Appendix G15

2017 Human Health Risk Assessment for the Consumption of Country Foods

AGNICO EAGLE

MEADOWBANK GOLD PROJECT

2017 Human Health Risk Assessment for Country Foods

In Accordance with NIRB Project Certificate No.004

Prepared by:

Agnico Eagle Mines Limited – Meadowbank Division

March, 2017

EXECUTIVE SUMMARY

In keeping with Agnico Eagle's Nunavut Impact Review Board Project Certificate, Condition 67, a preliminary quantitative risk assessment was completed to evaluate risks to human health from contaminant exposure through consumption of country foods during operation of the Meadowbank mine. The assessment is based on soil, water and plant tissue samples collected from mine site and reference sites in 2017. This report describes the methodology and results of the risk assessment, which follows the format of the pre-construction screening level risk assessment (2005), and initial assessments under operational conditions (2011, 2014). As per Condition 67, it incorporates recommendations from Health Canada's review of the 2011 and 2014 assessments, as well as updates from the 2012 federal guidance document (Health Canada, 2012).

As recommended by Health Canada, a hazard quotient (HQ) approach was used to classify the risk associated with the consumption of country food items from onsite, near-site, AWAR, and external reference locations. Risk was classified as negligible for each contaminant of potential concern (COPC) if the calculated HQ value was ≤ 0.2 (Health Canada, 2012). For each COPC with an HQ value > 0.2, it was determined whether onsite, near-site or AWAR HQ values exceeded the corresponding external reference HQ value. In those cases, further investigation into the underlying data was performed to understand the potential for incremental risk due to mining activities over and above contributions from background materials.

Overall, calculated hazard quotients were the same as or lower than the previous assessment in 2014, which used identical methods, indicating that excess risk is not occurring as a result of accumulation of chemical contaminants due to mining.

Key findings were as follows.

Caribou Meat (Muscle)

- Negligible risk (HQ ≤ 0.2) is associated with the consumption of caribou muscle (meat) for most COPCs. For chromium, lead, thallium, and zinc, HQ values exceeded 0.2 for some consumption scenarios at all study areas, including the external reference site, which also occurred in previous assessments.
    - For zinc, the exceedance only occurred for heavy consumption by toddlers, and was the same (0.3) for all sites, indicating no incremental risk as a result of mining activities.
    - For chromium, lead, and thallium, onsite or AWAR HQs exceeded the corresponding external reference value under some consumption scenarios. However, the difference in HQ values between impacted and reference sites was not expected to be significant in any case, based on analyses of background variability for each COPC/food item combination. These results indicate that potential incremental risk as a result of mining activities is not distinguishable from background variation.

Caribou Kidney

- Negligible risk (HQ ≤ 0.2) is associated with the consumption of caribou kidney from all study locations for all COPCs except thallium. The HQ value for thallium was 0.3 for the onsite study area for heavy consumption by toddlers, and was 0.2 for the AWAR and external reference locations.

    - This difference is not expected to be significant, considering that HQ values marginally exceed 0.2 and tolerable daily intakes are typically considered to be within an order of magnitude of true values. As a result, incremental risk of the project associated with this COPC is not expected to be significant.

Caribou Liver

- Negligible risk (HQ ≤ 0.2) is associated with the consumption of caribou liver from onsite, AWAR, and external reference study areas for all COPCs except lead, which had HQs > 0.2 for all study areas, including the external reference site under some scenarios (maximum HQ of 0.6).
    - Although HQ values for lead were higher at onsite or AWAR locations compared to the reference site under some consumption scenarios, differences were marginal (0.1). This difference is not expected to be significant, considering that HQ values are low and tolerable daily intakes are typically considered to be within an order of magnitude of true values. As a result, incremental risk of the project associated with this COPC is not expected to be significant.

Canada Goose Meat

- Negligible risk (HQ ≤ 0.2) is associated with the consumption of Canada goose meat from onsite, near-site, AWAR and external reference study areas for all COPCs except chromium, for which the HQ value for heavy consumption by toddlers was 0.3 for both onsite and reference areas indicating no incremental risk as a result of the project.

Combined Consumption

- The combined consumption analysis produced no additional scenarios under which adverse health effects may potentially occur.

Overall, this analysis indicated that mining activities do not appear to be contributing significant incremental risk from COPCs to consumers of country food items sourced in and around the Meadowbank area. This is consistent with the baseline assessment (2005) which concluded that based on projected concentrations of COPCs in environmental media (soil and water), risk to persons consuming country foods would not increase appreciably following mine development.

TABLE OF CONTENTS

APPENDICES

LIST OF TABLES

LIST OF FIGURES

1 INTRODUCTION

1.1 BACKGROUND

In 2010 Agnico Eagle Mines Ltd. (Agnico Eagle) began operation of the Meadowbank Gold mine, near Baker Lake, Nunavut, after purchasing the rights from Cumberland Resources Ltd. Prior to the purchase, Cumberland contracted Wilson Scientific Consulting Inc. (Wilson) to prepare a pre-construction human health screening level risk assessment (HHRA) to assess potential risks from the dietary uptake of mine-related contaminants in country foods.

Specifically, the pre-construction HHRA focused on identifying country foods consumed in the Meadowbank region, determining the contaminants of potential concern (COPCs) from predicted minesite activities, evaluating potential risks associated with consumption under baseline conditions, and determining recommended weekly intakes for each food item. Preliminary estimates of post-development contaminant concentrations in food items were then obtained from models used in the baseline wildlife screening level risk assessment (Azimuth, 2006), and expected potential risks to human health from consumption of country foods during mine operations were evaluated.

As required under the Nunavut Impact Review Board Project Certificate - Condition 67, the HHRA was updated in 2011 and 2014 to assess potential risk during mine operation. Results of these assessments indicated potentially unacceptable risk at various timepoints from consumption of some food items from both minesite and external reference study areas as a result of chromium, cadmium, nickel, lead, thallium, and zinc exposure. Most elevated concentrations were associated with samples from both minesite and external reference locations, indicating that potential risks existed independent of mining operations.

1.2 SITE DESCRIPTION

The Meadowbank site is located 70 km north of the hamlet of Baker Lake, Nunavut. A 115 km all-weather road was constructed between the hamlet and the mine to provide site access for personnel and deliveries arriving by commercial flight or marine barge. The hamlet itself is located 320 km inland from the west coast of Hudson Bay in the Kivalliq region of Nunavut, and an estimated population of 2164 people (GNBS, 2014).

Situated near the border of the Northern and Southern Arctic ecozones, the terrain in the Meadowbank area is typical barren-ground subarctic, with low-growing vegetation in poorly developed soil with continuous permafrost. The landscape is dominated by many interconnected lakes and isolated ponds with indistinct drainage patterns. Topography consists of rolling hills, boulder fields and bedrock outcrops. The mine site is located at the headwaters of the Quioch River system, which flows southeast through Chesterfield Inlet into Hudson Bay. Lakes in this region are ultra-oligotrophic, with low productivity levels. This region supports few terrestrial mammals (15 species) and birds (62 species) (Azimuth, 2006). Migratory species (primarily caribou and Canada geese) are present.

