Lower Duwamish Waterway Group

Port of Seattle / City of Seattle / King County / The Boeing Company

Lower Duwamish Waterway Remedial Investigation

REMEDIAL INVESTIGATION REPORT

APPENDIX B, BASELINE HUMAN HEALTH RISK ASSESSMENT

ERRATA: ADJUSTMENT TO TULALIP TRIBES SEAFOOD CONSUMPTION RATES AND THE IMPACT ON RISK ESTIMATES

For submittal to:

The US Environmental Protection Agency
Region 10
Seattle, WA

The Washington State Department of Ecology
Northwest Regional Office
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Human Health Risk Assessment Errata: Adjustment to Tulalip Tribes' Seafood Consumption Rates and the Impact on Risk Estimates

The final baseline human health risk assessment (HHRA) for the Lower Duwamish Waterway (LDW) (Windward 2007) was based, in part, on seafood consumption rate data supplied by the US Environmental Protection Agency (EPA) (EPA 2007). Some of the seafood consumption rates in the Framework were developed by EPA from data collected from a survey of the Tulalip Tribes' consumption of Puget Sound seafood. EPA recently discovered that some of the consumption rates it had calculated were incorrect and thus issued corrected rate information in comments on the draft final Remedial Investigation report for the LDW site (EPA 2009). Specifically, the apportionment of shellfish consumption (but not the total consumption rates) for scenarios developed from the Tulalip Tribes seafood consumption study were corrected. These errata present the revised shellfish consumption rates and the associated changes in the risk estimates for the Tulalip survey-based scenarios.

UPDATED SEAFOOD CONSUMPTION RATES

Table 1 compares the seafood consumption rates used in the final HHRA (Windward 2007) for the Tulalip Tribe scenarios to the revised consumption rates provided by EPA (2009). Essentially, the corrected apportionment of total shellfish consumption for crab and other shellfish categories is reversed from what was initially presented in the final HHRA. In the final HHRA, the percentage of shellfish consumption attributed to crabs was set at 53% while the percentage of shellfish associated with clams was set at 46%; the corrections provided by EPA reverse these percentages. The revised consumption rates were developed from these corrected percentages, following the process described in the final HHRA.

Table 1. HHRA consumption rates

SCENARIO NAME	CONSUMPTION CATEGORY	FINAL HHRA CONSUMPTION RATE (g/day)	REVISED CONSUMPTION RATE (g/day)
Adult Tribal RME (Tulalip data)	Pelagic fish – fillet	8.1	8.1
	Benthic fish – fillet	7.5	7.5
	Benthic fish – whole body	0	0
	Crab – edible meat	33	**28.7**
	Crab – whole body	10.4	**9.0**
	Mussels	0.8	0.8
	Clams	37.7	**43.4**

Scenario Name	Consumption Category	Final HHRA Consumption Rate (g/day)	Revised Consumption Rate (g/day)
Adult Tribal CT (Tulalip data)	Pelagic fish – fillet	1.3	1.3
	Benthic fish – fillet	1.2	1.2
	Benthic fish – whole body	0	0
	Crab – edible meat	5.0	**4.4**
	Crab – whole body	1.6	**1.4**
	Mussels	0.1	0.1
	Clams	5.8	**6.6**
Child Tribal RME (Tulalip data)	Pelagic fish – fillet	3.2	3.2
	Benthic fish – fillet	3.0	3.0
	Benthic fish – whole body	0	0
	Crab – edible meat	13.2	**11.5**
	Crab – whole body	4.2	**3.6**
	Mussels	0.33	0.33
	Clams	15.1	**17.4**
Child Tribal CT (Tulalip data)	Pelagic fish – fillet	0.52	0.52
	Benthic fish – fillet	0.48	0.48
	Benthic fish – whole body	0	0
	Crab – edible meat	2.0	**1.8**
	Crab – whole body	0.64	**0.6**
	Mussels	0.04	0.04
	Clams	2.3	**2.6**

Note: Underlined and bolded entries indicate that the rate has changed.
CT – central tendency
HHRA – human health risk assessment
RME – reasonable maximum exposure

As shown in Table 1, based on the EPA correction, the crab consumption rate decreased and the clam consumption rate increased. EPA did not make any changes in consumption rates for pelagic fish, benthic fish, or mussels.

Updated Risk Estimates

Risk estimates for the Tulalip survey-based seafood consumption scenarios were updated using the corrected consumption rates. Tables 2 through 5 present a comparison of the cancer chronic daily intakes (CDIs) based on the consumption rates from the final HHRA and EPA's revised rates, the percent change in the CDIs, and the excess cancer risks calculated using the consumption rates from the final HHRA and EPA's revised rates. Consistent with the final HHRA, the CDIs for the central tendency (CT) scenarios were developed using mean concentrations as the exposure point

concentrations (EPCs), whereas the CDIs for the reasonable maximum exposure (RME) scenarios were developed using the 95% upper confidence limit on the mean (UCL). Hence, the percent differences in the CDIs for the same chemicals may differ between the CT and RME scenarios.

Table 2. Comparison of excess cancer risk estimates for the adult tribal RME seafood consumption scenario based on Tulalip data

Chemical	Cancer CDI (mg/kg-day)		Percent Change in CDI	Excess Cancer Risk	
	Final HHRA	Revised		Final HHRA	Revised
Arsenic[a, b]	9.7×10^{-4}	1.1×10^{-3}	+13%	1×10^{-3}	2×10^{-3}
Bis(2-ethylhexyl) phthalate	4.5×10^{-4}	4.5×10^{-4}	0%	6×10^{-6}	6×10^{-6}
cPAHs[a, c]	9.8×10^{-6}	1.1×10^{-5}	+12%	7×10^{-5}	8×10^{-5}
PCB TEQ[a]	8.1×10^{-9}	8.1×10^{-9}	0%	1×10^{-3}	1×10^{-3}
Total PCBs	8.0×10^{-4}	8.1×10^{-4}	+1%	2×10^{-3}	2×10^{-3}
Pentachlorophenol	7.3×10^{-4}	7.2×10^{-4}	-1%	9×10^{-5}	9×10^{-5}
Subtotal excluding PCB TEQ				**3×10^{-3}**	**4×10^{-3}**
Subtotal excluding total PCBs				**2×10^{-3}**	**3×10^{-3}**
Tentatively identified chemicals (JN-qualified)					
Aldrin	2.8×10^{-6}	2.7×10^{-6}	-4%	5×10^{-5}	5×10^{-5}
alpha-BHC	2.6×10^{-6}	2.4×10^{-6}	-8%	2×10^{-5}	2×10^{-5}
beta-BHC	3.5×10^{-6}	3.4×10^{-6}	-3%	6×10^{-6}	6×10^{-6}
Carbazole	2.3×10^{-3}	2.2×10^{-3}	-4%	5×10^{-5}	4×10^{-5}
Total chlordane	1.7×10^{-5}	1.6×10^{-5}	-6%	6×10^{-6}	6×10^{-6}
Total DDTs	6.2×10^{-5}	6.0×10^{-5}	-3%	2×10^{-5}	2×10^{-5}
Dieldrin	8.2×10^{-6}	8.8×10^{-6}	+7%	1×10^{-4}	1×10^{-4}
gamma-BHC	4.2×10^{-6}	4.1×10^{-6}	-2%	6×10^{-6}	5×10^{-6}
Heptachlor	3.2×10^{-6}	3.0×10^{-6}	-6%	1×10^{-5}	1×10^{-5}
Heptachlor epoxide	3.4×10^{-6}	3.3×10^{-6}	-3%	3×10^{-5}	3×10^{-5}
Hexachlorobenzene	6.5×10^{-6}	6.0×10^{-6}	-8%	1×10^{-5}	1×10^{-5}
Subtotal				**3×10^{-4}**	**3×10^{-4}**
Total excess cancer risk excluding PCB TEQ				**3×10^{-3}**	**4×10^{-3}**
Total excess cancer risk excluding total PCBs				**2×10^{-3}**	**3×10^{-3}**

