APPENDIX D FOOD CHAIN MODEL AND PREDICTED CONCENTRATIONS OF CONTAMINANTS OF POTENTIAL CONCERN IN THE TISSUES OF SUBSISTENCE FOOD SPECIES

Appendix D: Food Chain Model and Predicted Concentrations of Contaminants of Potential Concern in the Tissues of Subsistence Food Species

1. INTRODUCTION

Concentrations of contaminants of potential concern (COPCs) in the tissues of subsistence food species were estimated using a food chain model. The subsistence food species include: Northwestern moose (*Alces alces*), mule deer (*Odocoileus hemionus*), American black bear (*Ursus americanus*), snowshoe hare (*Lepus americanus*), and blue grouse *(Dendragapus* ssp).

The food chain model predicts COPC concentrations in animal tissue by estimating the fraction of COPCs that are retained in the tissues when wildlife ingests environmental media such as vegetation, prey, soil, sediment, and surface water. The food chain model followed the methodology described in Golder Associates Ltd. (2005), which is recommended by Health Canada (2018). The modeled baseline and Project COPC concentrations in tissue were used in the Baseline and Project human health risk assessment (HHRA) to assess the potential for the subsistence foods to affect human health due to the Project.

2. METHODS

The following equation was used to predict COPC concentrations in animal tissue (C_{total} in mg/kg):

$$C_{total} = C_{m[soil]} + C_{m[water]} + C_{m[veg]} + C_{m[prey]} \quad \text{[Equation 1]}$$

where:

- $C_{m[soil]}$ = concentration in meat from exposure to COPCs in soil
- $C_{m[water]}$ = concentration in meat from exposure to COPCs in surface water
- $C_{m[veg]}$ = concentration in meat from exposure to COPCs in vegetation
- $C_{m[prey]}$ = concentration in meat from exposure to COPCs in prey

The wildlife uptake equations used to estimate the concentrations in animal tissue (meat) from exposure to soil or sediment, vegetation, prey, and water are presented in Table 1.

2.1 Biotransfer Factors

The tissue uptake calculations were based, in part, on COPC specific biotransfer factors (BTFs), which are rates at which COPCs are taken up and absorbed into wildlife tissue from their food. Food-to-tissue BTFs are used for water, sediment, and soil transfer calculations in the absence of BTFs for these media, as recommended by Golder Associates Ltd. (2005). No species-specific BTFs for the subsistence food species were available, therefore beef BTFs were used for mammals (Table 2; RAIS 2020; US EPA 2005). The use of beef BTFs for wild mammals is considered to be a conservative approach (RAIS 2020). There were no BTFs specifically for the avian wildlife species; therefore, chicken BTFs were used for bird species (RAIS 2020). The chicken BTFs were obtained from the Pacific Northwest National Laboratory's (PNNL) report and the US EPA (Staven et al. 2003; US EPA 2005). For COPCs without a published BTF, a BTF of 1 (100%) was assumed.

Table 1: Wildlife Uptake Equations for Contaminants of Potential Concern

Pathway	Equation and Parameters
Generic Equation	$C_{m[media]} = BTF * C * IR * ET * fw$
Ingestion Equations:	
Soil Ingestion	$C_{m[soil]} = BTF_{tissue-food} * C_{soil} * IR_{soil} * ET * fw$
Vegetation ingestion	$C_{m[veg]} = BTF_{tissue-food} * C_{veg} * IR_{veg} * ET * fw$
Prey Ingestion	$C_{m[prey]} = BTF_{tissue-food} * C_{prey} * IR_{prey} * ET * fw$
Water Ingestion	$C_{m[water]} = BTF_{tissue-food} * C_{water} * IR_{water} * ET * fw$

Notes:

$C_{m[media]}$ = concentration of COPCs in wildlife tissue (mg/kg wet weight) from ingestion of environmental media (e.g., soil, vegetation, prey, water)

$BTF_{tissue-food}$ = biotransfer factor for the wildlife species and COPC (day/kg)

$C_{[media]}$ = COPC concentration in soil, vegetation, prey, or water (mg/kg or mg/L)

$IR_{soil/veg/prey/water}$ = daily ingestion rate of environmental media for wildlife species (kg/day or L/day)

ET = exposure time spent in the area for wildlife species (unitless)

fw = fraction of daily consumption for wildlife species (assumed 1; unitless)

Table 2: Biotransfer Factors Used to Predict Uptake of Contaminants of Potential Concern into Wildlife Tissues

Parameter	Dietary BTF for Mammals (d/kg wet weight tissue)		Dietary BTF for Birds (d/kg wet weight tissue)	
	BTF_{beef}	Reference	$BTF_{poultry}$	Reference
Aluminum	0.0015	1	1	n/a
Antimony	0.001	1,2,3	0.006	2
Arsenic	0.002	1,2,3	0.83	2
Barium	0.0002	2	0.009	2
Beryllium	0.001	1,2,3	0.4	2
Bismuth	0.0004	2	0.098	2
Boron	0.0008	1	1	n/a
Cadmium	0.00055	1	0.8	2
Calcium	0.002	2	0.04	2
Chromium	0.009	2	0.2	2
Cobalt	0.02	1	2	2
Copper	0.01	1	0.5	2
Iron	0.02	1,2	1	2
Lead	0.0004	1,2	0.8	2
Lithium	0.01	1	1	n/a
Magnesium	0.02	2	0.03	2
Manganese	0.0005	2	0.05	2

Parameter	Dietary BTF for Mammals (d/kg wet weight tissue)		Dietary BTF for Birds (d/kg wet weight tissue)	
	BTF_{beef}	Reference	$BTF_{poultry}$	Reference
Mercury	0.25	1,2	0.03	2
Molybdenum	0.006	1	0.18	2
Nickel	0.006	1,3	0.001	2
Potassium	0.02	1,2	0.4	2
Selenium	0.015	1,2	9	2
Silver	0.003	1,3	2	2
Sodium	0.08	2	0.01	2
Strontium	0.008	2	0.08	2
Thallium	0.04	1,2,3	0.8	2
Tin	0.08	2	0.8	2
Uranium	0.0003	2	1	2
Vanadium	0.0025	1	1	n/a
Zinc	0.1	1,2	7	2

Notes:

BTF = Biotransfer Factor

References:

[1.] RAIS (2020) Chemical Parameters - Beef Transfer Coefficient. The Risk Assessment Information System. https://rais.ornl.gov/index.html (accessed July 2020).