1.3 BASELINE CONDITIONS

For the baseline wildlife screening level risk assessment, Azimuth (2006) screened baseline concentrations of metals in soil and water values against CCME guidelines to provide a general description of background concentrations of contaminants.

It was found that baseline concentrations of metals in the project lakes were below CCME guidelines for the protection of aquatic life, except cadmium and mercury. However cadmium was not detected in the project lake samples, but the detection limit was above the CCME guideline (adjusted for hardness). Similarly, while mercury was not detected in the project lakes, the detection limit (50 ng/L) was above the CCME guideline (26 ng/L).

Soil samples from the project area were screened against the most conservative CCME soil quality guidelines for the protection of environmental and human health (typically agricultural use criteria). Under baseline conditions, concentrations of arsenic, chromium and nickel exceeded their CCME guidelines of 12, 64, and 50 mg/kg, respectively, in 10, 17 and 9 out of 26 samples, respectively. Soil pH was below the CCME guideline of 6-8 in 37 of 50 samples (See Section 2.3.2, Azimuth, 2006).

The baseline HHRA predicted negligible risk (HQ < 1) for consumption of all foods with the exception of heavy consumption of lake trout by toddlers.

1.4 MINING ACTIVITIES

The Meadowbank project consists of several gold-bearing open-pit deposits (Portage, Goose, Vault and Phaser pits). Much of the infrastructure is located in close proximity to the mill and mine facilities, with the exception for the Vault and Phaser Pits which are approximately 10 km northeast of the site.

Waste rock from the Portage and Goose pits are stored in the Portage Rock Storage Facility (PRSF). During the construction period, non-potentially acid generating rock (NPAG) was used for dikes and roads with excess used as cover material in the PRSF. Potentially acid generating (PAG) waste rock is sent to the Portage waste rock area. The Portage Rock Storage Facility is constructed to minimize the disturbed area and will be capped with a layer of non-acid-generating rock. Waste rock from the Vault Pit will be stored in the Vault Rock Storage Facility. Mined ore is either processed in the mill or stockpiled for eventual processing.

Tailings are stored in the Tailings Storage Facility (TFS), defined by the series of dikes built around and across the basin of the dewatered northwest arm of Second Portage Lake. Tailings water is reclaimed for use in ore processing.

Much of the construction activity since the previous assessment (i.e. in 2015 - 2017) was related to increasing the level of the Central Dike to 143.0 masl and, finalizing structures for Saddle Dam 3 and 4. The Phaser Lake area was prepared for mining beginning in 2016, including dewatering and fishout, with operations starting around November 2017. Construction of a 64 kilometers exploration road between the Meadowbank site and the Amaruq exploration project was started in 2016 and completed in 2017.

1.5 GENERAL APPROACH

While the goal in the baseline HHRA was to quantify potential risks to humans from consumption of country foods under baseline and projected future site conditions, the aim of this assessment is to characterize risk under current (operational) conditions, and in particular, to determine potential

effects of the project over and above background concentrations. The general approach is the same however, and includes the common risk assessment components of problem formulation, exposure assessment, toxicity assessment and risk characterization.

This report follows the format and methodology of the baseline HHRA, developed by Wilson Scientific Consulting Inc. The risk assessment framework was taken from various Canadian, American and international sources (Health Canada, USEPA, USFDA, WHO). Neither the baseline assessment nor this updated report address risks for point-source events such as a fuel spill. Specific management plans are in place to handle those types of incidents.

All methods as described in Wilson (2006) are summarized herein. Each component has been examined to ensure relevance to the current conditions, and methods were updated to reflect the recent Health Canada guidance documents "Supplemental Guidance on Human Health Risk Assessment for Country Foods (HHRAFoods)" (Health Canada, 2010a) and "Guidance on Human Health Preliminary Quantitative Risk Assessment (PQRA) – Part 1" (Health Canada, 2012). Details of any changes are described in the sections below.

In general, the problem formulation stage developed by Wilson (2006) was assumed to be applicable to the current scenario, with the exception of estimated daily consumption values which were updated based on information collected since the initial assessment. The sources of contaminants and COPCs predicted in Azimuth (2006) prior to mine site development were evaluated in the initial HHRA under operational conditions (2011), and any changes were carried over to this assessment. The exposure assessment stage (concentrations in animal tissue) was updated with field data (analysis of soil, water, and vegetation samples) collected in 2017. The major differences in this assessment are that maximum measured environmental concentrations were used to calculate dose rates, instead of the 95% UCLM values used in the baseline assessment, and an HQ threshold of 0.2 was used, instead of 1. These procedures follow Health Canada (2012) recommendations for PQRA, and are more conservative. The tolerable daily intake values in the effects assessment stage were updated based on currently available values from the same sources consulted by Wilson (2006). Risk estimates (hazard quotients) were re-calculated. Any specific changes to values or methods are discussed in the sections below.

2 PROBLEM FORMULATION

Problem formulation for the HHRA in 2006 involved the development of a conceptual model to determine country foods consumed in the region, consumption patterns and COPCs. Each of these components are further described in that document (Wilson, 2006), and are summarized along with any changes below.

2.1 COUNTRY FOODS

In the baseline HHRA, the consumption of terrestrial mammals, waterfowl, fish and plants was assessed for people residing in the hamlet of Baker Lake. From reviews of oral testimony collected in 2005 (Traditional Knowledge Report as part of the Meadowbank FEIS), caribou meat, kidney and liver, Canada goose meat and lake trout were found to be the food items most representative of local consumption patterns. Lake trout was included in the baseline assessment because they represent the majority of fish in the project lakes, and because of their potential to accumulate mercury. However, since a no-fishing policy was put in place for workers and fish from project lakes are non-

migratory, consumption of fish impacted by the mine site is expected to be negligible. Analyses of risk from fish consumption were therefore excluded from subsequent assessments. Although Inuit may consume wild berries, it was found to be unlikely that they would be harvested from the mine site area due to distance, the fact that public access is prohibited past km 85 on the AWAR, and abundance of this food source closer to Baker Lake. Consumption of plants was therefore not evaluated in the baseline assessment or subsequent updates. Finally, although risk analyses for consumption of Canada goose are maintained in this report, it is noted that only 7% of the population of Baker Lake was found to consume this item, at a frequency of less than 1 day per month (Areva, 2011).

2.2 POTENTIAL RECEPTORS

For the baseline assessment, a young child (or toddler, aged 7 months – 4 years) and an adult were the human receptors evaluated. They are considered to be protective of the general population. Primarily Canadian sources were consulted to determine the characteristics of these receptors, described below, and site-specific values were incorporated where possible.

2.2.1 Body Weight

Body weight values from Richardson (1997) were used in this assessment, as recommended in Health Canada (2012). Considering sources such as Anderson (2005) which indicate these values are valid for Inuit populations, the body weights presented in Richardson (1997) were deemed appropriate for this assessment.

