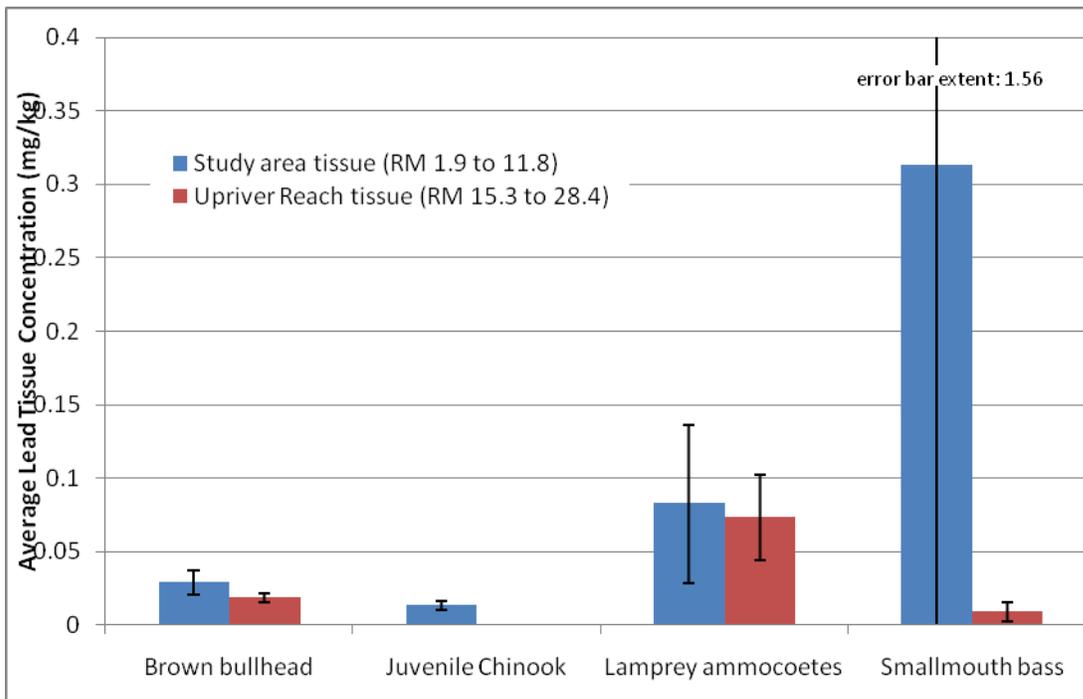
Figure 2-1. Fish Tissue Copper Concentrations in the Upriver Reach and Study Area

2.2 LEAD

Lead was identified as a COPC for peamouth and smallmouth bass. Lead was also identified as a COC for osprey and mink. Average lead concentrations in brown bullhead and lamprey ammocoetes were similar in tissues collected from upriver reach and the Study Area (Figure 2-2). Average lead concentrations in smallmouth bass were higher in the Study Area than in the upriver reach (Figure 2-2). Four juvenile Chinook salmon tissue samples were collected from the upriver reach; however, lead was not detected in any of the samples.

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Notes:

1. The dataset used to create the graph included detected data for whole body samples only and did not include an outlier for smallmouth bass collected from the Study Area (1,100 mg/kg lead).
2. Lead was only detected in 3 out of 15 samples of juvenile Chinook tissue collected from the Study Area and in none of the juvenile Chinook samples collected from the upriver reach (4 samples were collected).

Figure 2-2. Fish Tissue Lead Concentrations in the Upriver Reach and Study Area

2.3 MERCURY

Mercury was identified as a COC for northern pikeminnow and bald eagle. Average mercury concentrations in brown bullhead, lamprey ammocoetes, and smallmouth bass were greater in tissues collected from upriver reach than in those collected from the Study Area (Figure 2-3). These upriver reach data indicate that elevated concentrations (i.e., greater than the fish tissue 10th percentile LOAEL of 0.44 mg/kg ww) of mercury in certain fish species (i.e., smallmouth bass and lamprey) are found in other areas of the Willamette River.