[2.] Staven et al. (2003) A Compendium of Transfer Factors for Agricultural and Animal Products. Prepared for the U.S. Department of Energy. Pacific Northwest National Laboratory, Richland, WA

[3.] US EPA (2005) Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities. EPA520-R-05-006. United States Environmental Protection Agency, Office of Solid Waste and Emergency Response: Washington, DC.

n/a means that no BTF was available, so the BTF was assumed to be 1.

Food chain models can over- or under-predict contaminant concentrations in the tissues of wildlife species, and the concentrations predicted with the Golder Associates Ltd. (2005) food chain model are for the whole-body and are not tissue specific. However, people frequently consume the liver and kidney of moose and deer, which may have much higher metal concentrations than other tissues. Therefore, to obtain liver and kidney tissue concentrations for these ungulates, tissue distribution ratios were applied to the predicted whole-body tissue concentrations based on muscle, liver, and kidney concentrations in moose, deer, elk, and “bovine” tissue reported in peer reviewed literature. Tissue distribution ratios were calculated based on data provided in the following studies:

- Rescan Environmental Services Ltd. (Rescan). 2008. *Schaft Creek Tahltan (Country) Foods Baseline Assessment*. Prepared for Copper Fox Metals Inc., April 2008.
- L. Chan, O. Receveur, D. Sharp, H. Schwartz, A. Ing and C. Tikhonov. 2011. *First Nations Food, Nutrition and Environment Study (FNFNES): Results from British Columbia (2008/2009)*. Prince George: University of Northern British Columbia, 2011. (Data were obtained from pooled food samples collected from all participating BC communities.)

- M. Hashemi. 2018. Heavy metal concentrations in bovine tissues (muscle, liver and kidney) and their relationship with heavy metal contents in consumed feed. *Ecotoxicology and Environmental Safety* 154: 263–267

BTFs were calculated based on the geometric mean of wet weight concentrations, except in Chan (2011), where arithmetic mean concentrations were used. Tissue distribution ratios (or BTFs) for liver and kidney tissue were obtained by dividing the muscle concentration by the liver or kidney concentrations, respectively. Tissue distribution ratios for organs could not be calculated for COPCs that were not measured in both muscle and kidney or liver; therefore, those COPCs were assumed to have a tissue distribution ratio of one, based on a lack of data to determine appropriate distribution ratios for organs compared to muscle. The tissue distribution ratios presented in Table 3 were used to estimate organ meat (i.e., liver and kidney tissue) concentrations based on predicted whole-body concentrations by dividing the predicted whole body concentration by the COPC-specific BTFs.

2.2 Concentrations of Contaminants of Potential Concern in Environmental Media and Biota

A summary of the data used as inputs into the food chain model for vegetation, soil, water, and fish and prey tissue quality for Baseline, Operation, and Closure phases are presented in Tables 4, 5, and 6.

The data used for Baseline surface water quality was the 95th percentile of all P50 concentrations from the base case input to the surface water quality model from 11 surface water quality model nodes (**S4-C3, Appendix 1-M** (Tenas Water and Load Balance Technical Report)).

Project surface water quality was the maximum of the maximum of the annual 95% UCLM of the EA16 scenario water quality predictions (**S4-C3, Appendix 1-M** (Tenas Water and Load Balance Technical Report)).

Data used for Baseline soil quality was the 95% UCLM soil concentration of 30 surface soil samples collected from within the human health LSA that were outside of the future Project footprint (i.e., not under Mine Site infrastructure, roads, or the rail loadout). Data were used to predict the tissue concentrations of COPCs in moose, deer, black bear, snowshoe hare, and grouse under Baseline conditions.

Future conditions COPC concentrations in soil were based on COPC-in-dust deposition rates estimated from the air dispersion model (**S4-C1, Appendix 4.1-B**) and were calculated as recommended by the US EPA (US EPA 2005) as described in the **HHRA, Section 3.4.1** .

Baseline fish tissue samples included 101 rainbow trout muscle collected from eight locations along Tenas Creek, Four Creek, Goathorn Creek, Telkwa River, and the Bulkely River **(S4-C6, Appendix 4.6-A)**. The 95% UCLM of COPC concentrations in fish tissue were used in the food chain model as a diet item for piscivorous and omnivorous subsistence food species like the American black bear.

Future conditions COPC concentrations in fish tissues were based on predicted water COPC concentrations and the fish tissue biotransfer factor (BTF), as described in the **HHRA, Section 3.4.6.**

The vegetation baseline sampling programs included the collection of tissue metal samples from within the human health LSA. The species sampled included a wide variety of berry species (soopolallie, black twinberry, highbush cranberry, devils club, black gooseberry, red raspberry, red elderberry; n=21) and a mix of stems and leaves of scouler's willow, tea-leafed willow, Alaska willow, grey-leafed willow, subalpine fir, black cottonwood, alder, Western-mountain ash, red osier dogwood, red elderberry, bluejoint reedgrass, fireweed, common horsetail, beaked sedge, cow parsnip, devils club, black twinberry, and prickly rose (n=129). The vegetation tissue metal samples were used to support food chain modeling of herbivorous and omnivorous subsistence food species like deer.

Table 3: Muscle to Organ BTFs in Moose, Deer, Elk, and Bovines Based on the Mean of Measured Tissue Concentrations (mg/kg wet weight)

Study:	Moose, Schaft Creek 2007[a]		Moose, Chan (2011)[c]		Deer, Chan (2011)[c]	Elk, Chan (2011)[c]		Bovines, 2018[b]		Maximum BTF from Literature	
Chemical	Muscle to Liver	Muscle to Kidney	Muscle to Liver	Muscle to Kidney	Muscle to Liver	Muscle to Liver	Muscle to Kidney	Muscle to Liver	Muscle to Kidney	Muscle to Liver	Muscle to Kidney
Aluminum	2.13	2.35								2.125	2.346
Antimony	0.755	0.784								0.755	0.784
Arsenic	0.528	0.886	0.100	0.133	0.333					0.528	0.886
Barium	1.05	0.54								1.047	0.543
Beryllium	1	1								1.000	1.000
Bismuth	0.918	1.162								0.918	1.162
Cadmium	0.005466	0.001131	0.00570	0.00169	0.02222	0.045	0.333	0.739	0.405	0.739	0.405
Calcium	1.5	0.83								1.454	0.829
Chromium	1.10	1.4								1.099	1.428
Cobalt	0.0935	0.184								0.094	0.184
Copper	0.0160	0.2388						0.244	0.326	0.244	0.326
Lead	0.520	0.121	3.00	0.353	149		0.667	0.855	0.975	149.0	0.975
Lithium	1.28	1.31								1.276	1.313
Magnesium	1	1								1.000	1.000
Manganese	1.38	1.53								1.378	1.530
Mercury	0.082	0.120	0.667	0.200	0.200					0.667	0.200
Molybdenum	0.81	0.186								0.806	0.186
Nickel	0.0067	0.0215								0.007	0.021
Selenium	0.82	0.83								0.816	0.835
Strontium	0.1345	0.0889								0.135	0.089