Toddler:	16.5 kg
Adult:	70.7 kg

2.2.2 Estimated Daily Consumption

Based on a review of oral testimony and professional judgement, Wilson (2006) considered three scenarios (heavy, moderate and low consumption) for each food item:

Caribou Muscle

- heavy consumption: 2 meals per day, 365 days per year
- moderate consumption: 3 meals per week, 52 weeks per year
- low consumption: 1 meal per month, 12 months per year

Caribou Organs

- heavy consumption: 1 meal per week, 52 weeks per year
- moderate consumption: 2 meals per month, 12 months per year
- low consumption: 1 meal per month, 12 months per year

Waterfowl Muscle

- heavy consumption: 3 meals per week, 52 weeks per year
- moderate consumption: 1 meal per week, 52 weeks per year
- low consumption: 1 meal per month, 12 months per year

Using a serving size of 200 g/serving for adults and 86 g/serving for toddlers (Richardson, 1997), Wilson (2006) estimated average daily consumption values as presented in Table 2-1. Since the derivation of consumption rates used in Wilson (2006) could not be traced to quantitative survey data, a review of the literature was performed to verify that values were consistent with those available from published sources. This review indicated that some consumption rates for caribou meat may have been underestimated, while consumption rates for caribou organs and Canada goose may have been overestimated compared to values identified in local or regional surveys. As a result, consumption rates were updated to reflect data from published sources, as described in Table 2-1. Scenarios of heavy, moderate and low consumption were maintained to reflect variety in preferences for country foods and the range of consumption rates identified in the literature.

Table 2-1: Food items, consumption scenarios, and estimated consumption rates considered in Wilson (2006) and this assessment. Toddler values in this assessment are 43% of adult values (Richardson, 1997) unless otherwise indicated.

Food Item	Consumption Scenario	Baseline Assessment (g/d)		Current Assessment (g/d)		Reference/Rationale
		Toddler	Adult	Toddler	Adult	
Caribou meat (muscle)	Heavy	170	400	189.2	440	Highest daily intake in Kivalliq survey (Kuhnlein, 2000), as shown in Senes (2008), Table C-1
	Moderate	37	86	89.4	208	Average daily consumption in Nunavut survey (IHS, 2012); similar to value recommended by Health Canada (2012) for wild game consumption by Canadian Aboriginal Populations (270 g/d)
	Low	2.9	6.7	15	65	Average consumption for men and maximum consumption for toddlers in Baker Lake survey using ^{137}Cs body burdens in 1989-90 (Tracy and Kramer, 2000)
Caribou organ (kidney, liver)	Heavy	12	29	1.2	2.9	Harvest survey estimate: In 2010, there were 5020 caribou harvested by Baker Lake hunters (Areva, 2011) and an adult population of 1779 (GNBS, 2014). At a kidney weight of 187 g (Crete and Nault, 1989), maximum consumption would be of 2.9 g/d if adults consume all kidneys. This value is consistent with a Yukon survey by Schuster et al. (2011) indicating 3.2 g/d consumption of kidney, and 2.5 g/d consumption of liver. Larter and Nagy (2000) indicate 2.1 g/d for kidney. Chan et al. (2012) indicate 2.7 g/d for all ungulate organs combined.
	Moderate	5.7	13	0.6	1.3	Based on proportion of "heavy" in Wilson (2006)
	Low	2.9	6.7	0.3	0.7	Based on proportion of "heavy" in Wilson (2006)
Canada goose meat (muscle)	Heavy	37	86	9.9	23	Average daily consumption in Nunavut survey (IHS, 2012); also 95th centile of consumption in Chan et al. (2012) for 2 northern Manitoba reserves
	Moderate	12	29	5.6	13	Average daily consumption in Chan et al. (2012); also value used in Senes (2008) for ptarmigan consumption in Baker Lake
	Low	2.9	6.7	0.8	1.8	Based on proportion of "heavy" in Wilson (2006)

2.3 IDENTIFICATION OF COPCS

2.3.1 Potential Sources

Major mine site operations and their potential to contribute to contaminants of potential concern (COPCs) as determined in the baseline assessment are summarized here with updates as appropriate. No new potential sources of COPCs were identified.

Open pits – Currently, mining of the Portage, Goose Island (completed March 2015), Vault and Phaser pits is underway. Along with ore, pits produce waste rock, which may contribute to COPCs through dust emissions.

Rock storage facilities – The North Portage and Vault rock storage facilities are currently in use. Waste rock (not containing ore) is moved to these areas. Dust may be blown from the rock piles during dumping and vehicle traffic during transport of material. Seepage from rock storage facilities is controlled in sumps and pumped back to the reclaim pond.

Borrow pits and quarries – Borrow pits and quarries were used for the construction of mine site roads and the airstrip. The COPCs for borrow pits and quarries are similar to open pits. Currently, there are no active borrow pits or quarries (material is borrowed and crushed for road maintenance from open pit operations).

Tailings Storage Facilities (TSF) – The northwest arm of Second Portage Lake was partitioned off by the East Dike and de-watered from 2009 to 2012. The northwestern portion of this area was further partitioned by the Stormwater Dike, and is used for storage of tailings. The Stormwater Dike created the North and South Cell TSF. The North Cell was completed in 2015. Prior to 2013, much of the TSF had water cover or was covered by snow for most of the year; in 2013 and 2014, areas of the TSF had exposed tailings beaches. Although permafrost is expected to freeze the tailings, the material is fine-grained and could be a source of dust emissions during dry periods.

Roads and airstrip – Frequently used gravel haul roads run throughout the mine site to connect pits, waste rock storage and processing facilities. An airstrip, receiving approximately 4 planes per week, was built at the mine site to receive deliveries and personnel. Dust from these sources could be a potential source of contaminants. A 110 km long all weather access road (AWAR) was constructed between the mine and the Hamlet of Baker Lake, using gravel from quarries along the road. Previous SLRAs did not consider dust emissions from the AWAR in sampling programs, but following concerns from NIRB of dust deposition due to road activity a new station was added in 2014 to screen for potential risks associated with roadside habitat. The station was paired with dustfall studies and was located at km 78, 100m from the AWAR, on the downwind side. Construction of a 64 kilometer exploration road between the Meadowbank site and the Amaruq exploration project was started in 2016 and completed in 2017.

Effluent discharge – De-watering of lakes for pit development or TSF construction is considered effluent discharge and is regulated under the current NWB Water License. Lake water is treated for suspended solids removal before discharge, and since it is an existing surface water source, it is not likely to be a source of contaminants in the receiving water. Effluent is also periodically discharged from the Portage and Vault attenuation ponds into Third Portage Lake and Wally Lake respectively, pursuant to the existing Water License and MMER requirements. The Portage Attenuation Pond is no longer in use and has become the South Cell TSF. There will be no further discharge to Third Portage Lake from the Portage Attenuation Pond. Therefore, metals regulated under MMER were considered as COPCs in this assessment.