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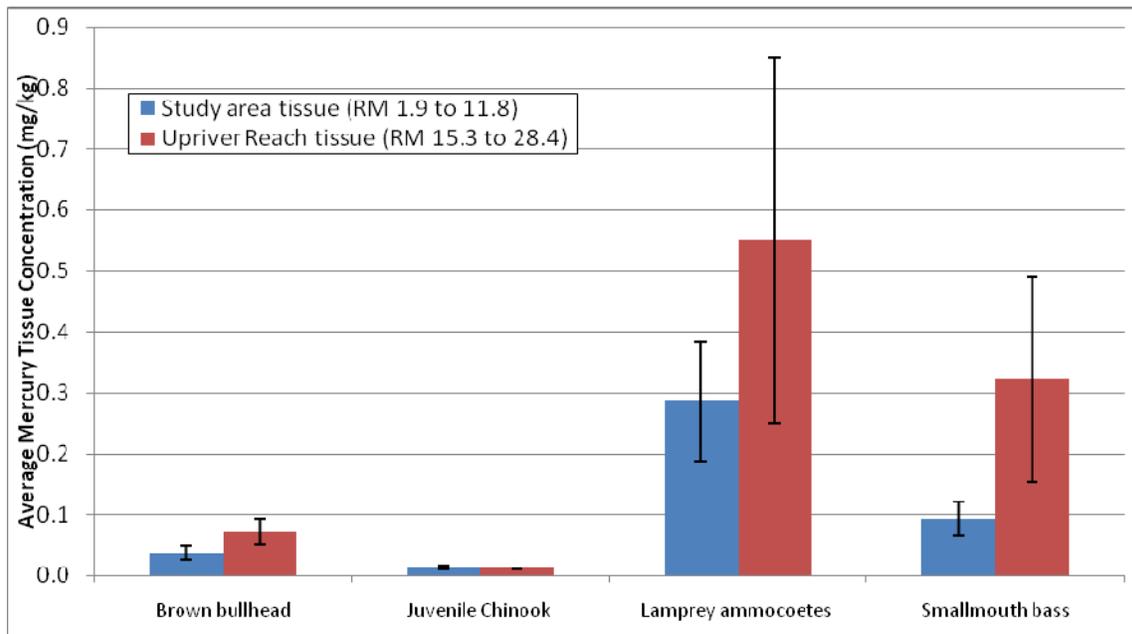


Figure 2-3. Fish Tissue Mercury Concentrations in the Upriver Reach and Study Area

2.4 TOTAL PCBs

Total PCBs were identified as a COPC for largescale sucker, sculpin, smallmouth bass, and northern pikeminnow. Total PCBs were also identified as a COC for hooded merganser, bald eagle, osprey, mink, and river otter. Average total PCB tissue concentrations were higher in the Study Area than in the upriver reach in all four species for which samples were available from both areas (Figure 2-4).

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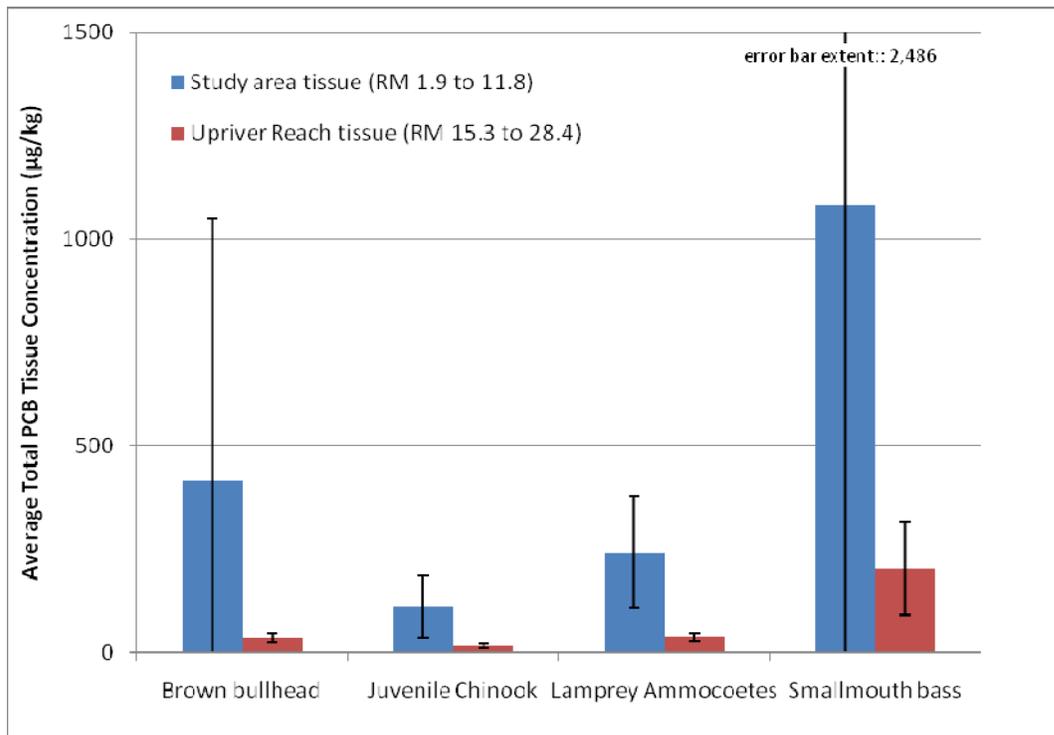