Study:	Moose, Schaft Creek 2007[a]		Moose, Chan (2011)[c]		Deer, Chan (2011)[c]	Elk, Chan (2011)[c]		Bovines, 2018[b]		Maximum BTF from Literature	
Thallium	1.5	0.73								1.521	0.725
Tin	1	1								1.000	1.000
Uranium	1	1								1.259	1.259
Vanadium	1	1								1.000	1.000
Zinc	2.14	1.41						0.946	2.37	2.144	2.370

Notes:

[a] Rescan Environmental Services Ltd. (Rescan). 2008. Schaft Creek Tahltan (Country) Foods Baseline Assessment. Prepared for Copper Fox Metals Inc., April 2008.

[b] M. Hashemi. 2018. Heavy metal concentrations in bovine tissues (muscle, liver and kidney) and their relationship with heavy metal contents in consumed feed. Ecotoxicology and Environmental Safety 154: 263–267

[c] L. Chan, O. Receveur, D. Sharp, H. Schwartz, A. Ing and C. Tikhonov. 2011. First Nations Food, Nutrition and Environment Study (FNFNES): Results from British Columbia (2008/2009). Prince George: University of Northern British Columbia, 2011. (Data were from pooled food samples collected from all participating BC communities.)

BTFs were calculated based on the geometric mean of wet weight concentrations, except in Chan (2011), where arithmetic mean concentrations were used.

Table 4: Baseline Concentrations of Contaminant of Potential Concern in Surface Water, Soil, Vegetation, and Fish and Prey Tissues

Parameter	Environmental Media		Diet Items				
	Baseline Surface Water Concentration (95th Percentile of P50; mg/L)	95% UCLM Soil Concentration (mg/kg dry weight)	95% UCLM Fish Concentration (mg/kg wet weight)	95% UCLM Berry Concentration (mg/kg wet weight)	95% UCLM Leaves/Stems Concentration (mg/kg wet weight)	Predicted Small Mammals	Predicted Large Mammals
Aluminum	0.0982	19404	52.5	0.79	10.68	0.0066	0.138
Arsenic	0.000465	9.24	0.0911	0.003180492	0.016493555	0.0000144	0.0131
Barium	0.0495	254	2.125	2.631828976	22.027743247	0.0018561	0.120
Boron	0.00983	3.0	0.113	3.409952463	11.263345994	0.0040781	0.261
Cadmium	0.00000725	0.462	0.0726	0.014698146	0.085810639	0.00002029	0.00629
Chromium	0.000258	24.8	0.0896	0.007231608	0.095687182	0.00036	0.0232
Cobalt	0.000050	12.5	0.1018	0.003782405	0.055501180	0.00046	0.0298
Iron	0.114	36438	96.8	4.013949695	33.553561786	0.28	18.3
Lithium	0.000833	13.5	0.0577	0.08419	0.08419	0.000483	0.0299
Manganese	0.00740	1079	9.16	13.632890799	53.267016886	0.0118	0.760
Mercury	0.0000025	0.0562	0.0323	0.002808558	0.003929877	0.000514	0.0111
Molybdenum	0.000291	0.85	0.0156	0.157125270	0.287368102	0.000853	0.1
Nickel	0.000250	20.8	0.0831	0.186629467	0.536509068	0.00148	0.0946
Selenium	0.0000463	0.177	2.40	0.020	0.044	0.00032	0.139
Strontium	0.109	59.4	4.78	2.660923593	35.764351789	0.118	7.69
Thallium	0.000005	0.070	0.00414	0.000699223	0.000997641	0.0000208	0.00130
Zinc	0.00150	108.4	22.1	2.279378703	14.603006515	0.624	26.6

Table 5: Predicted Operations Concentrations of Contaminant of Potential Concern in Surface Water, Soil, Vegetation, and Fish and Prey Tissues

Parameter	Environmental Media		Predicted Concentration in Diet Items (mg/kg wet weight)				
	Maximum of Annual 95% UCLM Water Concentration (mg/L)	95% UCLM Soil Concentration (mg/kg dry weight)	Fish	Berries	Leaves/Stems	Small Mammals	Large Mammals
Aluminum	0.108	19501	62.9	3.77	14.36	0.00820	0.170
Arsenic	0.000507	9.64	0.106	0.004929064	0.018681923	0.0000159	0.0144
Barium	0.0522	256	2.48	2.67447353726	22.134297274	0.00187	0.121
Boron	0.0141	16.9	0.352	3.465414824	11.441896145	0.0119	0.746
Cadmium	0.00000905	0.532	0.0984	0.014853758	0.086288211	0.0000216	0.00668
Chromium	0.000316	25.6	0.168	0.014085861	0.104570589	0.000383	0.0248
Cobalt	0.0000735	12.7	0.151	0.005741836	0.058063874	0.000474	0.0308
Iron	0.141	36585	133	9.317489831	40.127663404	0.320	20.7
Lithium	0.00323	13.5	0.794	0.08419029	0.084190286	0.000486	0.0302
Manganese	0.00903	1087	10.5	13.778366769	53.526715490	0.0119	0.764
Mercury	0.00000238	0.1278	0.0321	0.004623962	0.006313965	0.000988	0.0213
Molybdenum	0.00036	0.923	0.3567	0.158434502	0.289600455	0.00089	0.056
Nickel	0.000340	21.6	0.102	0.191586439	0.543867210	0.00152	0.0968
Selenium	0.000153	1.568	2.40	0.020	0.045	0.00141	0.608
Strontium	0.127	62.8	6.53	2.677014191	35.879239727	0.121	7.87
Thallium	0.00000683	0.227	0.0113	0.004128914	0.005313632	0.0000911	0.00570
Zinc	0.00170	118.9	26.0	2.300039265	14.661041200	0.649	27.7

Table 6: Predicted Closure Concentrations of Contaminant of Potential Concern in Surface Water, Soil, Vegetation, and Fish and Prey Tissues