[a] No mussel data were available for this chemical. When calculating the CDI and risk estimates, the portion of seafood consumption that had been assigned to mussels was divided proportionally among the remaining consumption categories.

[b] Arsenic risk estimates are based on inorganic arsenic.

[c] cPAH concentrations are presented as benzo(a)pyrene equivalents. Tissue data for cPAHs are from only 2004; historical data were not used because of high reporting limits. Risk related to 2004 and historical data for cPAHs were analyzed in the uncertainty analysis of the HHRA (Windward 2007).

BHC – benzene hexachloride
CDI – chronic daily intake
cPAH – carcinogenic polycyclic aromatic hydrocarbon
DDT – dichlorodiphenyltrichloroethane
HHRA – human health risk assessment
PCB – polychlorinated biphenyl
RME – reasonable maximum exposure
TEQ – toxic equivalent

Table 3. Comparison of excess cancer risk estimates for the adult tribal CT seafood consumption scenario based on Tulalip data

Chemical	Cancer CDI (mg/kg-day)		Percent Change	Excess Cancer Risk	
	Final HHRA	Revised		Final HHRA	Revised
Arsenic[a, b]	4.1×10^{-5}	4.5×10^{-5}	+10%	6×10^{-5}	7×10^{-5}
Bis(2-ethylhexyl) phthalate	1.2×10^{-5}	1.2×10^{-5}	0%	2×10^{-7}	2×10^{-7}
cPAHs[a, c]	5.1×10^{-7}	5.5×10^{-7}	+8%	4×10^{-6}	4×10^{-6}
PCB TEQ[a]	3.8×10^{-10}	3.5×10^{-10}	-8%	6×10^{-5}	5×10^{-5}
Total PCBs	3.2×10^{-5}	3.1×10^{-5}	-3%	6×10^{-5}	6×10^{-5}
Pentachlorophenol	1.4×10^{-5}	1.4×10^{-5}	0%	2×10^{-6}	2×10^{-6}
Subtotal excluding PCB TEQ				**1×10^{-4}**	**1×10^{-4}**
Subtotal excluding total PCBs				**1×10^{-4}**	**1×10^{-4}**
Tentatively identified chemicals (JN-qualified)					
Aldrin	8.7×10^{-8}	8.3×10^{-8}	-5%	1×10^{-6}	1×10^{-6}
alpha-BHC	8.6×10^{-8}	8.2×10^{-8}	-5%	5×10^{-7}	5×10^{-7}
beta-BHC	1.4×10^{-7}	1.4×10^{-7}	-0%	3×10^{-7}	2×10^{-7}
Carbazole	5.0×10^{-5}	4.6×10^{-5}	-8%	1×10^{-6}	9×10^{-7}
Total chlordane	5.7×10^{-7}	5.5×10^{-7}	-4%	2×10^{-7}	2×10^{-7}
Total DDTs	3.1×10^{-6}	3.0×10^{-6}	-3%	1×10^{-6}	1×10^{-6}
Dieldrin	1.6×10^{-7}	1.6×10^{-7}	0%	3×10^{-6}	3×10^{-6}
gamma-BHC	9.8×10^{-8}	9.4×10^{-8}	-4%	1×10^{-7}	1×10^{-7}
Heptachlor	8.9×10^{-8}	8.5×10^{-8}	-4%	4×10^{-7}	4×10^{-7}
Heptachlor epoxide	1.3×10^{-7}	1.2×10^{-7}	-8%	1×10^{-6}	1×10^{-6}
Hexachlorobenzene	1.5×10^{-7}	1.5×10^{-7}	0%	2×10^{-7}	2×10^{-7}
Subtotal				**9×10^{-6}**	**9×10^{-6}**
Total risk across all exposure routes/pathways excluding PCB TEQ				**1×10^{-4}**	**1×10^{-4}**
Total risk across all exposure routes/pathways excluding total PCBs				**1×10^{-4}**	**1×10^{-4}**

[a] No mussel data were available for this chemical. When calculating the CDI and risk estimates, the portion of seafood consumption that had been assigned to mussels was divided proportionally among the remaining consumption categories.

[b] Arsenic risk estimates are based on inorganic arsenic.

[c] cPAH concentrations are presented as benzo(a)pyrene equivalents. Tissue data for carcinogenic PAHs are from only 2004; historical data were not used because of high reporting limits. Risk related to 2004 and historical data for cPAHs were analyzed in the uncertainty analysis of the HHRA (Windward 2007).

BHC – benzene hexachloride
CDI – chronic daily intake
cPAH – carcinogenic polycyclic aromatic hydrocarbon
CT – central tendency
DDT – dichlorodiphenyltrichloroethane
HHRA – human health risk assessment
PCB – polychlorinated biphenyl
TEQ – toxic equivalent

Table 4. Comparison of excess cancer risk estimates for the child tribal RME seafood consumption scenario based on Tulalip data