Figure 2-4. Fish Tissue Total PCB Concentrations in the Upriver Reach and Study Area

2.5 DIOXINS, FURANS, AND DIOXIN-LIKE PCBS

Dioxin/furan TEQ was identified as a COC for bald eagle, osprey and mink. The average dioxin/furan TEQ-mammal concentrations were higher in Study Area tissue samples than in upriver reach tissue samples for all four species compared (Figure 2-5).

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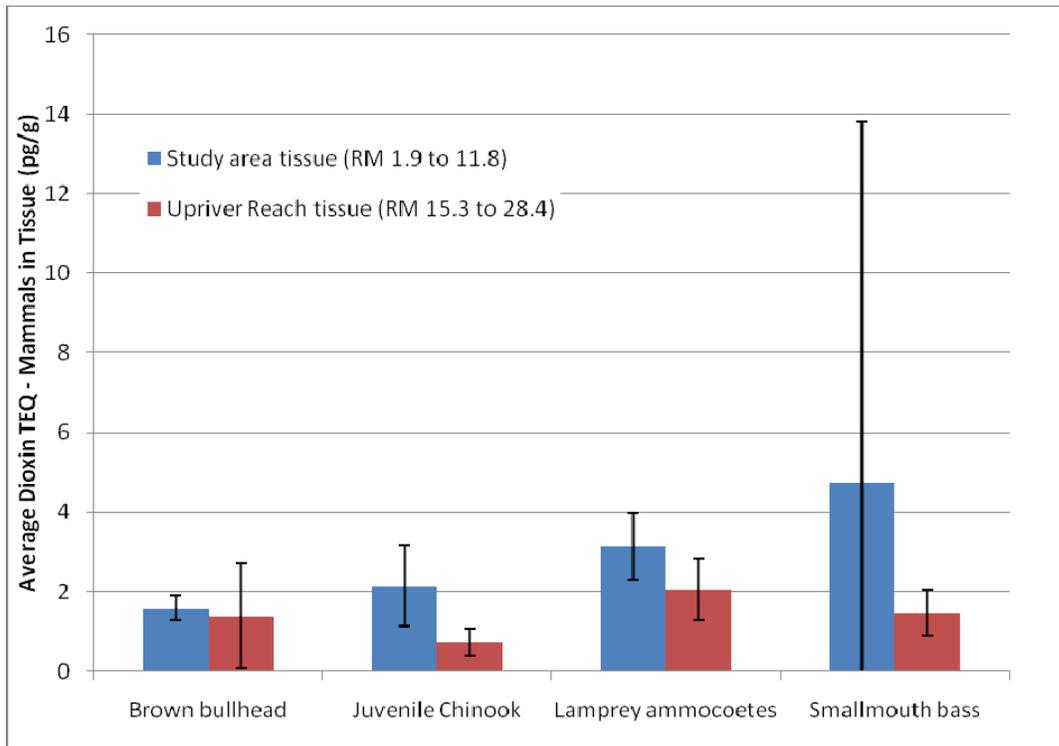


Figure 2-5. Fish Tissue Dioxin/Furan TEQ-Mammal Concentrations in the Upriver Reach and Study Area

PCB TEQ was identified as a COC for bald eagle, osprey, and mink. Average PCB TEQ-mammal tissue concentrations were higher in the Study Area than in the upriver reach for all four species compared, but the greatest difference was observed for smallmouth bass, where average tissue concentrations were about two and a half times as high in the Study Area (Figure 2-6).