Parameter	Environmental Media		Predicted Concentrations in Diet Items (mg/kg wet weight)				
	Maximum of Annual 95% UCLM Water Concentration (mg/L)	95% UCLM Soil Concentration (mg/kg dry weight)	Fish	Berries	Leaves/Stems	Small Mammals	Large Mammals
Aluminum	0.115	19501	67.1	0.79	10.72	0.00667	0.139
Arsenic	0.000869	9.64	0.2393	0.00	0.02	0.0000148	0.0134
Barium	0.0538	256	2.488	2.64	22.091	0.00187	0.121
Boron	0.0462	16.9	0.535	3.46	11.44	0.0119	0.746
Cadmium	0.0000332	0.532	0.3765	0.01	0.09	0.0000215	0.00667
Chromium	0.000585	25.6	0.2385	0.01	0.10	0.000362	0.0235
Cobalt	0.000813	12.7	1.2131	0.00	0.06	0.000463	0.0302
Iron	0.132	36585	137.5	4.03	33.66	0.284	18.4
Lithium	0.0253	13.5	3.5227	0.08	0.08	0.000513	0.0331
Manganese	0.0179	1087	38.02	13.66	53.39	0.0119	0.763
Mercury	0.00000248	0.13	0.0323	0.00	0.01	0.000912	0.0196
Molybdenum	0.00168	0.923	0.5630	0.16	0.29	0.001	0.056
Nickel	0.00156	21.6	0.3702	0.19	0.54	0.00151	0.0963
Selenium	0.00128	1.568	2.40	0.02	0.04	0.00141	0.609
Strontium	0.310	62.8	17.73	2.67	35.87	0.121	7.89
Thallium	0.000245	0.227	0.417	0.00	0.00185	0.0000533	0.00338
Zinc	0.00245	118.9	40.0	2.29	14.64	0.649	27.6

The vegetation COPC concentration used in the food chain model was the 95% UCLM concentration of COPCs in the berries and stems/leaves collected. The vegetation diet items for the wildlife species that required food chain modeling were limited to the vegetation species that were available for collection at the time of sampling; thus, they may not entirely represent the actual diet of these wildlife species. Furthermore, diets shift during the year (e.g., due plant abundance during the growing season versus winter) whereas the model uses a generalized diet for the year. Therefore, there are several assumptions for the diet composition of the subsistence food species modeled and best professional judgement was used in the diet determination. Uncertainties with the use of the vegetation data are presented in the Uncertainty Section (Section 7) of the HHRA.

Modelled small and large mammal tissue COPC concentrations were used as a diet input for carnivorous or omnivorous subsistence food species, like the American black bear.

2.3 Wildlife Characteristics

Wildlife characteristics are species-specific parameters that were used to estimate the amount of time an animal would spend in the human Health LSA and the amount of environmental media that each species would be exposed to during that time. Table 7 presents the species-specific characteristics that were used to predict subsistence food concentrations of COPCs.

Concentrations of COPCs in tissue were not measured in prey species (except for Baseline fish); thus, tissue concentrations in prey species were modeled and used as diet items for carnivores and omnivores. Only the wildlife subsistence foods were considered as prey species which is a simplification of the food chain. The diet items of the species included in the assessment is provided in Table 7.

Ingestion rates for different wildlife species were obtained from Environment Canada (2012).
The calculations required the percent moisture of the food items, which was obtained from site-specific data (for berries, vegetation, and fish) or from literature values (mammals), and is presented in Table 7.

3. SAMPLE CALCULATION AND MODEL RESULTS

To calculate the amount of COPCs that each ingestion pathway contributes, an equation for all ingestion routes is presented in Table 8, followed by media specific equations. Table 8 also provides a sample calculation for aluminum concentration in moose tissue resulting from ingesting soil, water, and vegetation during baseline conditions. As described in Section 2.1, the food chain model predicts whole-body tissue concentrations; therefore, Table 8 also provides a sample calculation for the calibrated muscle, liver, and kidney tissue aluminum concentration in moose. Calibration factors are based on the mean tissue concentration for caribou and bovine tissues available from literature sources (Aastrup et al. 2000; Chan et al. 2011; Gamberg et al. 2016; Hashemi 2018; Table 9).

Tables 10 to 15 present the modeled concentrations of COPCs in tissue of subsistence food species for the Baseline, Operations, and Closure conditions, respectively. Each ingestion pathway (i.e., soil, water, prey, and vegetation) contributes to the total concentration of COPCs in these species. The baseline concentrations of COPCs modeled in subsistence food tissue were used in the existing conditions HHRA to calculate the estimated daily intake of COPCs for people who eat these foods from within the human health LSA.

Table 7: Wildlife Receptor Characteristics, Diet Items, and Proportions

Receptor Common Name	Foraging Guild	Foraging Range (km^2)	Adjustment for Foraging Range	Seasonal User	Exposure Time	Average Body Weight (kg)	Diet Proportions					Food Ingestion Rate (kg dry food/ kg BW/d)	Food Ingestion Rate (kg dry food/d)	Food Ingestion Rate (kg wet food/ kg BW/d)	Food Ingestion Rate (kg wet food/d)	Water Ingestion Rate (L/kg BW/d)	Water Ingestion Rate (L/day)	Soil Ingestion Rate (kg dw/d)	Data Source
							Fish	Berries	Terrestrial Plants	Small Mammals	Large Mammals								
Northwestern moose	Herbivore	4.6	1	No	1	400	0	0	1	0	0	0.0200	8.0	0.07	28	0.054	22	0.6	EC 2012
Mule Deer	Herbivore	0.3	1	No	1	75	0	0.1	0.9	0	0	0.027	2.0	0.10	7	0.06	4.8	0.15	EC 2012
American black bear	Omnivore/ piscivore/ carnivore	3	1	Yes	0.5	68	0.05	0.5	0.325	0.075	0.05	0.032	2.2	0.14	10	0.06	4.4	0.19	EC 2012
Blue grouse	Herbivore	0.03	1	No	1	0.6	0	0.3	0.7	0	0	0.070	0.042	0.28	0.17	0.07	0.042	0.0034	EC 2012
Snowshoe hare	Herbivore	0.016	1	No	1	1.3	0	0.1	0.9	0	0	0.060	0.0780	0.220	0.29	0.096	0.125	0.018	EC 2012
Moisture Content of Food Item							78.4	80.8	71.4	65	65	-	-	-	-	-	-	-	

Data Source:

Environment Canada. 2012. Federal Contaminated Sites Action Plan (FCSAP) Ecological Risk Assessment Guidance. Module 3: Standardization of Wildlife Receptor Characteristics. Gatineau, QC.