Diesel generating plant, mine mill plant and associated facilities – Three diesel generating plants provide power for the mine. The Air Quality Impact Assessment (2005) determined emission of PAHs was “very low” and did not require modeling. The milling of rock in the processing plant takes place under wet conditions, and is not a source of particulate emissions. All health and safety-related requirements to reduce particulate emissions during handling of the ore at the mine plant before processing are met, so these are not expected to be a significant source of contaminants.

Overall, roads, waste rock and tailings were determined to be the main sources potentially contributing to COPCs through dust emissions. Dewatering effluent discharge may potentially contribute to COPCs in water sources.

2.3.2 Contaminants of Potential Concern

In the baseline WSLRA, Azimuth (2006) identified contaminants of potential concern (COPCs) based on the chemical composition of the identified dust sources, the predicted effects of effluent on water quality in Third Portage Lake (from Golder, 2005), and a review of metals regulated under MMER (see Azimuth 2006, Section 2.5 for details).

Projected concentrations of metals in four dust sources (roads, waste rock and tailings) that exceeded the 90th centile of baseline soil concentrations or the CCME guidelines (CCME 1999) were included as COPCs. Five metals regulated under MMER (arsenic, copper, lead, nickel and zinc) were also included in the assessment. Arsenic was assessed here as inorganic arsenic, which was assumed to be 1% of total arsenic based Schoof et al. (1999) as described in Wilson (2006). Carcinogenic and non-carcinogenic effects were evaluated for this COPC. Tin was assessed as inorganic tin, which was assumed to be 100% of total tin. Although mercury was not predicted to exceed baseline soil concentrations or CCME criteria, it was included because it was found to be of concern to the general public in the Arctic. All metals assessed in Azimuth (2006) were included in this assessment. CCME guidelines for tin and uranium (non-radiological) have been published since 2006, so these metals were added during the 2011 assessment.

The COPCs for this assessment are:

Antimony	Lead	Tin (inorganic)
Arsenic (inorganic)	Manganese	Uranium (non-radiological)
Barium	Mercury (inorganic and methylmercury)	Vanadium
Beryllium	Molybdenum	Zinc
Cadmium	Nickel	
Chromium	Selenium	
Cobalt	Strontium	
Copper	Thallium	

Certain chemicals which are controlled through best management practices, and, which were not addressed in the baseline assessment, include petroleum hydrocarbons, process chemicals, dioxins, nitrates, ammonia and PAHs. For each source of these chemicals, best management practices are in place and environmental exposures are not expected to occur.

3 EXPOSURE ASSESSMENT

Exposure assessment is used to calculate the dose of each COPC received by each ROC. The exposure assessment used here for humans follows the method from Wilson (2006), and is based on the food chain model for caribou and Canada goose developed by Azimuth (2006). The model was developed to include the influence of COPC concentrations in exposure pathways, dietary preferences, ingestion rates and dose-adjustment factors.

3.1 COPC CONCENTRATIONS IN SOURCE MEDIA

To estimate risk from consumption of country foods, concentrations in each food item (caribou meat, caribou organs, Canada goose meat) were modelled from collected samples of environmental media (soil, water, sedge, lichen, berries) collected in onsite, near-site, AWAR, and external reference study areas. Methods are summarized here, and further details are provided in the 2017 wildlife screening level risk assessment.

Concentrations of COPCs were measured in and around the Meadowbank site in water, soil and plant tissue (sedges, lichens, berries) in August, 2017. Methods of collection were as in Azimuth (2006). A total of 55 samples each of soil and plant tissue (lichen, sedge, berries) were collected. This included five samples of each media type from four onsite locations, three near-site locations, one AWAR location (km 78; 100 m downwind of the road) and three external reference locations (see Figure 3-1). The AWAR location was new in 2014, and was added to conduct preliminary screening in recognition of concerns raised by the Hamlet of Baker Lake regarding generation of dust along this road.

Water samples were collected as part of the 2017 Core Receiving Environment Monitoring Program (CREMP). Onsite concentrations are from samples collected in Second Portage Lake (SPL) and the east and north basins of Third Portage Lake (TPE, TPN). Near-site concentrations are from samples collected in Tehek Lake (TE), and external reference samples are from Inuggugayualik Lake (INUG) and Pipedream Lake (PDL; see Figure 3-1). Onsite water concentrations were used for the AWAR study area analysis.

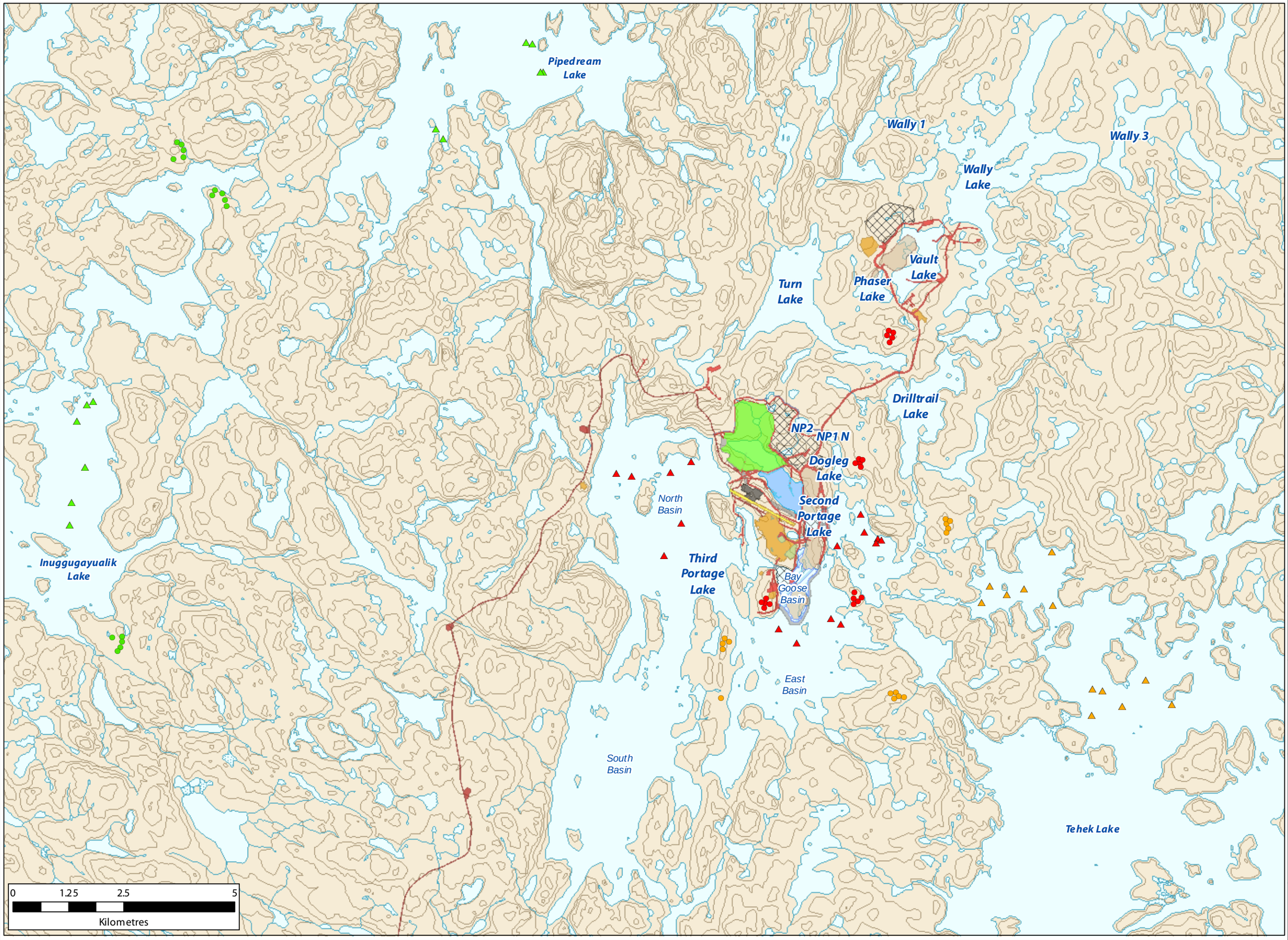
Concentrations in soil and plant tissue used for food chain modeling were maximum measured values for each location (onsite, near-site, AWAR, external reference), as recommended by Health Canada (2012) as opposed to the 95% UCLM values used in the baseline assessment. If values were below the laboratory detection limit, a value of ½ the detection limit was used.