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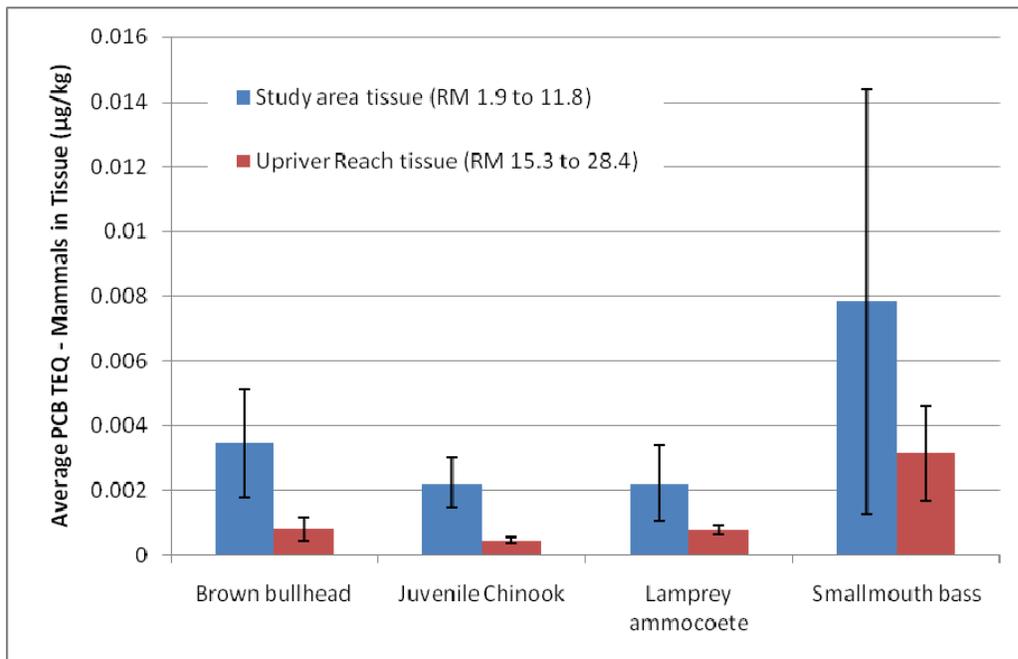


Figure 2-6. Fish Tissue PCB TEQ-Mammal Concentrations in the Upriver Reach and Study Area

Total TEQ was identified as a COC for bald eagle, osprey, and mink. Average total TEQ tissue concentrations were higher in the Study Area than in the upriver reach for all four species compared, but the greatest difference was observed for smallmouth bass, where average tissue concentrations were about three times as high in the Study Area (Figure 2-7).

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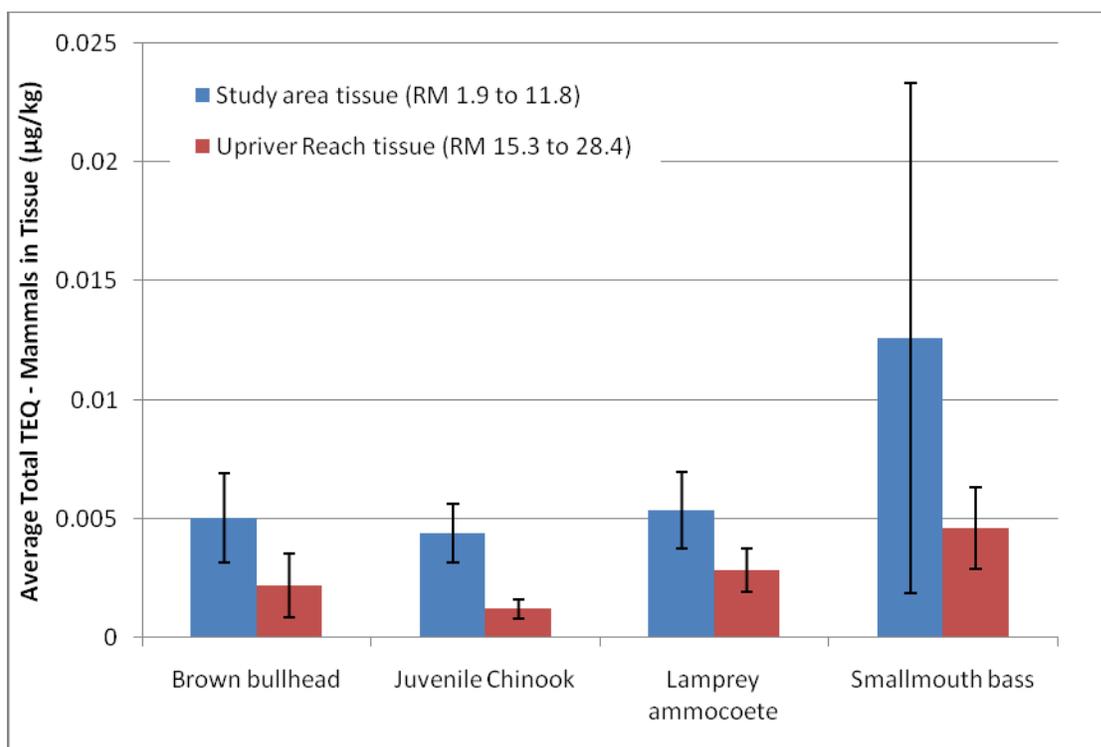