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Table 8: Sample Calculation of Aluminum Concentration in Moose Tissue due to Uptake from Soil, Surface Water, and Vegetation in Project Case (Operations)

Overall Equation		
$C_{total}=C_{m[soil]}+C_{m[veg]}+C_{m[water]}$		
where:		
Soil Ingestion		$C_{m[soil]}=BTF_{soil\text{-}tissue}*C_{soil}*IR_{soil}*FRF*fw$
Vegetation ingestion		$C_{m[veg]}=BTF_{food\text{-}tissue}*C_{veg}*IR_{veg}*FRF*fw$
Water Ingestion		$C_{m[water]}=BTF_{food\text{-}tissue}*C_{water}*IR_{water}*FRF*fw$
Parameters:		
C_{total}	=	Total concentration of COPC (aluminum) in animal tissue (moose) from all ingestion pathways (mg/kg)
$C_{m[veg]}$	=	Total concentration of COPC (aluminum) in animal tissue (moose) from vegetation ingestion (mg/kg)
$C_{m[soil]}$	=	Total concentration of COPC (aluminum) in animal tissue (moose) from soil ingestion (mg/kg)
$C_{m[water]}$	=	Total concentration of COPC (aluminum) in animal tissue (moose) from water ingestion (mg/kg)
$BTF_{food\text{-}tissue}$	=	Biotransfer factor (d/kg) from food consumption to tissues for a selected COPC. This BTF is also used for $BTF_{tissue\text{-}water}$.
$BTF_{soil\text{-}tissue}$	=	Biotransfer factor from incidental soil ingestion to tissues for a selected COPC. The $BTF_{soil\text{-}tissue}$ is calculated as: $$BTF_{soil\text{-}tissue}=\frac{BCF_{soil\text{-}veg}}{IR_{soil}}\times BTF_{food\text{-}tissue}*IR_{veg}$$
$C_{m[media]}$	=	COPC concentration in media (mg/kg)
$IR_{soil/veg/water}$	=	Ingestion rate of media (i.e., soil, vegetation, or water; kg/day or L/day)
FRF	=	Foraging range factor, which represents the proportion of the site area that overlaps with the territory or foraging range of the species (unitless)
Fw	=	Fraction of daily consumption for animal (assumed 1; unitless)
Sample Calculation for Muscle Tissue Concentration:		
$C_{m[veg]}$	=	(0.0015 day/kg) x (14.4 mg/kg) x (28 kg/day) x 1 x 1 = 0.605 mg/kg
$C_{m[soil]}$	=	(0.000022 day/kg) x (19501 mg/kg) x (0.559 kg/day) x 1 x 1 = 0.240 mg/kg
$C_{m[water]}$	=	(0.0015 day/kg) x (0.108 mg/L) x (22 L/day) x 1 x 1 = 0.0036 mg/kg
C_{total}	=	(0.605 mg/kg + 0.240 mg/kg + 0.0036 mg/kg) = 0.849 mg/kg
CF_i	=	Calibration factor for model for COPC i $$CF_i = \frac{\text{Mean moose whole body concentration from literature}}{C_{total}\ at\ Baseline}$$ $$CF_{Al} = \frac{0.145\ {}^{mg}/_{kg}}{0.691\ {}^{mg}/_{kg}} = 0.2$$
Calibrated C_{total}	=	$$C_{total} = \left(C_{m[soil]} + C_{m[veg]} + C_{m[water]}\right) \times CF_i$$ C_{total} = 0.849 mg/kg x 0.2 = 0.170 mg/kg
Sample Calculation for Concentrations in Liver and Kidney Tissue Using the Tissue Distribution Ratio:		
C_{liver}	=	C_{total} / liver distribution ratio = 0.170 mg/kg / 2.125 = 0.0799 mg/kg
C_{kidney}	=	C_{total} / kidney distribution ratio = 0.170 mg/kg / 2.346 = 0.0725 mg/kg

Note:

Values in this table may differ slightly from final results in other tables due to rounding of numbers used in calculations.

Table 9: Calibration Factors for Concentrations of Contaminants of Potential Concern in Moose and Deer Tissue based on Literature Data

Contaminant of Potential Concern	Moose			Mule Deer		
	Base Case Modelled Tissue Concentration (mg/kg wet weight)	Measured Tissue Concentration (mg/kg wet weight)	Calibration Factor	Base Case Modelled Tissue Concentration (mg/kg wet weight)	Measured Tissue Concentration (mg/kg wet weight)	Calibration Factor
Aluminum	0.692	0.145	0.2	0.848	0.1	0.8
Arsenic	0.00149	0.0130	8.7	0.00164	0.0130	35
Barium	0.192	NA	1	0.194	NA	1
Boron	0.416	NA	1	1.18	NA	1
Cadmium	0.00209	0.00627	3	0.00222	0.00627	12
Chromium	0.0371	NA	1	0.0340	NA	1
Cobalt	0.0476	NA	1	0.0494	NA	1
Iron	29.3	NA	1	33.1	NA	1
Lithium	0.0473	NA	1	0.0477	NA	1
Manganese	1.21	NA	1	1.22	NA	1
Mercury	0.0510	0.0119	0.2	0.100	0.0119	0.9
Nickel	0.151	NA	1	0.154	NA	1
Molybdenum	0.0856	NA	1	0.0221	NA	1
Selenium	0.0322	0.137	4.3	0.139	0.137	17
Strontium	30.4	NA	1	42.9	NA	1
Thallium	12.3	NA	1	12.6	NA	1
Zinc	0.00400	27.7	0.4	0.00494	27.7	1.7

Note:

Measured tissue concentrations are based on (Aastrup et al. 2000; Chan et al. 2011; Gamberg, Cuyler, and Wang 2016; Hashemi 2018).

Table 10: Modelled Concentrations of Contaminants of Potential Concern in Northwestern Moose under Baseline and Project Conditions