Chemical	Cancer CDI (mg/kg-day)		Percent Change	Excess Cancer Risk	
	Final HHRA	Revised		Final HHRA	Revised
Arsenic[a, b]	1.8×10^{-4}	2.0×10^{-4}	+11%	3×10^{-4}	3×10^{-4}
Bis(2-ethylhexyl) phthalate	8.3×10^{-5}	8.3×10^{-5}	0%	1×10^{-6}	1×10^{-6}
cPAHs[a, c]	1.8×10^{-6}	2.1×10^{-6}	+17%	7×10^{-5}	8×10^{-5}
PCB TEQ[a]	1.5×10^{-9}	1.5×10^{-9}	0%	2×10^{-4}	2×10^{-4}
Total PCBs	1.5×10^{-4}	1.5×10^{-4}	0%	3×10^{-4}	3×10^{-4}
Pentachlorophenol	1.3×10^{-4}	1.3×10^{-4}	0%	2×10^{-5}	2×10^{-5}
Subtotal excluding PCB TEQ				**7×10^{-4}**	**7×10^{-4}**
Subtotal excluding total PCBs				**6×10^{-4}**	**6×10^{-4}**
Tentatively identified chemicals (JN-qualified)					
Aldrin	5.2×10^{-7}	5.0×10^{-7}	-4%	9×10^{-6}	8×10^{-6}
alpha-BHC	4.8×10^{-7}	4.5×10^{-7}	-6%	3×10^{-6}	3×10^{-6}
beta-BHC	6.5×10^{-7}	6.2×10^{-7}	-5%	1×10^{-6}	1×10^{-6}
Carbazole	4.2×10^{-4}	4.0×10^{-4}	-5%	8×10^{-6}	8×10^{-6}
Total chlordane	3.1×10^{-6}	3.0×10^{-6}	-3%	1×10^{-6}	1×10^{-6}
Total DDTs	1.1×10^{-5}	1.1×10^{-5}	0%	4×10^{-6}	4×10^{-6}
Dieldrin	1.5×10^{-6}	1.6×10^{-6}	+7%	2×10^{-5}	3×10^{-5}
gamma-BHC	7.8×10^{-7}	7.5×10^{-7}	-4%	1×10^{-6}	1×10^{-6}
Heptachlor	5.9×10^{-7}	5.6×10^{-7}	-5%	3×10^{-6}	3×10^{-6}
Heptachlor epoxide	6.2×10^{-7}	6.1×10^{-7}	-2%	6×10^{-6}	6×10^{-6}
Hexachlorobenzene	1.2×10^{-6}	1.1×10^{-6}	-8%	2×10^{-6}	2×10^{-6}
Subtotal				**6×10^{-5}**	**7×10^{-5}**
Total risk across all exposure routes/pathways excluding PCB TEQ				**8×10^{-4}**	**8×10^{-4}**
Total risk across all exposure routes/pathways excluding total PCBs				**7×10^{-4}**	**7×10^{-4}**

[a] No mussel data were available for this chemical. When calculating the CDI and risk estimates, the portion of seafood consumption that had been assigned to mussels was divided proportionally among the remaining consumption categories.

[b] Arsenic risk estimates are based on inorganic arsenic.

[c] cPAH concentrations are presented as benzo(a)pyrene equivalents. Tissue data for carcinogenic PAHs are from only 2004; historical data were not used because of high reporting limits. Risk related to 2004 and historical data for cPAHs were analyzed in the uncertainty analysis of the HHRA (Windward 2007).

BHC – benzene hexachloride
CDI – chronic daily intake
cPAH – carcinogenic polycyclic aromatic hydrocarbon
DDT – dichlorodiphenyltrichloroethane
HHRA – human health risk assessment
PCB – polychlorinated biphenyl
RME – reasonable maximum exposure
TEQ – toxic equivalent

Table 5. Comparison of excess cancer risk estimates for the child tribal CT seafood consumption scenario based on Tulalip data

Chemical	Cancer CDI (mg/kg-day)		Percent Change	Excess Cancer Risk	
	Final HHRA	Revised		Final HHRA	Revised
Arsenic[a, b]	1.8×10^{-5}	1.9×10^{-5}	+6%	3×10^{-5}	3×10^{-5}
Bis(2-ethylhexyl) phthalate	5.2×10^{-6}	5.3×10^{-6}	+2%	7×10^{-8}	7×10^{-8}
cPAHs[a, c]	2.1×10^{-7}	2.3×10^{-7}	+10%	8×10^{-6}	9×10^{-6}
PCB TEQ[a]	1.5×10^{-10}	1.5×10^{-10}	0%	2×10^{-5}	2×10^{-5}
Total PCBs	1.4×10^{-5}	1.3×10^{-5}	-7%	3×10^{-5}	3×10^{-5}
Pentachlorophenol	5.9×10^{-6}	6.1×10^{-6}	+3%	7×10^{-7}	7×10^{-7}
Subtotal excluding PCB TEQ				**7×10^{-5}**	**7×10^{-5}**
Subtotal excluding total PCBs				**6×10^{-5}**	**6×10^{-5}**
Tentatively identified chemicals (JN-qualified)					
Aldrin	3.7×10^{-8}	3.6×10^{-8}	-3%	6×10^{-7}	6×10^{-7}
alpha-BHC	3.7×10^{-8}	3.5×10^{-8}	-5%	2×10^{-7}	2×10^{-7}
beta-BHC	6.0×10^{-8}	5.9×10^{-8}	-2%	1×10^{-7}	1×10^{-7}
Carbazole	2.2×10^{-5}	2.0×10^{-5}	-9%	4×10^{-7}	4×10^{-7}
Total chlordane	2.5×10^{-7}	2.3×10^{-7}	-8%	9×10^{-8}	8×10^{-8}
Total DDTs	1.3×10^{-6}	1.2×10^{-6}	-8%	4×10^{-7}	4×10^{-7}
Dieldrin	6.9×10^{-8}	6.9×10^{-8}	0%	1×10^{-6}	1×10^{-6}
gamma-BHC	4.2×10^{-8}	4.0×10^{-8}	-5%	5×10^{-8}	5×10^{-8}
Heptachlor	3.8×10^{-8}	3.7×10^{-8}	-3%	2×10^{-7}	2×10^{-7}
Heptachlor epoxide	5.6×10^{-8}	5.3×10^{-8}	-5%	5×10^{-7}	5×10^{-7}
Hexachlorobenzene	6.6×10^{-8}	6.3×10^{-8}	-5%	1×10^{-7}	1×10^{-7}
Subtotal				**4×10^{-6}**	**4×10^{-6}**
Total risk across all exposure routes/pathways excluding PCB TEQ				**7×10^{-5}**	**7×10^{-5}**
Total risk across all exposure routes/pathways excluding total PCBs				**6×10^{-5}**	**6×10^{-5}**

[a] No mussel data were available for this chemical. When calculating the CDI and risk estimates, the portion of seafood consumption that had been assigned to mussels was divided proportionally among the remaining consumption categories.

[b] Arsenic risk estimates are based on inorganic arsenic.

[c] cPAH concentrations are presented as benzo(a)pyrene equivalents. Tissue data for carcinogenic PAHs are from only 2004; historical data were not used because of high reporting limits. Risk related to 2004 and historical data for cPAHs were analyzed in the uncertainty analysis of the HHRA (Windward 2007).

BHC – benzene hexachloride
CDI – chronic daily intake
cPAH – carcinogenic polycyclic aromatic hydrocarbon
CT – central tendency
DDT – dichlorodiphenyltrichloroethane
HHRA – human health risk assessment
PCB – polychlorinated biphenyl
TEQ – toxic equivalent

As shown in Tables 2 through 5, changes to the consumption rates resulted in increased CDIs and chemical-specific risk estimates in some cases and decreased CDIs and chemical-specific risk estimates in other cases. The largest increase in the cancer CDI (17% change) using the revised consumption rates was for carcinogenic polycyclic aromatic hydrocarbons (cPAHs) for the child tribal RME seafood consumption scenario based on the Tulalip data. The largest decrease in the cancer CDI (-9% change) using the revised consumption rates was for carbazole for the child tribal CT seafood consumption scenario based on the Tulalip data. Overall, the total excess cancer risk estimates across chemicals stayed the same or increased a relatively small amount.

