

APPENDIX C DERIVATION OF SCREENING BENCHMARKS FOR SUBSISTENCE FOODS

Appendix C: Derivation of Screening Benchmarks for Subsistence Foods

1. OBJECTIVE

Screening benchmarks (also known as target concentrations) were derived to facilitate the screening for contaminants of potential concern (COPCs) in subsistence foods. Screening benchmarks were calculated consistent with the methodology recommended in the guidance from Canadian Council of Ministers of the Environment on deriving soil quality guidelines (CCME 2006). Screening benchmarks are concentrations of metal parameters in subsistence foods that are considered to have a low probability of risk to human health. If measured or modelled parameter concentrations in any subsistence food were found to be above the benchmarks, these parameters will be carried forward as COPCs in the human health risk assessment (HHRA).

2. METHODOLOGY

Screening benchmarks are back-calculated using Equation 1 and are based on the most conservative (toddler) oral toxicity reference value (TRV) and receptor-specific subsistence foods consumption rates.

$$SB = \frac{TRV \times AF \times BW}{ER \times RAF \times ET} \quad \text{[Equation 1]}$$

where:

SB = screening benchmark concentration (mg/kg wet weight)

TRV = toxicity reference value (mg/kg BW-day)

AF = allocation factor (unitless; amount subsistence foods contribute to the overall human health risk from intake of COPCs from five exposure pathways; assumed to be 0.2)

BW = body weight (toddler; 16.5 kg BW)

ER = total consumption rate of all subsistence foods (kg wet weight/day)

RAF = relative absorption factor (unitless; assumed to be 1)

ET = exposure time (day; assumed to be 1)

Toxicity reference values are provided in Section 5 and Appendix F of the HHRA. Note that screening benchmarks are based on total subsistence foods consumption rates per day (i.e., from all subsistence foods combined) and are amortized over one year. Subsistence food consumption rates are provided in Table 1 and are the same rates used in the HHRA (see Section 4.1 of the *Human Health Risk Assessment Report*). Screening benchmarks for combined subsistence foods are the same as for individual subsistence foods because the calculation of food-specific benchmarks would have to account for both the proportion of the allocation factor for a given food and the ingestion rate of that food.

The allocation factor of 0.2 was used as there are five operable exposure pathways for human receptors to COPCs that were considered in the HHRA including: ingestion of drinking water, incidental ingestion of soil, ingestion of market foods, other insignificant exposure pathways (including dermal exposure to soil and inhalation), and ingestion of subsistence foods (see Section 3.3 of the *Human Health Risk Assessment Report*).

An example calculation of the screening benchmark using Equation 1 for aluminum is as follows:

$$SB_{Al} = \frac{\frac{0.29 \text{ mg}}{\text{kg-day}} \times 0.2 \times 16.5 \text{ kg}}{\frac{0.033 \text{ kg ww}}{\text{day}} \times 1 \times 1}$$
$$SB_{Al} = 29 \text{ mg/kg ww}$$

3. RESULTS

Screening benchmarks for each parameter are provided in Table 2. These benchmarks were used in the screening of subsistence foods for COPCs in the Base Case and Project Case HHRA.

4. REFERENCES

- CCME. 2006. *A protocol for the derivation of environmental and human health soil quality guidelines*.
Winnipeg, ON: Environment Canada. Canadian Council of Ministers of the Environment.
- Chan, L., O. Receveur, D. Sharp, H. Schwartz, A. Ing, and C. Tikhonov. 2011. *First Nations Food, Nutrition & Environment Study (FNFNES): Results from British Columbia (2008/2009)*.
University of Northern British Columbia: Prince George, BC.

Table 1: Subsistence Foods Consumption Rates Used in the Derivation of Screening Benchmarks for Subsistence Foods

Subsistence Food	Consumption Rate (or Serving Size)* (g/day)		Consumption Frequency* (days per year)	Annual Amortization		Annual Amortization	
				Consumption Rate (g/year)	Consumption Rate (g/day)	Consumption Rate (g/year)	Consumption Rate (g/day)
	Adult	Toddler**	Adult and Toddler	Adult		Toddler	
Land mammal meat (moose)	155	78	71	11,005	30.2	5,503	15.1
Land mammal meat (deer)	155	78	8	1,240	3.4	620	1.7
Moose liver	155	78	8	1,240	3.4	620	1.7
Deer liver	155	78	8	1,240	3.4	620	1.7
Moose kidney	155	78	8	1,240	3.4	620	1.7
Deer kidney	155	78	8	1,240	3.4	620	1.7
Black bear Meat	155	78	8	1,240	3.4	620	1.7
Land mammal meat (rabbit)	155	78	8	1,240	3.4	620	1.7
Wild birds (grouse)	75	38	8	600	1.6	300	0.8
Fish (trout)	126	63	9	1,131	3.1	566	1.5
Vegetation and Berries	48	24	49	2,328	6.4	1,164	3.2
Total subsistence foods consumption (kg/d), amortized over 1 year					0.065		0.033

Note:

Based on top ten traditional food items consumed in Ecozone 5. For food items that are not included in the top ten list, it was assumed that their consumption rate was one day less than the 10th (least consumed) food item in the list = 8 days.