Contaminant of Potential Concern	Northwestern Moose Tissue Concentration (mg/kg wet weight)											
	Base Case				Project Case (Operations)				Project Case (Closure)			
	[COPC] from Water	[COPC] from Soil	[COPC] from Diet	Total [COPC] in Tissue	[COPC] from Water	[COPC] from Soil	[COPC] from Diet	Total [COPC] in Tissue	[COPC] from Water	[COPC] from Soil	[COPC] from Diet	Total [COPC] in Tissue
Aluminum	0.00320	0.241	0.448	0.138	0.00356	0.242	0.603	0.170	0.00423	0.242	0.450	0.139
Arsenic	0.0000202	0.000550	0.000923	0.0130	0.0000261	0.000574	0.00105	0.0143	0.0000712	0.000574	0.000926	0.0137
Barium	0.000215	0.0690	0.123	0.192	0.000222	0.0696	0.124	0.194	0.000231	0.0696	0.124	0.193
Boron	0.000171	0.164	0.252	0.416	0.000264	0.927	0.256	1.18	0.00105	0.927	0.256	1.18
Cadmium	0.0000000867	0.000773	0.00132	0.00628	0.000000209	0.000890	0.00133	0.00665	0.00000103	0.000890	0.00133	0.00665
Chromium	0.0000506	0.0130	0.0241	0.0371	0.0000586	0.0134	0.0263	0.0397	0.0000828	0.0134	0.0242	0.0377
Cobalt	0.0000218	0.0166	0.0310	0.0477	0.000115	0.0168	0.0325	0.0494	0.000974	0.0168	0.0312	0.0489
Iron	0.0494	10.5	18.8	29.3	0.0600	10.6	22.4	33.1	0.0582	10.6	18.8	29.4
Lithium	0.000181	0.0235	0.0235	0.0473	0.000729	0.0235	0.0235	0.0478	0.00586	0.0235	0.0235	0.0530
Manganese	0.0000805	0.468	0.745	1.21	0.0000936	0.471	0.749	1.22	0.000129	0.471	0.747	1.22
Mercury	0.0000136	0.0236	0.0275	0.0102	0.0000136	0.0536	0.0442	0.0196	0.0000136	0.0536	0.0366	0.0180
Molybdenum	0.0000380	0.0373	0.0482	0.0856	0.0000471	0.0407	0.0486	0.0893	0.000220	0.0407	0.0485	0.0894
Nickel	0.0000326	0.0607	0.0900	0.151	0.0000443	0.0629	0.0913	0.154	0.000204	0.0629	0.0904	0.154
Selenium	0.0000151	0.0135	0.0186	0.138	0.000104	0.120	0.0188	0.597	0.000945	0.120	0.0187	0.600
Strontium	0.0189	4.30	8.00	12.3	0.0221	4.55	8.03	12.60	0.0540	4.55	8.03	12.6
Thallium	0.00000435	0.000949	0.00112	0.00207	0.000213	0.00309	0.00595	0.00925	0.00177	0.00309	0.00206	0.00692
Zinc	0.00326	23.6	40.8	25.8	0.00358	25.9	41.0	26.8	0.00453	25.9	41.0	26.7

Notes:

All concentrations in mg/kg wet weight.

[COPC] = concentration of contaminant of potential concern

Table 11: Modelled Concentrations of Contaminants of Potential Concern in the Tissues of Mule Deer under Baseline and Project Conditions

Contaminant of Potential Concern	Mule Deer Tissue Concentration (mg/kg wet weight)											
	Base Case				Project Case (Operations)				Project Case (Closure)			
	[COPC] from Water	[COPC] from Soil	[COPC] from Diet	Total [COPC] in Tissue	[COPC] from Water	[COPC] from Soil	[COPC] from Diet	Total [COPC] in Tissue	[COPC] from Water	[COPC] from Soil	[COPC] from Diet	Total [COPC] in Tissue
Aluminum	0.000710	0.0637	0.108	0.138	0.000790	0.0641	0.148	0.170	0.000937	0.0641	0.108	0.138
Arsenic	0.00000448	0.000146	0.000225	0.0131	0.00000579	0.000152	0.000256	0.0145	0.0000158	0.000152	0.000225	0.0138
Barium	0.0000477	0.0183	0.0298	0.0481	0.0000492	0.0184	0.0299	0.0484	0.0000511	0.0184	0.0298	0.0483
Boron	0.0000379	0.0435	0.0621	0.106	0.0000585	0.245	0.0631	0.308	0.000233	0.245	0.0630	0.309
Cadmium	0.0000000192	0.000205	0.000321	0.00630	0.0000000463	0.000236	0.000322	0.00670	0.000000229	0.000236	0.000322	0.00669
Chromium	0.0000112	0.00343	0.00579	0.00923	0.0000130	0.00354	0.00637	0.00992	0.0000184	0.00354	0.00582	0.00938
Cobalt	0.00000482	0.00439	0.00745	0.0118	0.0000255	0.00445	0.00783	0.0123	0.000216	0.00445	0.00748	0.0121
Iron	0.0110	2.78	4.53	7.33	0.0133	2.79	5.49	8.29	0.0129	2.79	4.55	7.35
Lithium	0.0000402	0.00623	0.00623	0.0125	0.000162	0.00623	0.00623	0.0126	0.00130	0.00623	0.00623	0.0138
Manganese	0.0000178	0.124	0.183	0.306	0.0000207	0.125	0.183	0.308	0.0000287	0.125	0.183	0.308
Mercury	0.00000301	0.00624	0.00707	0.0120	0.00000301	0.0142	0.0114	0.0230	0.00000301	0.0142	0.00941	0.0212
Molybdenum	0.00000841	0.00988	0.0122	0.0221	0.00001045	0.0108	0.0123	0.0231	0.00004870	0.0108	0.0123	0.0231
Nickel	0.00000723	0.0161	0.0223	0.0384	0.00000982	0.0167	0.0226	0.0393	0.0000452	0.0167	0.0224	0.0391
Selenium	0.00000334	0.00359	0.00466	0.140	0.0000230	0.0317	0.00470	0.620	0.000210	0.0317	0.00469	0.623
Strontium	0.00419	1.14	1.92	3.07	0.00491	1.20	1.93	3.14	0.0120	1.20	1.93	3.14
Thallium	0.000000964	0.000251	0.000287	0.000539	0.0000473	0.000818	0.00154	0.00240	0.000393	0.000818	0.000530	0.00174
Zinc	0.000723	6.25	9.90	27.5	0.000794	6.86	9.94	28.6	0.00100	6.86	9.93	28.5

Notes:

All concentrations in mg/kg wet weight.