Revised non-cancer CDIs and non-cancer hazard quotients for the four tribal seafood consumption scenarios based on Tulalip data were also calculated (Tables 6 through 9). Changes to the consumption rates resulted in increased non-cancer CDIs and hazard quotients in some cases and decreased non-cancer CDIs and hazard quotients in other cases. The largest increase in the non-cancer CDI (14% change) using the revised consumption rates was for tributyltin (TBT) for the adult tribal RME seafood consumption scenario based on the Tulalip data and also for arsenic for the child tribal RME seafood consumption scenario based on the Tulalip data. The largest decrease in the non-cancer CDI (-17% change) using the revised consumption rates was for butyl benzyl phthalate for the child tribal CT seafood consumption scenario based on the Tulalip data. In almost all cases, hazard indices by endpoint stayed the same or increased slightly.

Table 6. Comparison of non-cancer hazard estimates for the adult tribal RME seafood consumption scenario based on Tulalip data

Chemical	Non-Cancer CDI (mg/kg-day)		Percent Change	Hazard Quotient	
	Final HHRA	Revised		Final HHRA	Revised
4-Methylphenol	5.0×10^{-4}	4.6×10^{-4}	-8%	0.1	0.09
Antimony	4.7×10^{-5}	5.3×10^{-5}	+13%	0.1	0.1
Arsenic[a, b]	9.7×10^{-4}	1.1×10^{-3}	+13%	3	4
Bis(2-ethylhexyl) phthalate	4.5×10^{-4}	4.5×10^{-4}	0%	0.02	0.02
Butyl benzyl phthalate	5.4×10^{-4}	4.9×10^{-4}	-9%	0.003	0.002
Cadmium	9.3×10^{-5}	9.6×10^{-5}	+3%	0.09	0.1
Chromium	4.7×10^{-4}	5.1×10^{-4}	+9%	0.2	0.2
Copper	8.6×10^{-3}	8.3×10^{-3}	-3%	0.2	0.2
Mercury	5.1×10^{-5}	4.8×10^{-5}	-6%	0.5	0.5
Nickel	4.0×10^{-4}	4.5×10^{-4}	+13%	0.02	0.02
Total PCBs	8.0×10^{-4}	8.1×10^{-4}	+1%	40	40
Pentachlorophenol	7.3×10^{-4}	7.2×10^{-4}	-1%	0.02	0.02
TBT (as ion)	2.1×10^{-4}	2.4×10^{-4}	+14%	1	2
Vanadium	8.3×10^{-4}	9.3×10^{-4}	+12%	0.8	0.9
Zinc	3.4×10^{-2}	3.3×10^{-2}	-3%	0.1	0.1
Tentatively identified chemicals (JN-qualified)					
Aldrin	2.8×10^{-6}	2.7×10^{-6}	-4%	0.09	0.09
alpha-BHC	2.6×10^{-6}	2.4×10^{-6}	-8%	0.005	0.005
beta-BHC	3.5×10^{-6}	3.4×10^{-6}	-3%	0.02	0.02
Total chlordane	1.7×10^{-5}	1.6×10^{-5}	-6%	0.03	0.03
Total DDTs	6.2×10^{-5}	6.0×10^{-5}	-3%	0.1	0.1
Dieldrin	8.2×10^{-6}	8.8×10^{-6}	+7%	0.2	0.2
Endrin	3.0×10^{-6}	2.8×10^{-6}	-7%	0.01	0.009
Endrin aldehyde	1.1×10^{-5}	1.1×10^{-5}	0%	0.04	0.04
gamma-BHC	4.2×10^{-6}	4.1×10^{-6}	-2%	0.01	0.01
Heptachlor	3.2×10^{-6}	3.0×10^{-6}	-6%	0.006	0.006
Heptachlor epoxide	3.4×10^{-6}	3.3×10^{-6}	-3%	0.3	0.3
Hexachlorobenzene	6.5×10^{-6}	6.0×10^{-6}	-8%	0.008	0.008
Hazard index for cardiovascular endpoint[c]				**4**	**5**
Hazard index for developmental endpoint[d]				**41**	**41**
Hazard index for hematologic endpoint[e]				**0.2**	**0.2**
Hazard index for immunological endpoint[f]				**41**	**42**
Hazard index for kidney endpoint[g]				**0.4**	**0.4**
Hazard index for liver endpoint[h]				**1**	**1**
Hazard index for neurological endpoint[i]				**41**	**41**
Hazard index for dermal endpoint[j]				**3**	**4**

[a] No mussel data were available for this chemical. When calculating the CDI and risk estimates, the portion of seafood consumption that had been assigned to mussels was divided proportionally among the remaining consumption categories.

[b] Arsenic risk estimates are based on inorganic arsenic.

[c] Cardiovascular endpoint is for arsenic and vanadium.

[d] Developmental endpoint is for PCBs and mercury.

[e] Hematologic endpoint is for antimony and zinc.

[f] Immunological endpoint is for PCBs and TBT.

[g] Kidney endpoint is for 4-methylphenol, cadmium, copper, gamma-BHC, and pentachlorophenol.

[h] Liver endpoint is for 4-methylphenol, aldrin, alpha-BHC, beta-BHC, bis(2-ethylhexyl) phthalate, butyl benzyl phthalate, chlordane, copper, total DDTs, dieldrin, endrin, endrin aldehyde, gamma-BHC, heptachlor, heptachlor epoxide, hexachlorobenzene, and pentachlorophenol.

[i] Neurological endpoint is for 4-methylphenol, mercury, and total PCBs.

[j] Dermal endpoint is for 4-methylphenol and arsenic.

BHC – benzene hexachloride

CDI – chronic daily intake

DDT – dichlorodiphenyltrichloroethane

HHRA – human health risk assessment

PCB – polychlorinated biphenyl

RME – reasonable maximum exposure

TBT – tributyltin

Table 7. Comparison of non-cancer hazard estimates for the adult tribal CT seafood consumption scenario based on Tulalip data