Complete (100%) absorption of COPCs in ingested media across the gastrointestinal tract was assumed. Based on published literature, methyl mercury was assumed to comprise 1% of total mercury in soil, 0% in water, 17% in insects, and 34% of total mercury in plant tissue (Azimuth, 2006, Section 3.1.3.2). Concentrations of COPCs in insects were modeled in several cases (arsenic, cadmium, copper, lead, zinc) from soil concentrations using published bioaccumulation models (see

Azimuth (2006), Appendix D). For the rest of the COPCs, an insect BAF of 1 was assumed (i.e. 100% of soil concentration).

For both caribou and Canada goose, exposure values were calculated based on an assumed 33% of time in the study area (onsite, near-site, or AWAR) with the remainder of exposure (67%) based on external reference study area values, as in Senes (2008). Because it was assumed reasonable for a caribou to easily travel between onsite and near-site sample stations within a day (Martin Gebauer, Nunavut Environmental, 2012, personal communication), onsite and near-site samples were combined for the “onsite” assessment for caribou.

Further description of the assumptions used to calculate daily intake rates of COPCs for caribou and Canada goose can be found in the 2017 wildlife screening level risk assessment (WSLRA), including dietary preferences and intake factors for soil, water and food. Laboratory certificates of analysis are also provided in that document.



Legend

Soil/Veg Sampling Location

- Onsite
- Near Site
- External Reference

Water Sampling Locations

- Onsite
- Near Site
- External Reference

2014 Mine Plan

- Quarry
- AWPAR Quarry
- Dewatered Lake
- Portage Attenuation Facility
- Tailings Storage Facility
- Roads
- AWPAR
- Dikes
- Diversion Ditch
- Stockpiles
- Pits
- Facility
- Airstrip
- Waste Dump

Wildlife Screening Level Risk Assessment

DOUGAN & ASSOCIATES
ECOLOGICAL CONSULTING & DESIGN
77 Wyndham Street South • Guelph ON N1E 5R3
T 519.822.1609 • F 519.822.5389 • www.dougan.ca

PROJECT: DA11-062-03

CLIENT: Agnico-Eagle Mines Ltd., Meadowbank Div.

N / W / E / S

UTM Zone 14 NAD83

DATE: MARCH 2015

SCALE: 1:80,000

DRAWN BY: LW

CHECKED BY:MAY

FIGURE:

1

3.2 COPC CONCENTRATIONS IN COUNTRY FOOD ITEMS

3.2.1 Caribou Muscle

To estimate concentrations of COPCs in caribou muscle, estimated daily intake values for caribou were multiplied by caribou weight (75 kg; Dauphine (1976) in Wilson (2006)) and feed-to-muscle biotransfer factors from the literature. Feed-to-muscle biotransfer factors were updated for the 2011 assessment, and all values are maintained here. All biotransfer factors are provided in Appendix B.

Muscle concentrations (C_M) were calculated as:

$$C_M = EDI_C \times W_C \times BTF$$

Where:

C_M = Concentration in muscle tissue (meat); mg/kg ww

EDI_C = estimated daily intake of COPC by caribou; mg/kg ww/d

W_C = caribou weight; kg

BTF = biotransfer factor (feed to muscle; beef); d/kg ww

Estimated concentrations in caribou muscle are shown in Appendix D.

3.2.2 Caribou Kidney and Liver

Concentrations of COPCs in caribou kidney and liver were estimated from muscle concentrations using muscle-to-kidney and muscle-to-liver transfer factors for caribou provided by Gamberg (2012) (Appendix B). While these factors are unpublished, they are from a large scale and long-term study that is currently part of the Northern Contaminants Program. Transfer factors for inorganic mercury and methylmercury were not available and were assumed to be the same as for total mercury. The values used here differ from the 2006 assessment, in which only kidney transfer factors calculated from mean concentrations were available (mainly for moose), and these were assumed to be representative of both organs in caribou.

Kidney concentrations (C_K) and liver concentrations (C_L) were calculated as:

$$C_K \text{ or } C_L = C_M \times BTF$$

Where:

C_K = concentration of COPC in caribou kidney; mg/kg ww

C_L = concentration of COPC in caribou liver; mg/kg ww

C_M = concentration of COPC in caribou muscle; mg/kg ww (see Section 3.2.1)

BTF = transfer factor (muscle to organ; caribou)

Estimated concentrations in caribou kidney and liver are shown in Appendix D.

3.2.3 Canada Goose Muscle

To estimate concentrations in Canada goose muscle, estimated daily intake rates were multiplied by goose weight (2 kg; Mowbray et al. (2002) in Wilson (2006)) and feed-to-muscle biotransfer factors from the literature. Feed-to-muscle biotransfer factors were maintained from the baseline assessment (see Wilson, 2006), which used the source US DOE (2003) – see Appendix B.

Goose muscle concentrations (C_{GM}) were calculated as:

$$C_{GM} = EDI_G \times W_G \times BTF$$

Where:

C_G = concentration of COPC in goose muscle; mg/kg ww

EDI_G = estimated daily intake of COPC by goose; mg/kg ww/d

W_G = weight of goose; kg

BTF = biotransfer factor (feed to muscle; chicken); d/kg ww

Estimated concentrations in Canada goose muscle are shown in Appendix C.