[COPC] = concentration contaminant of potential concern

Table 12: Modelled Concentrations of Contaminants of Potential Concern in Kidney and Liver of Moose and Mule Deer under Baseline and Project Conditions

Contaminant of Potential Concern	Base Case				Operation Case				Closure Case			
	Moose		Mule Deer		Moose		Mule Deer		Moose		Mule Deer	
	[COPC] in Liver	[COPC] in Kidney	[COPC] in Liver	[COPC] in Kidney	[COPC] in Liver	[COPC] in Kidney	[COPC] in Liver	[COPC] in Kidney	[COPC] in Liver	[COPC] in Kidney	[COPC] in Liver	[COPC] in Kidney
Aluminum	0.0651	0.0590	0.0648	0.0587	0.0798	0.0723	0.0800	0.0725	0.0655	0.0593	0.0651	0.0590
Arsenic	0.0172	0.0103	0.0174	0.0104	0.0190	0.0113	0.0192	0.0114	0.0180	0.0107	0.0181	0.0108
Barium	0.184	0.355	0.046	0.089	0.185	0.357	0.046	0.089	0.185	0.356	0.046	0.089
Boron	0.416	0.416	0.106	0.106	1.18	1.18	0.308	0.308	1.18	1.18	0.309	0.309
Cadmium	0.00850	0.0155	0.00853	0.0156	0.00900	0.0164	0.00906	0.0165	0.00900	0.0164	0.00906	0.0165
Chromium	0.0338	0.0260	0.00840	0.00646	0.0362	0.0278	0.00902	0.00695	0.0343	0.0264	0.00853	0.00657
Cobalt	0.510	0.260	0.127	0.065	0.528	0.269	0.131	0.067	0.520	0.265	0.129	0.066
Copper	11.1	8.32	11.8	8.83	25.4	19.0	27.6	20.7	25.4	19.0	27.5	20.7
Iron	29.3	29.3	7.33	7.33	33.1	33.1	8.29	8.29	29.4	29.4	7.35	7.35
Lithium	0.0371	0.0360	0.00981	0.00953	0.0374	0.0363	0.00988	0.00960	0.0404	0.0392	0.0105	0.0102
Manganese	0.880	0.793	0.222	0.200	0.885	0.797	0.224	0.201	0.884	0.796	0.223	0.201
Mercury	0.0153	0.0511	0.0180	0.0599	0.0293	0.0978	0.0345	0.115	0.0271	0.0902	0.0319	0.106
Molybdenum	0.106	0.461	0.0274	0.119	0.111	0.481	0.0286	0.124	0.111	0.482	0.0286	0.124
Nickel	22.5	7.02	5.73	1.79	23.0	7.18	5.86	1.83	22.9	7.16	5.84	1.82
Selenium	0.170	0.166	0.172	0.168	0.731	0.715	0.759	0.743	0.734	0.718	0.762	0.745
Strontium	91.6	138.5	22.8	34.5	93.7	142	23.3	35.3	94.1	142.4	23.4	35.4
Thallium	0.00136	0.00285	0.00035	0.000743	0.00597	0.01252	0.00156	0.00326	0.00368	0.00773	0.000952	0.00200
Zinc	12.0	10.9	12.8	11.6	12.5	11.3	13.3	12.0	12.5	11.3	13.3	12.0

Notes:

All concentrations in mg/kg wet weight.

[COPC] = concentration contaminant of potential concern

Table 13: Modelled Concentrations of Contaminants of Potential Concern in the Tissues of American Black Bear under Baseline and Project Conditions

Contaminant of Potential Concern	American Black Bear Tissue Concentration (mg/kg wet weight)											
	Base Case				Project Case (Operations)				Project Case (Closure)			
	[COPC] from Water	[COPC] from Soil	[COPC] from Diet	Total [COPC] in Tissue	[COPC] from Water	[COPC] from Soil	[COPC] from Diet	Total [COPC] in Tissue	[COPC] from Water	[COPC] from Soil	[COPC] from Diet	Total [COPC] in Tissue
Aluminum	0.000325	0.0411	0.0465	0.0879	0.000362	0.0413	0.0701	0.112	0.000429	0.0413	0.0580	0.0997
Arsenic	0.00000205	0.0000939	0.000116	0.000212	0.00000265	0.0000980	0.000192	0.000293	0.00000723	0.0000980	0.000274	0.000379
Barium	0.0000219	0.0118	0.00819	0.0200	0.0000225	0.0119	0.00827	0.0202	0.0000234	0.0119	0.00824	0.0201
Boron	0.0000174	0.0280	0.0206	0.0486	0.0000268	0.158	0.0210	0.179	0.000107	0.158	0.0211	0.179
Cadmium	0.00	0.000132	0.000103	0.000235	0.0000000212	0.000152	0.000121	0.000273	0.000000105	0.000152	0.000203	0.000355
Chromium	0.00000513	0.00221	0.00173	0.00395	0.00000595	0.00228	0.00213	0.00441	0.00000840	0.00228	0.00190	0.00419
Cobalt	0.00000221	0.00283	0.00253	0.00536	0.0000117	0.00287	0.00709	0.00997	0.0000989	0.00287	0.0143	0.0173
Iron	0.00502	1.79	1.78	3.58	0.00608	1.80	2.43	4.23	0.00590	1.80	2.01	3.81
Lithium	0.0000184	0.00402	0.00352	0.00756	0.0000740	0.00402	0.00541	0.00950	0.000595	0.00402	0.0122	0.0168
Manganese	0.00000817	0.0798	0.0587	0.139	0.00000949	0.0804	0.0593	0.140	0.0000131	0.0804	0.0599	0.140
Mercury	0.00000138	0.00402	0.00584	0.00986	0.00000138	0.00914	0.00849	0.0176	0.00000138	0.00914	0.00744	0.0166
Molybdenum	0.00000385	0.0064	0.0050	0.0114	0.00000478	0.0069	0.0056	0.0125	0.0000223	0.0069	0.0058	0.0128
Nickel	0.00000331	0.0104	0.00792	0.0183	0.00000450	0.0107	0.00809	0.0188	0.0000207	0.0107	0.00837	0.0191
Selenium	0.00000153	0.00231	0.0108	0.0132	0.0000106	0.0205	0.0125	0.0330	0.0000959	0.0205	0.0132	0.0338
Strontium	0.00192	0.733	0.519	1.25	0.00225	0.776	0.524	1.30	0.00548	0.776	0.545	1.33
Thallium	0.000000441	0.000162	0.000181	0.000343	0.0000217	0.000527	0.000856	0.00140	0.000180	0.000527	0.00468	0.00538
Zinc	0.000331	4.03	3.99	8.02	0.000364	4.42	4.11	8.53	0.000460	4.42	4.28	8.70

Notes:

All concentrations in mg/kg wet weight.