Chemical	Non-Cancer CDI (mg/kg-day)		Percent Change	Hazard Quotient	
	Final HHRA	Revised		Final HHRA	Revised
4-Methylphenol	4.5×10^{-5}	4.1×10^{-5}	-9%	0.009	0.008
Antimony	4.0×10^{-6}	4.4×10^{-6}	+10%	0.01	0.01
Arsenic[a, b]	9.7×10^{-5}	1.0×10^{-4}	+3%	0.3	0.4
Bis(2-ethylhexyl) phthalate	2.8×10^{-5}	2.9×10^{-5}	+4%	0.001	0.002
Butyl benzyl phthalate	5.4×10^{-5}	4.9×10^{-5}	-9%	0.0003	0.0002
Cadmium	1.2×10^{-5}	1.3×10^{-5}	+8%	0.01	0.01
Chromium	5.5×10^{-5}	6.2×10^{-5}	+13%	0.02	0.02
Copper	1.1×10^{-3}	1.1×10^{-3}	0%	0.03	0.03
Mercury	6.9×10^{-6}	6.6×10^{-6}	-4%	0.07	0.07
Nickel	5.3×10^{-5}	5.8×10^{-5}	+9%	0.003	0.003
Total PCBs	7.5×10^{-5}	7.3×10^{-5}	-3%	4	4
Pentachlorophenol	3.2×10^{-5}	3.4×10^{-5}	+6%	0.001	0.001
TBT (as ion)	2.4×10^{-5}	2.7×10^{-5}	+13%	0.2	0.2
Vanadium	1.1×10^{-4}	1.2×10^{-4}	+9%	0.1	0.1
Zinc	4.8×10^{-3}	4.7×10^{-3}	-2%	0.02	0.02
Tentatively identified chemicals (JN-qualified)					
Aldrin	2.0×10^{-7}	1.9×10^{-7}	-5%	0.007	0.007
alpha-BHC	2.0×10^{-7}	1.9×10^{-7}	-5%	0.0004	0.0004
beta-BHC	3.3×10^{-7}	3.2×10^{-7}	-3%	0.002	0.002
Total chlordane	1.3×10^{-6}	1.3×10^{-6}	0%	0.003	0.003
Total DDTs	7.1×10^{-6}	6.9×10^{-6}	-3%	0.01	0.01
Dieldrin	3.7×10^{-7}	3.8×10^{-7}	+3%	0.007	0.008
Endrin	2.6×10^{-7}	2.5×10^{-7}	-4%	0.0009	0.0008
Endrin aldehyde	3.0×10^{-7}	2.9×10^{-7}	-3%	0.001	0.001
gamma-BHC	2.3×10^{-7}	2.2×10^{-7}	-4%	0.0008	0.0007
Heptachlor	2.1×10^{-7}	2.0×10^{-7}	-5%	0.0004	0.0004
Heptachlor epoxide	3.0×10^{-7}	2.9×10^{-7}	-3%	0.02	0.02
Hexachlorobenzene	3.6×10^{-7}	3.4×10^{-7}	-6%	0.0004	0.0004
Hazard index for cardiovascular endpoint[c]				**0.4**	**0.5**
Hazard index for developmental endpoint[d]				**4**	**4**
Hazard index for hematologic endpoint[e]				**0.03**	**0.03**
Hazard index for immunological endpoint[f]				**4**	**4**
Hazard index for kidney endpoint[g]				**0.05**	**0.05**
Hazard index for liver endpoint[h]				**0.1**	**0.1**
Hazard index for neurological endpoint[i]				**4**	**4**
Hazard index for dermal endpoint[j]				**0.3**	**0.4**

[a] No mussel data were available for this chemical. When calculating the CDI and risk estimates, the portion of seafood consumption that had been assigned to mussels was divided proportionally among the remaining consumption categories.

[b] Arsenic risk estimates are based on inorganic arsenic.

[c] Cardiovascular endpoint is for arsenic and vanadium.

[d] Developmental endpoint is for PCBs and mercury.

[e] Hematologic endpoint is for antimony and zinc.

[f] Immunological endpoint is for PCBs and TBT.

[g] Kidney endpoint is for 4-methylphenol, cadmium, copper, gamma-BHC, and pentachlorophenol.

[h] Liver endpoint is for 4-methylphenol, aldrin, alpha-BHC, beta-BHC, bis(2-ethylhexyl) phthalate, butyl benzyl phthalate, chlordane, copper, total DDTs, dieldrin, endrin, endrin aldehyde, gamma-BHC, heptachlor, heptachlor epoxide, hexachlorobenzene, and pentachlorophenol.

[i] Neurological endpoint is for 4-methylphenol, mercury, and total PCBs.

[j] Dermal endpoint is for 4-methylphenol and arsenic.

BHC – benzene hexachloride

CDI – chronic daily intake

CT – central tendency

DDT – dichlorodiphenyltrichloroethane

HHRA – human health risk assessment

J – estimated concentration

N – tentative identification

PCB – polychlorinated biphenyl

TBT – tributyltin

Table 8. Comparison of non-cancer hazard estimates for the child tribal RME seafood consumption scenario based on Tulalip data

Chemical	Non-Cancer CDI (mg/kg-day)		Percent Change	Hazard Quotient	
	Final HHRA	Revised		Final HHRA	Revised
4-Methylphenol	1.1×10^{-3}	9.9×10^{-4}	-10%	0.2	0.2
Antimony	1.0×10^{-4}	1.1×10^{-4}	+10%	0.3	0.3
Arsenic[a, b]	2.1×10^{-3}	2.4×10^{-3}	+14%	7	8
Bis(2-ethylhexyl) phthalate	9.7×10^{-4}	9.7×10^{-4}	0%	0.05	0.05
Butyl benzyl phthalate	1.2×10^{-3}	1.1×10^{-3}	-8%	0.006	0.005
Cadmium	2.0×10^{-4}	2.1×10^{-4}	+5%	0.2	0.2
Chromium	1.0×10^{-3}	1.1×10^{-3}	+10%	0.3	0.4
Copper	1.8×10^{-2}	1.8×10^{-2}	0%	0.5	0.4
Mercury	1.1×10^{-4}	1.0×10^{-4}	-9%	1	1
Nickel	8.7×10^{-4}	9.7×10^{-4}	+11%	0.04	0.05
PCBs (total calc'd)	1.7×10^{-3}	1.7×10^{-3}	0%	86	87
Pentachlorophenol	1.6×10^{-3}	1.5×10^{-3}	-6%	0.05	0.05
TBT (as ion)	4.5×10^{-4}	5.1×10^{-4}	+13%	3	3
Vanadium	1.8×10^{-3}	2.0×10^{-3}	+11%	2	2
Zinc	7.3×10^{-2}	7.2×10^{-2}	-1%	0.2	0.2
Tentatively identified chemicals (JN-qualified)					
Aldrin	6.1×10^{-6}	5.8×10^{-6}	-5%	0.2	0.2
alpha-BHC	5.6×10^{-6}	5.2×10^{-6}	-7%	0.01	0.01
beta-BHC	7.6×10^{-6}	7.3×10^{-6}	-4%	0.04	0.04
Chlordane (total calc'd)	3.6×10^{-5}	3.5×10^{-5}	-3%	0.07	0.07
DDTs (total calc'd)	1.3×10^{-4}	1.3×10^{-4}	0%	0.3	0.3
Dieldrin	1.8×10^{-5}	1.9×10^{-5}	+6%	0.4	0.4
Endrin	6.4×10^{-6}	6.0×10^{-6}	-6%	0.02	0.02
Endrin aldehyde	2.4×10^{-5}	2.4×10^{-5}	0%	0.08	0.08
gamma-BHC	9.1×10^{-6}	8.8×10^{-6}	-3%	0.03	0.03
Heptachlor	6.9×10^{-6}	6.5×10^{-6}	-6%	0.01	0.01
Heptachlor epoxide	7.3×10^{-6}	7.1×10^{-6}	-3%	0.6	0.5
Hexachlorobenzene	1.4×10^{-5}	1.3×10^{-5}	-7%	0.02	0.02
Hazard index for cardiovascular endpoint[c]				**9**	**10**
Hazard index for developmental endpoint[d]				**87**	**88**
Hazard index for hematologic endpoint[e]				**0.5**	**0.5**
Hazard index for immunological endpoint[f]				**89**	**90**
Hazard index for kidney endpoint[g]				**1**	**0.9**
Hazard index for liver endpoint[h]				**3**	**2**
Hazard index for neurological endpoint[i]				**87**	**88**
Hazard index for dermal endpoint[j]				**7**	**8**

[a] No mussel data were available for this chemical. When calculating the CDI and risk estimates, the portion of seafood consumption that had been assigned to mussels was divided proportionally among the remaining consumption categories.