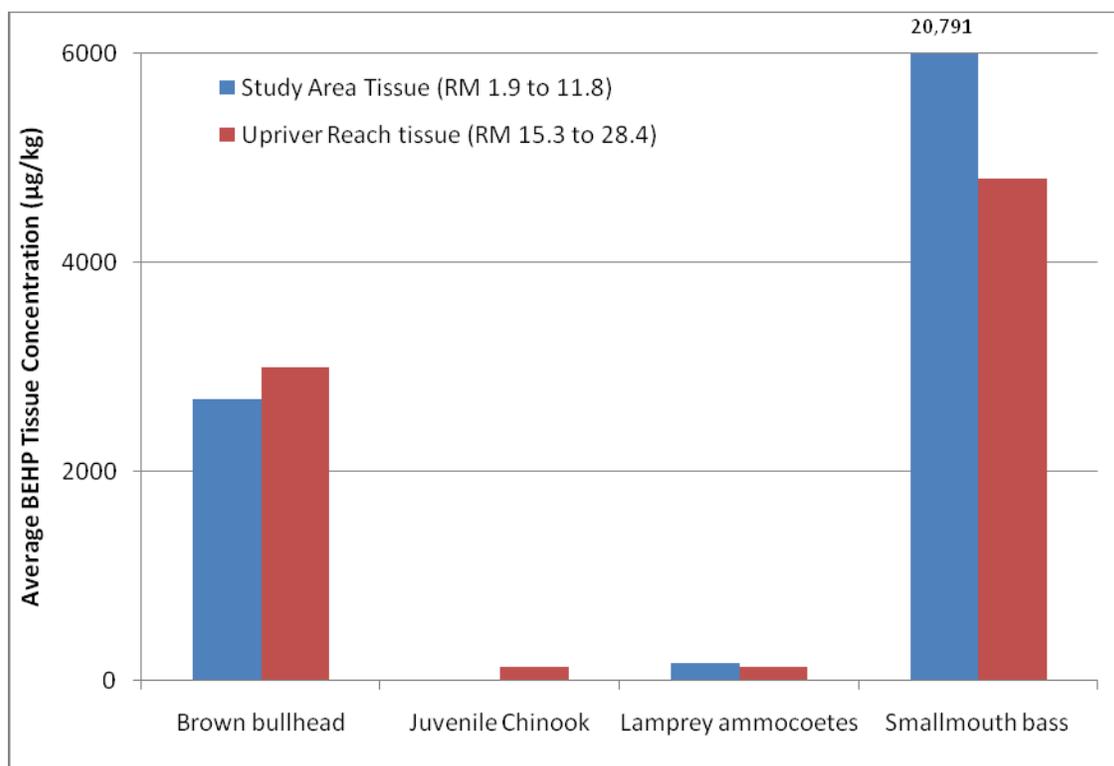
Figure 2-7. Fish Tissue Total TEQ-Mammal Concentrations in the Upriver Reach and Study Area