[COPC] = concentration contaminant of potential concern

Table 14: Modelled Concentrations of Contaminants of Potential Concern in the Tissues of Snowshoe Hare under Baseline and Project Conditions

Contaminant of Potential Concern	Snowshoe Hare Tissue Concentration (mg/kg wet weight)											
	Base Case				Project Case (Operations)				Project Case (Closure)			
	[COPC] from Water	[COPC] from Soil	[COPC] from Diet	Total [COPC] in Tissue	[COPC] from Water	[COPC] from Soil	[COPC] from Diet	Total [COPC] in Tissue	[COPC] from Water	[COPC] from Soil	[COPC] from Diet	Total [COPC] in Tissue
Aluminum	0.0000185	0.00246	0.00416	0.00664	0.0000205	0.00247	0.00571	0.00820	0.0000244	0.00247	0.00417	0.00667
Arsenic	0.000000117	0.00000563	0.00000868	0.0000144	0.000000151	0.00000587	0.00000990	0.0000159	0.000000410	0.00000587	0.00000871	0.0000150
Barium	0.00000124	0.000705	0.00115	0.00186	0.00000128	0.000711	0.00116	0.00187	0.00000133	0.000711	0.00115	0.00187
Boron	0.000000986	0.00168	0.00240	0.00408	0.00000152	0.00948	0.00244	0.0119	0.00000605	0.00948	0.00244	0.0119
Cadmium	0.00	0.00000791	0.0000124	0.0000203	0.00	0.00000911	0.0000125	0.0000216	0.00	0.00000911	0.0000124	0.0000215
Chromium	0.000000291	0.000132	0.000224	0.000356	0.000000338	0.000137	0.000246	0.000383	0.000000477	0.000137	0.000225	0.000362
Cobalt	0.000000125	0.000170	0.000288	0.000458	0.000000664	0.000172	0.000302	0.000475	0.00000562	0.000172	0.000289	0.000466
Iron	0.000285	0.107	0.175	0.283	0.000346	0.108	0.212	0.320	0.000335	0.108	0.176	0.284
Lithium	0.00000104	0.000241	0.000241	0.000483	0.00000420	0.000241	0.000241	0.000486	0.0000338	0.000241	0.000241	0.000515
Manganese	0.000000464	0.00478	0.00705	0.0118	0.000000539	0.00482	0.00709	0.0119	0.000000746	0.00482	0.00707	0.0119
Mercury	0.0000000784	0.000241	0.000273	0.000514	0.0000000784	0.000548	0.000439	0.000988	0.0000000784	0.000548	0.000363	0.000912
Molybdenum	0.000000219	0.000381	0.000471	0.000853	0.000000272	0.000416	0.000475	0.000891	0.00000127	0.000416	0.000474	0.000891
Nickel	0.000000188	0.000621	0.000861	0.001482	0.000000255	0.000644	0.000873	0.001517	0.00000	0.000644	0.000864	0.00151
Selenium	0.0000000870	0.000139	0.000180	0.000319	0.000000599	0.00123	0.000182	0.00141	0.00000545	0.00123	0.000181	0.00141
Strontium	0.000109	0.0440	0.0743	0.118	0.000128	0.0465	0.0745	0.121	0.000311	0.0465	0.0745	0.121
Thallium	0.0000000251	0.00000971	0.0000111	0.0000208	0.00000123	0.0000316	0.0000594	0.0000923	0.0000102	0.0000316	0.0000205	0.0000623
Zinc	0.0000188	0.241	0.383	0.624	0.0000207	0.265	0.384	0.649	0.0000261	0.265	0.384	0.649

Notes:

All concentrations in mg/kg wet weight.

[COPC] = concentration contaminant of potential concern

Table 15: Modelled Concentrations of Contaminants of Potential Concern in the Tissues of Blue Grouse under Baseline and Project Conditions

Contaminant of Potential Concern	Blue Grouse Tissue Concentration (mg/kg wet weight)											
	Base Case				Project Case (Operations)				Project Case (Closure)			
	[COPC] from Water	[COPC] from Soil	[COPC] from Diet	Total [COPC] in Tissue	[COPC] from Water	[COPC] from Soil	[COPC] from Diet	Total [COPC] in Tissue	[COPC] from Water	[COPC] from Soil	[COPC] from Diet	Total [COPC] in Tissue
Aluminum	0.00411	0.966	1.30	2.27	0.00458	0.971	1.88	2.86	0.00543	0.971	1.30	2.28
Arsenic	0.0000162	0.00138	0.00175	0.00314	0.0000209	0.00143	0.00203	0.00349	0.0000569	0.00143	0.00175	0.00325
Barium	0.0000187	0.0187	0.0246	0.0433	0.0000193	0.0188	0.0247	0.0436	0.0000200	0.0188	0.0246	0.0435
Boron	0.000412	1.24	1.50	2.74	0.000636	6.97	1.52	8.50	0.00253	6.97	1.52	8.50
Cadmium	0.000000243	0.00677	0.00869	0.0155	0.000000586	0.00780	0.00874	0.0165	0.00000289	0.00780	0.00872	0.0165
Chromium	0.00000216	0.00173	0.00233	0.00406	0.00000251	0.00179	0.00261	0.00440	0.00000354	0.00179	0.00234	0.00413
Cobalt	0.00000419	0.00998	0.0135	0.0235	0.0000222	0.0101	0.0143	0.0244	0.000188	0.0101	0.0135	0.0238
Iron	0.00476	3.16	4.16	7.33	0.00578	3.18	5.20	8.38	0.00560	3.18	4.17	7.35
Lithium	0.0000349	0.0142	0.0142	0.0284	0.000140	0.0142	0.0142	0.0285	0.00113	0.0142	0.0142	0.0295
Manganese	0.0000155	0.282	0.348	0.630	0.0000180	0.284	0.350	0.634	0.0000249	0.284	0.349	0.633
Mercury	0.00	0.0000170	0.0000182	0.0000352	0.00	0.0000387	0.0000293	0.0000681	0.00	0.0000387	0.0000242	0.0000629
Molybdenum	0.00000219	0.00674	0.00753	0.0143	0.00000272	0.00735	0.00759	0.0149	0.00001270	0.00735	0.00758	0.0149
Nickel	0.0000000105	0.0000609	0.0000727	0.000134	0.0000000142	0.0000631	0.0000738	0.000137	0.0000000654	0.0000631	0.0000730	0.000136
Selenium	0.0000174	0.0489	0.0563	0.105	0.000120	0.433	0.0567	0.490	0.00109	0.433	0.0566	0.491
Strontium	0.000364	0.259	0.348	0.607	0.000427	0.274	0.349	0.624	0.001040	0.274	0.349	0.624
Thallium	0.000000168	0.000114	0.000122	0.000237	0.00000822	0.000372	0.000668	0.00105	0.0000683	0.000372	0.000226	0.000666
Zinc	0.000440	9.95	12.9	22.8	0.000483	10.9	12.9	23.8	0.000611	10.9	12.9	23.8

Notes:

All concentrations in mg/kg wet weight.

[COPC] = concentration contaminant of potential concern

4. REFERENCES

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