[b] Arsenic risk estimates are based on inorganic arsenic.

[c] Cardiovascular endpoint is for arsenic and vanadium.

[d] Developmental endpoint is for PCBs and mercury.

[e] Hematologic endpoint is for antimony and zinc.

[f] Immunological endpoint is for PCBs and TBT.

[g] Kidney endpoint is for 4-methylphenol, cadmium, copper, gamma-BHC, and pentachlorophenol.

[h] Liver endpoint is for 4-methylphenol, aldrin, alpha-BHC, beta-BHC, bis(2-ethylhexyl) phthalate, butyl benzyl phthalate, chlordane, copper, total DDTs, dieldrin, endrin, endrin aldehyde, gamma-BHC, heptachlor, heptachlor epoxide, hexachlorobenzene, and pentachlorophenol.

[i] Neurological endpoint is for 4-methylphenol, mercury, and total PCBs.

[j] Dermal endpoint is for 4-methylphenol and arsenic.

BHC – benzene hexachloride

CDI – chronic daily intake

DDT – dichlorodiphenyltrichloroethane

HHRA – human health risk assessment

J – estimated concentration

N – tentative identification

PCB – polychlorinated biphenyl

RME – reasonable maximum exposure

TBT – tributyltin

Table 9. Comparison of non-cancer hazard estimates for the child tribal CT seafood consumption scenario based on Tulalip data

Chemical	Non-Cancer CDI (mg/kg-day)		Percent Change	Hazard Quotient	
	Final HHRA	Revised		Final HHRA	Revised
4-Methylphenol	9.7×10^{-5}	8.9×10^{-5}	-8%	0.02	0.02
Antimony	8.5×10^{-6}	9.4×10^{-6}	+11%	0.02	0.02
Arsenic[a, b]	2.1×10^{-4}	2.2×10^{-4}	+5%	0.7	0.7
Bis(2-ethylhexyl) phthalate	6.1×10^{-5}	6.2×10^{-5}	+2%	0.003	0.003
Butyl benzyl phthalate	1.2×10^{-4}	1.0×10^{-4}	-17%	0.0006	0.0005
Cadmium	2.7×10^{-5}	2.7×10^{-5}	0%	0.03	0.03
Chromium	1.2×10^{-4}	1.3×10^{-4}	+8%	0.04	0.04
Copper	2.5×10^{-3}	2.3×10^{-3}	-8%	0.06	0.06
Mercury	1.5×10^{-5}	1.4×10^{-5}	-7%	0.1	0.1
Nickel	1.1×10^{-4}	1.2×10^{-4}	+9%	0.006	0.006
Total PCBs	1.6×10^{-4}	1.5×10^{-4}	-6%	8	8
Pentachlorophenol	6.9×10^{-5}	7.2×10^{-5}	+4%	0.002	0.002
TBT (as ion)	5.2×10^{-5}	5.8×10^{-5}	+12%	0.3	0.4
Vanadium	2.3×10^{-4}	2.5×10^{-4}	+9%	0.2	0.3
Zinc	1.0×10^{-2}	1.0×10^{-2}	0%	0.03	0.03
Tentatively identified chemicals (JN-qualified)					
Aldrin	4.4×10^{-7}	4.2×10^{-7}	-5%	0.01	0.01
alpha-BHC	4.3×10^{-7}	4.1×10^{-7}	-5%	0.0009	0.0008
beta-BHC	7.0×10^{-7}	6.8×10^{-7}	-3%	0.004	0.003
Total chlordane	2.9×10^{-6}	2.7×10^{-6}	-7%	0.006	0.005
Total DDTs	1.5×10^{-5}	1.4×10^{-5}	-7%	0.03	0.03
Dieldrin	8.0×10^{-7}	8.0×10^{-7}	0%	0.02	0.02
Endrin	5.6×10^{-7}	5.3×10^{-7}	-5%	0.002	0.002
Endrin aldehyde	6.5×10^{-7}	6.2×10^{-7}	-5%	0.002	0.002
gamma-BHC	4.9×10^{-7}	4.7×10^{-7}	-4%	0.002	0.002
Heptachlor	4.5×10^{-7}	4.3×10^{-7}	-4%	0.0009	0.0009
Heptachlor epoxide	6.5×10^{-7}	6.1×10^{-7}	-6%	0.05	0.05
Hexachlorobenzene	7.7×10^{-7}	7.3×10^{-7}	-5%	0.001	0.0009
Hazard index for cardiovascular endpoint[c]				**0.9**	**1**
Hazard index for developmental endpoint[d]				**8**	**8**
Hazard index for hematologic endpoint[e]				**0.05**	**0.05**
Hazard index for immunological endpoint[f]				**8**	**8**
Hazard index for kidney endpoint[g]				**0.1**	**0.1**
Hazard index for liver endpoint[h]				**0.3**	**0.3**
Hazard index for neurological endpoint[i]				**8**	**8**
Hazard index for dermal endpoint[j]				**0.7**	**0.7**

[a] No mussel data were available for this chemical. When calculating the CDI and risk estimates, the portion of seafood consumption that had been assigned to mussels was divided proportionally among the remaining consumption categories.

[b] Arsenic risk estimates are based on inorganic arsenic.

[c] Cardiovascular endpoint is for arsenic and vanadium.

[d] Developmental endpoint is for PCBs and mercury.

[e] Hematologic endpoint is for antimony and zinc.

[f] Immunological endpoint is for PCBs and TBT.

[g] Kidney endpoint is for 4-methylphenol, cadmium, copper, gamma-BHC, and pentachlorophenol.

[h] Liver endpoint is for 4-methylphenol, aldrin, alpha-BHC, beta-BHC, bis(2-ethylhexyl) phthalate, butyl benzyl phthalate, chlordane, copper, total DDTs, dieldrin, endrin, endrin aldehyde, gamma-BHC, heptachlor, heptachlor epoxide, hexachlorobenzene, and pentachlorophenol.

[i] Neurological endpoint is for 4-methylphenol, mercury, and total PCBs.

[j] Dermal endpoint is for 4-methylphenol and arsenic.