2.6 BEHP

BEHP was identified as a COPC for sculpin and for smallmouth bass because the HQ was > 1.0 as derived from a NOAEL (no BEHP LOAEL was available). BEHP was detected in 50% of upriver reach samples of juvenile Chinook salmon (detected in 2 out of 4 samples) but was not detected in any of the 11 juvenile Chinook salmon tissue samples collected from the Study Area. The average concentrations of BEHP in lamprey ammocoete tissue were similar between the Study Area and the upriver reach (Figure 2-8). The average concentration of BEHP in smallmouth bass tissue was more than four times greater in the Study Area than in the upriver reach, but the average concentration of BEHP in brown bullhead tissue were greater in the upriver reach than in the Study Area¹. The NOAEL TRV for BEHP is 9,600 µg/kg. Only the average BEHP concentration for smallmouth bass from the Study Area was above the TRV.

¹ It should be noted that only 1 out of 6 brown bullhead samples from the Study Area had a detected BEHP concentration.

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Notes:

1. Error bars are not shown on this graph because the standard deviation could only be calculated for smallmouth bass within the Study Area and lamprey ammocoetes in the upriver reach due to low detection frequencies for the other species.
2. BEHP was only detected in 1 out of 6 brown bullhead samples collected from the Study Area, and there is only one lamprey ammocoete tissue BEHP result available from the Study Area.
3. BEHP was not detected in any of the 11 juvenile Chinook tissue samples collected from the Study Area.
4. BEHP was detected in 6 out of 31 samples of smallmouth bass tissue collected from the Study Area.
5. The detection frequency of BEHP in upriver reach juvenile Chinook samples was 50% (2 out of 4).
6. BEHP was detected in 1 out of 6 smallmouth bass tissue samples collected from the upriver reach.
7. BEHP was detected in 1 out of 3 brown bullhead tissue samples collected from the upriver reach.

Figure 2-8. Fish Tissue BEHP Concentrations in the Upriver Reach and Study Area

2.7 DDX

Total DDx (sum of all six DDT isomers [2,4'-DDD, 4,4'-DDD, 2,4'-DDE, 4,4'-DDE, 2,4'-DDT and 4,4'-DDT]) was identified as a COPC for sculpin, and for bald eagle and osprey. Average total DDT tissue concentrations were higher in tissue samples collected from the Study Area than in samples collected from the upriver reach in all four species compared (Figure 2-9).

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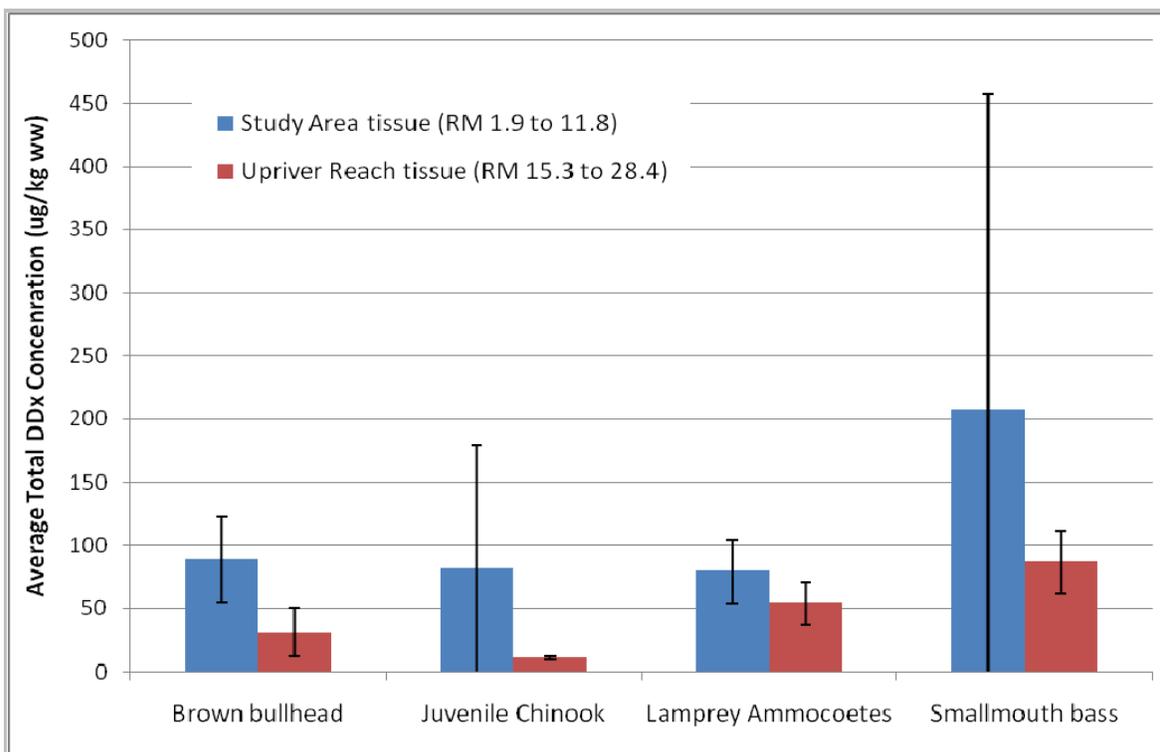