* Source: Chan et al. (2011).

** The toddler was assumed to eat half the serving size of an adult.

Table 2: Derivation of Subsistence Foods Risk-based Screening Benchmarks

Parameter	Toxicity Reference Value (mg/kg BW-day)		Allocation Factor	Body Weight (kg BW)		Total Ingestion Rate (kg wet weight/day)		Relative Absorption Factor	Exposure Time	Risk-based Screening Benchmark Concentration for Subsistence Foods (mg/kg wet weight)	
	Toddler	Adult		Toddler	Adult	Toddler	Adult			Toddler	Adult
Aluminum	0.29	0.29	0.2	16.5	70.7	0.033	0.065	1	1	29	63
Antimony	0.0004	0.0004	0.2	16.5	70.7	0.033	0.065	1	1	0.041	0.087
Arsenic	0.0003	0.0003	0.2	16.5	70.7	0.033	0.065	1	1	0.030	0.065
Barium	0.2	0.2	0.2	16.5	70.7	0.033	0.065	1	1	20	43
Beryllium	0.002	0.002	0.2	16.5	70.7	0.033	0.065	1	1	0.20	0.43
Boron	0.2	0.2	0.2	16.5	70.7	0.033	0.065	1	1	20.3	43
Cadmium	0.001	0.001	0.2	16.5	70.7	0.033	0.065	1	1	0.101	0.22
Chromium	0.002	0.002	0.2	16.5	70.7	0.033	0.065	1	1	0.203	0.43
Cobalt	0.0014	0.0014	0.2	16.5	70.7	0.033	0.065	1	1	0.142	0.304
Copper	0.426	0.426	0.2	16.5	70.7	0.033	0.065	1	1	43.2	93
Iron	0.7	0.7	0.2	16.5	70.7	0.033	0.065	1	1	71	152
Lead	0.0005	0.0005	0.2	16.5	70.7	0.033	0.065	1	1	0.051	0.11
Lithium	0.002	0.002	0.2	16.5	70.7	0.033	0.065	1	1	0.20	0.43
Manganese	0.025	0.025	0.2	16.5	70.7	0.033	0.065	1	1	3	5
Mercury	0.0003	0.0003	0.2	16.5	70.7	0.033	0.065	1	1	0.030	0.065
Molybdenum	0.005	0.005	0.2	16.5	70.7	0.033	0.065	1	1	0.5	1.09
Nickel	0.0013	0.0013	0.2	16.5	70.7	0.033	0.065	1	1	0.13	0.3
Rubidium	0.004	0.004	0.2	16.5	70.7	0.033	0.065	1	1	0.41	0.87
Selenium	0.006	0.0057	0.2	16.5	70.7	0.033	0.065	1	1	0.61	1.24
Silver	0.005	0.005	0.2	16.5	70.7	0.033	0.065	1	1	0.51	1.09

Parameter	Toxicity Reference Value (mg/kg BW-day)		Allocation Factor	Body Weight (kg BW)		Total Ingestion Rate (kg wet weight/day)		Relative Absorption Factor	Exposure Time	Risk-based Screening Benchmark Concentration for Subsistence Foods (mg/kg wet weight)	
	Toddler	Adult		Toddler	Adult	Toddler	Adult			Toddler	Adult
Strontium	0.6	0.6	0.2	16.5	70.7	0.033	0.065	1	1	61	130
Thallium	0.000088	0.000025	0.2	16.5	70.7	0.033	0.065	1	1	0.0089	0.005
Tin	0.2	0.2	0.2	16.5	70.7	0.033	0.065	1	1	20	43
Tungsten	0.0008	0.0008	0.2	16.5	70.7	0.033	0.065	1	1	0.081	0.17
Uranium	0.0006	0.0006	0.2	16.5	70.7	0.033	0.065	1	1	0.061	0.130
Vanadium	0.00504	0.00504	0.2	16.5	70.7	0.033	0.065	1	1	0.51	1.10
Zinc	0.48	0.57	0.2	16.5	70.7	0.033	0.065	1	1	49	124