BHC – benzene hexachloride

CDI – chronic daily intake

CT – central tendency

DDT – dichlorodiphenyltrichloroethane

HHRA – human health risk assessment

J – estimated concentration

N – tentative identification

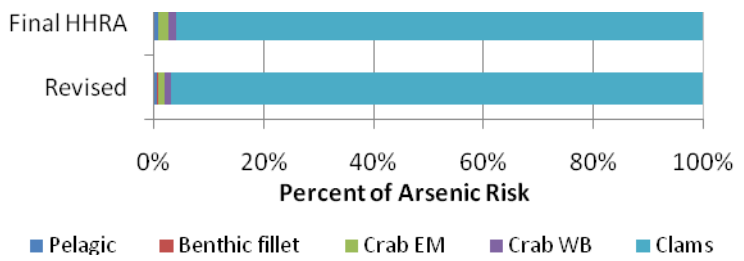
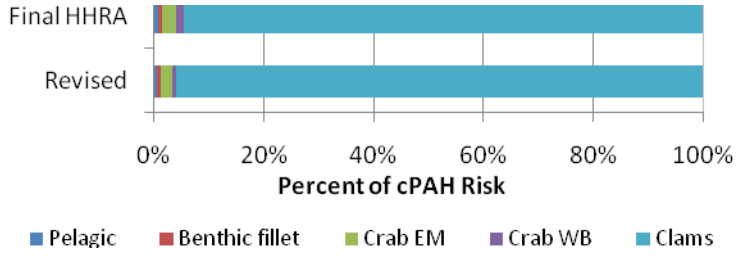
PCB – polychlorinated biphenyl

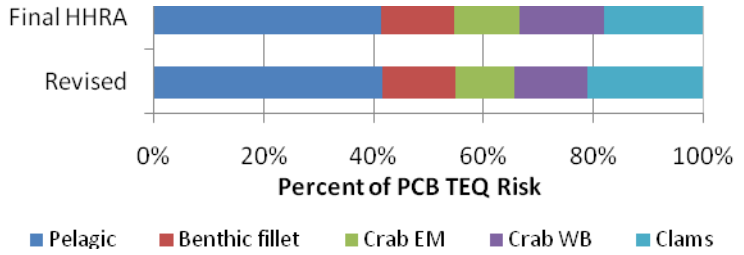
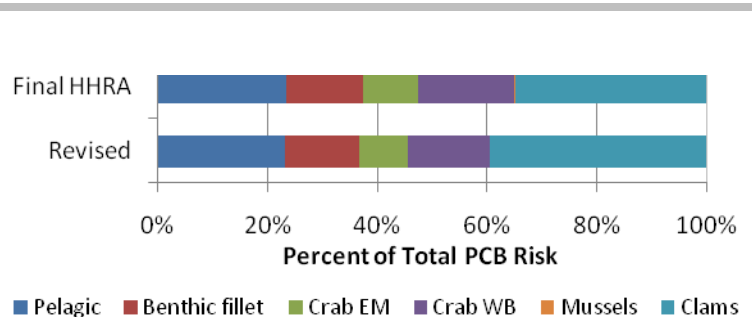
TBT – tributyltin

UPDATED RISK ESTIMATES BY SEAFOOD CATEGORY

This section summarizes the contribution of different seafood consumption categories to the total risk estimates by chemical (for arsenic, cPAHs, polychlorinated biphenyl [PCB] toxic equivalent [TEQ], and total PCB TEQ) based on the consumption rates used in the final HHRA and the revised consumption rates. Comparisons of the percent contribution to the risk estimates for each seafood consumption category are presented in Tables 10 and 11 for the adult/child tribal RME and the adult/child tribal CT seafood consumption scenarios, respectively, based on Tulalip data. For all four scenarios, the estimates using the revised consumption rates, which assumed a higher consumption of clams and a lower consumption of crabs, resulted in a slightly higher percentage of the risk attributable to clams and a lower percentage of risk attributable to crabs.

Table 10. Comparison of the percent contribution of seafood consumption categories to the excess cancer risks and non-cancer hazards for selected chemicals in the adult tribal RME and child tribal RME seafood consumption scenarios based on Tulalip data

Consumption Category	Adult Consumption Rate (g/day)		Child Consumption Rate (g/day)		Percent of Chemical's Risk		Adult or Child Tribal RME (Tulalip data) Seafood Consumption Risk Expressed as Percentage of the Total Risk[a]
	Final HHRA	Revised	Final HHRA	Revised	Final HHRA	Revised	
Arsenic[b]							
Pelagic	8.2	8.2	3.3	3.2	0.9%	0.8%	
Benthic – fillet	7.6	7.6	3.0	3.0	0.06%	0.05%	
Crab – edible meat	33	29	13	12	1.8%	1.3%	
Crab – whole body	10	9.1	4.2	3.6	1.5%	1.1%	
Clams	38	44	15	18	95.8%	96.7%	
cPAHs (2004 data only)[b, c]							
Pelagic	8.2	8.2	3.3	3.2	1.0%	0.8%	
Benthic – fillet	7.6	7.6	3.0	3.0	0.6%	0.5%	
Crab – edible meat	33	29	13	12	2.7%	2.1%	
Crab – whole body	10	9.1	4.2	3.6	1.2%	0.9%	
Clams	38	44	15	18	94.5%	95.7%	

Consumption Category	Adult Consumption Rate (g/day)		Child Consumption Rate (g/day)		Percent of Chemical's Risk		Adult or Child Tribal RME (Tulalip data) Seafood Consumption Risk Expressed as Percentage of the Total Risk[a]
	Final HHRA	Revised	Final HHRA	Revised	Final HHRA	Revised	
PCB TEQ[b]							
Pelagic	8.2	8.2	3.3	3.2	41.4%	41.7%	
Benthic – fillet	7.6	7.6	3.0	3.0	13.3%	13.4%	
Crab – edible meat	33	29	13	12	12.0%	10.6%	
Crab – whole body	10	9.1	4.2	3.6	15.3%	13.3%	
Clams	38	44	15	18	18.0%	21.0%	
Total PCBs[d]							
Pelagic	8.1	8.1	3.2	3.2	23.6%	23.3%	
Benthic – fillet	7.5	7.5	3.0	3.0	13.8%	13.6%	
Crab – edible meat	33	29	13	12	10.1%	8.7%	
Crab – whole body	10	9.0	4.2	3.6	17.6%	15.0%	
Mussels	0.82	0.80	0.33	0.30	0.05%	0.05%	
Clams	38	43	15	17	34.8%	39.4%	

[a] Figures represent both cancer and non-cancer risks. Risk percentages are based on EPC and consumption rates, meaning that the percentage of risk from each consumption category is the same for cancer and non-cancer risks.

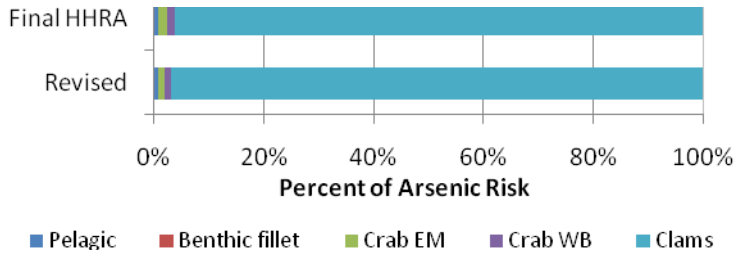
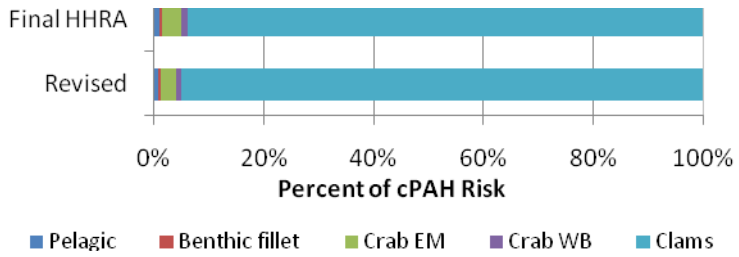
[b] No mussel data were available for this chemical. When calculating the CDI and risk estimates, the portion of seafood consumption that had been assigned to mussels was divided proportionally among the remaining consumption categories.