Figure 2-9. Fish Tissue Total DDx Concentrations in the Upriver Reach and Study Area

4,4'-DDE was identified as a COC for bald eagle and osprey. Average total DDE tissue concentrations were higher in the Study Area than in the upriver reach for all four species compared, but the greatest difference was observed for juvenile Chinook, where average tissue concentrations were more than four times as high in the Study Area (Figure 2-10). Total DDE concentrations were similar between the Study Area and the upriver reach for lamprey ammocoetes (Figure 2-10).

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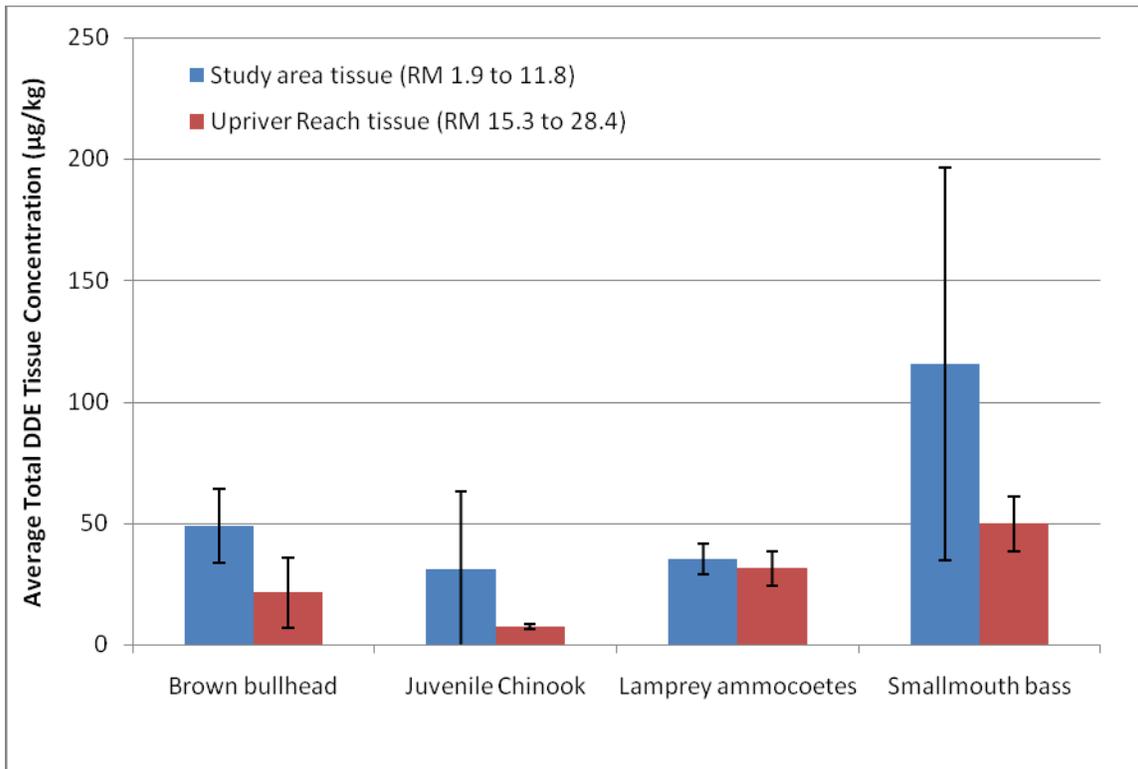


Figure 2-10. Fish Tissue Sum DDE Concentrations in the Upriver Reach and Study Area

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