3.3 EXPOSURE FROM CONSUMPTION OF COUNTRY FOOD

As in Wilson (2006), daily exposure from consumption of country foods was calculated based on Health Canada (2012) as:

$$Dose = C_F \times IR_F \times RAF_{ORAL} / BW$$

Where:

Dose = estimated daily intake of COPC from consumption of food item; ug/kg bw/day

C_F = concentration of COPC in food item (caribou meat, kidney, liver, goose meat); mg/kg ww

IR_F = consumption rate of food item; g/day

RAF_{ORAL} = relative absorption factor (assumed to be 1)

BW = body weight of person; kg

4 TOXICITY ASSESSMENT

The toxicity reference values (TRVs) used in the baseline assessment were collated from regulatory agencies such as Health Canada, USEPA and the WHO. Values were updated in the 2014 assessment to follow the order of preferences for sources described in Health Canada (2012). As a result, values from Health Canada (2010b), USEPA (2017) (IRIS database), RIVM (2001) and ATSDR (2015) are used with two exceptions (lead and thallium – see Sections 4.1.3 and 4.1.9). All values and sources are presented in Table 4-1, and are the same as the 2014 assessment. Details

for values that changed between 2011 and 2014 are provided below. Details for all other values can be found in the baseline and 2011 assessments.

As in the baseline assessment, TRVs for metals are expressed as Tolerable Daily Intakes (TDIs) for non-cancer endpoints, and cancer slope factors for cancer endpoints. Inorganic arsenic was the only COPC identified as a potential carcinogen through the oral ingestion route, and the cancer slope factor was 1.80 $(mg/kg \cdot day)^{-1}$ (Health Canada, 2010b).

Table 4-1: Tolerable daily intake (TDI) values used in the baseline (2005) assessment and subsequent updates (2011, 2014, 2017). USEPA (2006, 2012a, 2015, 2018) sources represent the IRIS database.

COPC	TDI (µg/kg·day)			Source		
	2005	2011	2014 2017	2005	2011	2014 2017
Antimony	0.4	0.4	0.4	USEPA 2006	USEPA 2012a	USEPA 2015/2018
Arsenic	2	0.3	0.3	HC 2002	USEPA 2012a	USEPA 2015/2018
Barium	200	200	200	USEPA 2006	USEPA 2012a	HC 2010b
Beryllium	2	2	2	USEPA 2006	USEPA 2012a	USEPA 2015/2018
Cadmium	1	0.8	1*	HC 2004a	HC 2004a	HC 2010b
Chromium	5.4	1	1	HC 1996	HC 2004a	HC 2010b
Cobalt	1.4	1.4	1.4	RIVM 2001	RIVM 2001	RIVM 2001
Copper	250	30	91#	HC 2002	HC 2004a	HC 2010b
Lead	3.6	3.6	0.1+	HC 2004a	HC 2004a	HC 2014
Manganese	140	-	136#	USEPA 2006	-	HC 2010b
Mercury (inorganic)	0.71	0.3	0.3	HC 2002	HC 2004a	HC 2010b
Mercury (methyl)	0.2	0.1	0.2^	HC 2002	USEPA 2012a	HC 2010b
Molybdenum	5	5	23000#	USEPA 2006	USEPA 2012a	HC 2010b
Nickel	17	17	20	IM 2001	IM 2001	USEPA 2015/2018
Selenium	5	5	6200#	USEPA 2006	USEPA 2012a	HC 2010b
Strontium	600	-	600	USEPA 2006	-	USEPA 2015/2018
Thallium	0.07	0.07	0.01*	USEPA 2006	USEPA 2012a	USEPA 2012b
Tin	-	200	300	-	ITER 2012	ATSDR 2005
Uranium	-	0.6	0.6	-	HC 2004a	HC 2010b
Vanadium	5	5	5	USEPA 2006	USEPA 2012a	USEPA 2015/2018
Zinc	700	300	480#	HC 2002	USEPA 2012a	HC 2010b

*provisional or screening value

#essential trace element toxicity value (toddlers)

^value for women of child-bearing age and children <12 yrs

+median dietary lead exposure for the Canadian population (see Section 4.1.3)

4.1.1 Cadmium

Health Canada (2010b) reports a provisional TDI for cadmium of 1 ug/kg bw/d. Use of a provisional value for cadmium of 1 ug/kg bw/d was also described in the baseline assessment.

4.1.2 Copper

Guidance documents from Health Canada (Health Canada, 2010b) have amended TRVs for essential trace elements, including copper, to better reflect benefits and risks by using the tolerable upper intake level as the reference exposure level. Values are provided for various age groups, and the

value for toddlers has been used for this assessment. As a result, the TDI for copper has increased to 91 ug/kg bw/d from 30 ug/kg bw/d in the 2011 assessment.

4.1.3 Lead

Health Canada (2010b) lists the TDI for lead as “in review”. During their review of the 2011 Meadowbank HHRA, Health Canada indicated that dietary exposure to lead should be As Low As Reasonably Achievable (ALARA principle). Health Canada compared exposure from consumption of country foods in the Meadowbank area to the median dietary lead exposure for the Canadian population (0.1 ug/kg bw/d), as determined in Health Canada’s Final Human Health State of the Science Report on Lead (2012). As a result, this value was adopted as the TRV for this assessment. However, it is noted that average daily intake values of lead are commonly higher among First Nations, as measured in BC and Manitoba (0.23 ug/kg bw/d and 1.35 ug/kg bw/d, respectively; Chan et al. (2011, 2012)).

4.1.4 Manganese

Guidance documents from Health Canada (Health Canada, 2010b) have now amended TRVs for essential trace elements, including manganese, to better reflect benefits and risks by using the tolerable upper intake level as the reference exposure level. Values are provided for various age groups, and the value for toddlers has been used for this assessment. As a result, the TDI for manganese has decreased to 136 ug/kg bw/d from 140 ug/kg bw/d in the 2005 assessment. Manganese was not analyzed in the 2011 assessment.

4.1.5 Methylmercury

Guidance documents from Health Canada (Health Canada, 2010b) present two values for methylmercury, and this assessment has used the lower value presented (for women of child-bearing age and children <12 yrs) of 0.2 ug/kg bw/d. This corresponds to the value from Health Canada used in the baseline assessment.

4.1.6 Molybdenum

Guidance documents from Health Canada (Health Canada, 2010b) have now amended TRVs for essential trace elements, including molybdenum, to better reflect benefits and risks by using the tolerable upper intake level as the reference exposure level. Values are provided for various age groups, and the value for toddlers has been used for this assessment. As a result, the TDI for molybdenum has increased to 23,000 ug/kg bw/d from 5 ug/kg bw/d in the previous assessments.

4.1.7 Nickel

The source for the TRV for nickel used in the previous assessments (Institute of Medicine, 2001) is not a Health Canada-recommended source, and as a result the TRV for nickel was amended to the USEPA IRIS database RfD of 20 ug/kg bw/d, which is a slight increase from the previously-used value of 17 ug/kg bw/d.

4.1.8 Selenium

Guidance documents from Health Canada (Health Canada, 2010b) have now amended TRVs for essential trace elements, including selenium, to better reflect benefits and risks by using the tolerable upper intake level as the reference exposure level. Values are provided for various age groups, and the value for toddlers has been used for this assessment. As a result, the TDI for selenium has increased to 6200 ug/kg bw/d from 5 ug/kg bw/d in the previous assessments.