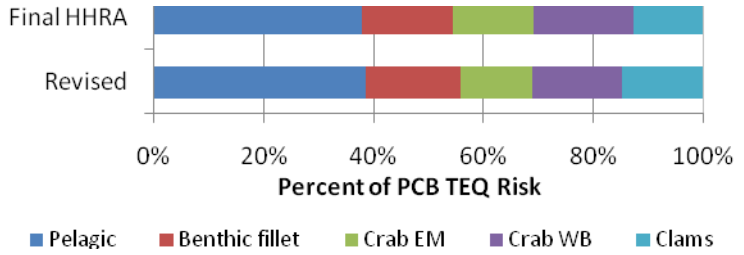
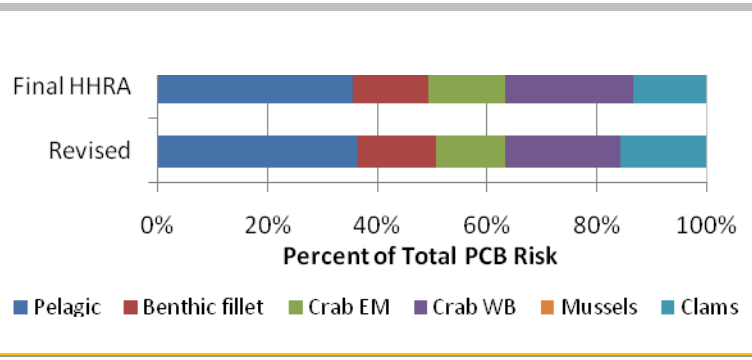
[c] cPAH concentrations are given in terms of benzo(a)pyrene equivalents. Data used in the risk characterization portion of this document are from only 2004 because of high reporting limits in historical data. All cPAH data are analyzed in the uncertainty analysis (HHRA, Section B.6).

[d] Although total PCBs data for mussels were included in the risk estimates, mussels are not shown in the bar charts because their percentage of total risk was so small.

cPAH – carcinogenic polycyclic aromatic hydrocarbon
EM – edible meat
EPC – exposure point concentration
HHRA – human health risk assessment
na – not applicable
PCB – polychlorinated biphenyl
RME – reasonable maximum exposure
TEQ – toxic equivalent
WB – whole body

Table 11. Comparison of the percent contribution of seafood consumption categories to the excess cancer risks and non-cancer hazards for selected chemicals in the adult tribal CT and child tribal CT seafood consumption scenarios based on Tulalip data

Consumption Category	Adult Consumption Rate (g/day)		Child Consumption Rate (g/day)		Percent of Chemical's Risk		Adult or Child Tribal RME (Tulalip data) Seafood Consumption Risk Expressed as Percentage of the Total Risk[a]
	Final HHRA	Revised	Final HHRA	Revised	Final HHRA	Revised	
Arsenic[b]							
Pelagic	1.4	1.3	0.55	0.52	0.9%	0.9%	
Benthic – fillet	1.3	1.2	0.51	0.48	0.06%	0.06%	
Crab – edible meat	5.3	4.4	2.1	1.8	1.5%	1.2%	
Crab – whole body	1.7	1.4	0.68	0.60	1.6%	1.2%	
Clams	6.1	6.6	2.4	2.6	95.8%	96.6%	
cPAHs (2004 data only)[b, c]							
Pelagic	1.4	1.3	0.55	0.52	1.1%	1.0%	
Benthic fillet	1.3	1.2	0.51	0.48	0.6%	0.5%	
Crab –edible meat	5.3	4.4	2.1	1.8	3.4%	2.7%	
Crab – whole body	1.7	1.4	0.68	0.60	1.3%	1.0%	
Clams	6.1	6.6	2.4	2.6	93.6%	94.8%	

Consumption Category	Adult Consumption Rate (g/day)		Child Consumption Rate (g/day)		Percent of Chemical's Risk		Adult or Child Tribal RME (Tulalip data) Seafood Consumption Risk Expressed as Percentage of the Total Risk[a]
	Final HHRA	Revised	Final HHRA	Revised	Final HHRA	Revised	
PCB TEQ[b]							
Pelagic	1.4	1.3	0.55	0.52	37.9%	38.8%	
Benthic – fillet	1.3	1.2	0.51	0.48	16.7%	17.1%	
Crab – edible meat	5.3	4.4	2.1	1.8	14.7%	13.2%	
Crab – whole body	1.7	1.4	0.68	0.60	18.1%	16.2%	
Clams	6.1	6.6	2.4	2.6	12.6%	14.7%	
Total PCBs[d]							
Pelagic	1.3	1.3	0.52	0.52	35.6%	36.6%	
Benthic – fillet	1.2	1.2	0.48	0.48	13.8%	14.1%	
Crab – edible meat	5.0	4.4	2.0	1.8	13.9%	12.6%	
Crab – whole body	1.6	1.4	0.64	0.60	23.3%	21.0%	
Mussels	0.10	0.10	0.40	0.04	0.06%	0.06%	
Clams	5.8	6.6	2.3	2.6	13.3%	15.6%	

[a] Figures represent both cancer and non-cancer risks. Risk percentages are based on EPC and consumption rates, meaning that the percentage of risk from each consumption category is the same for cancer and non-cancer risks.

[b] No mussel data were available for this chemical. When calculating the CDI and risk estimates, the portion of seafood consumption that had been assigned to mussels was divided proportionally among the remaining consumption categories.

[c] cPAH concentrations are given in terms of benzo(a)pyrene equivalents. Data used in the risk characterization portion of this document are from only 2004 because of high reporting limits in historical data. All cPAH data are analyzed in the uncertainty analysis (HHRA, Section B.6).

[d] Although total PCBs data for mussels were included in the risk estimates, mussels are not shown in the bar charts because their percentage of total risk was so small.

cPAH –carcinogenic polycyclic aromatic hydrocarbon
CT – central tendency
EM – edible meat
EPC – exposure point concentration
HHRA – human health risk assessment
na – not applicable
PCB – polychlorinated biphenyl
TEQ – toxic equivalent
WB – whole body

CONCLUSIONS

As presented in these errata, the revised consumption rates for the child and adult tribal seafood consumption scenarios based on Tulalip data do not result in substantial changes to the risk estimates presented in the final LDW HHRA (Windward 2007). Risk estimates increased for some chemicals and decreased for other chemicals. In addition, although the revised consumption rates resulted in a slightly higher percentage of the risk attributable to clams, this change was minimal. The changes in excess cancer risk estimates or hazard quotients with the revised shellfish consumption rates do not change the chemicals of concern or risk drivers for any of the Tulalip survey-based seafood consumption scenarios that were identified in the final HHRA.

References

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