4.1.9 Thallium

As noted in the De Beers Canada Inc. Snap Lake Mine - Thallium and Cesium in Fish Tissue Response Plan for the Mackenzie Valley Land and Water Board (April 2016), no federal or international agencies publish a TRV for thallium. As a result, the screening value developed by USEPA (Provisional Peer-Reviewed Toxicity Values for Thallium and Compounds, October 2012) for chronic exposure to soluble thallium of 0.01 ug/kg bw/d was adopted for this assessment. This represents a decrease from the previously-used screening value of 0.07 ug/kg bw/d formerly published on the USEPA IRIS database.

4.1.10 Tin

In keeping with the Health Canada (2010b) preferred sources, the TRV for inorganic tin in this assessment was amended to the ATSDR value of 300 ug/kg bw/d, which is for intermediate-duration exposure to inorganic tin as stannous chloride.

4.1.11 Zinc

Guidance documents from Health Canada (Health Canada, 2010b) have now amended TRVs for essential trace elements, including zinc, to better reflect benefits and risks by using the tolerable upper intake level as the reference exposure level. Values are provided for various age groups, and the value for toddlers has been adopted for this assessment. As a result, the TDI for zinc has increased to 480 ug/kg bw/d from 300 ug/kg bw/d in the 2011 assessment.

5 RISK CHARACTERIZATION

5.1 HAZARD QUOTIENTS

The risk characterization stage compares predicted exposure concentrations with published tolerable daily intake (TDI) values from the literature. Non-cancer risks were classified using hazard quotients (HQs), which are calculated as:

$$HQ = Dose / TDI$$

Where:

Dose = estimated daily intake from country foods; ug/kg bw/day

TDI = toxicity reference value; ug/kg bw/day

Based on recommendations in Health Canada (2012) for single-substance exposure in PQRA, a hazard quotient ≤ 0.2 indicates negligible risk when exposure from one pathway (i.e. country foods) is considered. This is different from the baseline assessment in which negligible risk was associated with an HQ ≤ 1.

Because of the conservative assumptions included at this level of assessment, there is generally considered to be a high degree of certainty associated with results indicating negligible risk. For HQs greater than 0.2, adverse health effects will not necessarily occur. Rather, the assumptions and uncertainties associated with the risk analysis should be studied, and the possibility for more detailed or probabilistic assessment may be considered.

The main goal of this assessment is to determine potential effects of the project over and above background concentrations. Therefore, when HQs exceeded the threshold of 0.2, HQ values for onsite, near-field and AWAR locations were compared with external reference values or historical data in order to comment on the incremental effects of the project on exposure to COPCs in country foods. Values are not directly compared to baseline HQs, because TDIs and some exposure parameters differ in certain cases, as described in the preceding sections. It is noted that the magnitude of HQs is not necessarily proportional to risk, due to differences in underlying dose-response curves. While very large HQ values may indicate higher potential for risk, small differences in HQs cannot be considered to be significant (Ritter et al. 2002). The expectation of what represents a small difference is explored individually for each food item/COPC below where necessary, and expected significance of the incremental risk (difference in HQs) investigated through additional analysis of the underlying data where warranted.

HQ values exceeding the threshold of 0.2 are presented and discussed below for each food item and combined consumption of all items. All calculated HQs are provided in Appendix D.

5.1.1 Caribou Muscle

For the consumption of caribou muscle (meat) HQ values exceeding 0.2 are shown in Table 5-1.

For chromium, lead, and thallium, one or more onsite or AWAR HQ values exceeded the external reference value. Each of these COPCs is discussed in more detail below.

Table 5-1. HQ values exceeding 0.2 for consumption of caribou meat from onsite, AWAR and external reference study areas.

COPC	Receptor	Consumption Scenario	Onsite	AWAR	External Reference
Chromium	Adult	Heavy	2.6	1.8	1.2
		Moderate	1.2	0.9	0.6
		Low	0.4	0.3	0.2
	Toddler	Heavy	4.8	3.4	2.2
		Moderate	2.3	1.6	1.0
		Low	0.4	0.3	0.2
Lead	Adult	Heavy	0.4	0.3	0.3
	Toddler	Heavy	0.7	0.6	0.5
		Moderate	0.3	0.3	0.2
Thallium	Adult	Heavy	2.0	1.4	1.1
		Moderate	0.9	0.6	0.5
		Low	0.3	0.2	0.2
	Toddler	Heavy	3.6	2.5	2.1
		Moderate	1.7	1.2	1.0
		Low	0.3	0.2	0.2
Zinc	Toddler	Heavy	0.3	0.3	0.3

5.1.1.1 *Discussion for Chromium*

While HQ values for chromium exceeded the threshold of 0.2 in this assessment, exceedances occurred at all study locations including the external reference site. Elevated HQ values were also observed in the 2011 and 2014 assessment for all sites. This may be explained by the fact that ultramafic rock, which is commonly found in the region, is generally known to contain elevated concentrations of chromium (e.g., on the order of 2000 mg/kg) relative to other rock types (Motzer

and Engineers, 2004). While potentially elevated chromium in the region may be of interest to regulators, as discussed in previous assessments (although all HQ values in 2017 were lower than 2014), several assumptions that make this a very conservative assessment should be taken into consideration. These include: modeling of tissue concentrations from soil, plant and water measurements; use of maximum measured concentrations in environmental media; and the assumption that 100% of the total chromium measured in soil, water and plant tissue occurs in caribou muscle as hexavalent chromium, which is the significantly more toxic form, whereas it has been estimated that only about 11-63% of total chromium in food items occurs in the hexavalent form (Schroeder et al. 1961).

However, since HQ values for high and moderate consumption rates associated with samples from onsite and AWAR locations were higher than external reference sites, an investigation of the underlying data (concentrations of chromium in environmental media) and significance of the difference was performed. Visual examination of the data (Table 5-2 and 5-3) indicated that differences in HQ values between sites were likely driven by a decline in maximum concentrations of chromium in lichen and sedge in external reference samples compared to historical values (~6 and 40x lower, respectively), while values at onsite and near-site locations remained similar to previous years.

In order to determine whether the observed differences in HQ values may be considered significant enough to warrant further detailed assessment, an evaluation of the range of observed background concentrations of chromium in lichen was performed, since this food items contributes 65% to caribou diets. The range of maximum measured background values for chromium in lichen observed to date (8.8 – 60.9 mg/kg) produces a range of HQ values for heavy consumption rates in toddlers (most sensitive receptor) between 1.9 and 7.5 for the external reference site. These data indicate that a span in HQ values of ±5.4 is within background variation and may be considered a “small” difference for this food item/COPC combination. Since all onsite and AWAR HQ values are within 5.4 points of external reference values in 2017 (maximum difference of 2.6), no incremental effect of the minesite on risk from consumption of caribou muscle can be distinguished.

However, near future monitoring of chromium in lichen and sedge is recommended to determine whether the observed differences between onsite and external references samples are sustained.

Table 5-2. Concentrations of chromium in lichen (mg/kg ww) for onsite, near-site and external reference locations in baseline, 2011, 2014 and 2017. *baseline value = mean of all sites (n=50), calculated from dry weight mean using average moisture content.

Site	Onsite (mg/kg ww)			Near-site (mg/kg ww)			External Reference (mg/kg ww)		
	Mean	SD	Max	Mean	SD	Max	Mean	SD	Max
Baseline (2005)							2.6*	1.87	8.8
2011	27.5	17.82	63.0	19.5	17.74	76.7	10.1	8.86	36.3
2014	28.0	15.25	59.4	15.7	9.00	31.9	8.0	14.75	60.9
2017	34.5	26.67	81.1	21.2	16.90	72.3	3.5	3.19	11.2

Table 5-3. Concentrations of chromium in sedge (mg/kg ww) for onsite, near-site and external reference locations in baseline, 2011, 2014 and 2017. *baseline value = mean of all sites (n=50), calculated from dry weight mean using average moisture content.

Site	Onsite (mg/kg ww)			Near-site (mg/kg ww)			External Reference (mg/kg ww)		
	Mean	SD	Max	Mean	SD	Max	Mean	SD	Max
Baseline (2005)							3.7*	7.46*	42.5
2011	10.0	12.41	50.6	6.1	5.08	20.1	3.6	4.33	16.5
2014	8.1	5.52	23.7	7.8	10.61	44.1	7.8	10.19	37.6
2017	4.6	1.49	7.7	2.1	1.06	5.3	0.6	0.23	0.9

5.1.1.2 *Discussion for Lead*

Some HQ values for lead marginally exceeded the threshold of 0.2 in this assessment (up to 0.7) for all locations. Some onsite and AWAR HQ values did exceed external reference values by up to 0.2 points, so an assessment of the significance of this difference was performed. The range of background values measured to date for lead in lichen (the primary contributor to the caribou diet; Table 5-4) of 2.97 – 4.99 mg/kg produces an HQ range of 0.5 – 0.8 for toddlers under the heavy consumption scenario, indicating that a difference of 0.3 between external reference and onsite values is within the range of historical background variation. Since all onsite and AWAR HQ values were within this range, no incremental effect of the project on risk from consumption of caribou meat can be distinguished.

Table 5-4. Concentrations of lead in lichen (mg/kg ww) for onsite, near-site and external reference locations in baseline, 2011, 2014 and 2017. *baseline value = mean of all sites (n=50), calculated from dry weight mean using average moisture content.

Site	Onsite (mg/kg ww)			Near-site (mg/kg ww)			External Reference (mg/kg ww)		
	Mean	SD	Max	Mean	SD	Max	Mean	SD	Max
Baseline (2005)							2.23*	0.97	4.53
2011	1.87	0.99	4.27	1.85	1.01	4.27	2.05	1.06	4.99
2014	1.37	0.79	3.98	1.30	0.69	3.98	2.41	0.97	4.11
2017	2.38	1.04	5.83	2.30	1.24	5.83	1.29	0.80	2.97

5.1.1.3 *Discussion for Thallium*

The TDI for thallium used in this assessment is a screening provisional value for chronic exposure to soluble thallium presented in USEPA (2012b). The screening provisional value is provided in the absence of sufficient data to develop a provisional reference dose, so results cannot be interpreted with high confidence.

However, since some onsite and AWAR HQ values did exceed external reference values, an assessment of the significance of this difference was performed. The range of background values measured to date for thallium in lichen (the primary contributor to the caribou diet; Table 5-5) of 0.014 – 0.035 mg/kg produces an HQ range of 2.1 – 3.8 for toddlers under the heavy consumption scenario, indicating that a difference of up to 1.7 between external reference and onsite values is within the range of historical background variation. Since all onsite and AWAR HQ values were within

this range, no incremental effect of the project on risk from consumption of caribou meat can be distinguished.

Table 5-5. Concentrations of thallium in lichen (mg/kg ww) for onsite, near-site and external reference locations in baseline, 2011, 2014 and 2017. *baseline value = mean of all sites (n=50), calculated from dry weight mean using average moisture content.

Site	Onsite (mg/kg ww)			Near-site (mg/kg ww)			External Reference (mg/kg ww)		
	Mean	SD	Max	Mean	SD	Max	Mean	SD	Max
Baseline (2005)							0.026	0	0.035
2011	0.011	0.008	0.029	0.014	0.0089	0.035	0.014	0.007	0.026
2014	0.02	0.0097	0.048	0.018	0.0088	0.048	0.016	0.0082	0.031
2017	0.019	0.012	0.067	0.018	0.012	0.067	0.0067	0.0028	0.014

5.1.2 Caribou Kidney

HQ values exceeding 0.2 are shown in Table 5-6. The only COPC presenting potentially unacceptable risk under any consumption scenario is thallium (see discussion in Section 5.1.1.3). The HQ values for onsite and AWAR locations are within 0.1 of external reference values, which is not expected to be significant, considering that HQ values are low and tolerable daily intakes are typically considered to be within an order of magnitude of true values.

Therefore, incremental effects of the project on risk related to consumption of caribou kidney are not distinguishable from background effects.

Table 5-6. HQ values exceeding 0.2 for consumption of caribou kidney from onsite, AWAR and external reference study areas

COPC	Receptor	Consumption Scenario	Onsite	AWAR	External Reference
Thallium	Toddler	Heavy	0.3	0.2	0.2

5.1.3 Caribou Liver

HQ values exceeding 0.2 are shown in Table 5-7. The only COPC presenting potentially unacceptable risk is lead. Only the onsite HQ for heavy consumption by toddlers and adults exceeds the corresponding external reference value, but considering that these HQ values are low and tolerable daily intakes are typically considered to be within an order of magnitude of true values, this difference (0.1) is not considered to be significant. As a result, incremental risk as a result of the project from consumption of caribou liver is not expected to be distinguishable from background rates.

Table 5-7. HQ values exceeding 0.2 for consumption of caribou liver from onsite, AWAR and external reference study areas

COPC	Receptor	Consumption Scenario	Onsite	AWAR	External Reference
Lead	Adult	Heavy	0.4	0.3	0.3
	Toddler	Heavy	0.6	0.5	0.5
		Moderate	0.3	0.3	0.2

5.1.4 Canada Goose Muscle

HQ values exceeding 0.2 are shown in Table 5-8. The only COPCs presenting potentially unacceptable risk are chromium and lead. All HQ values for onsite, near-site or AWAR locations are the same as or lower than external reference values for these COPCs, indicating no incremental effect of the project on risk from consumption of Canada goose meat.

Table 5-8. HQ values exceeding 0.2 for consumption of Canada goose meat from onsite, AWAR and external reference study areas

COPC	Receptor	Consumption Scenario	Onsite	Near-site	AWAR	External Reference
Chromium	Toddler	Heavy	0.3	0.2	0.2	0.3

5.1.5 Combined Consumption

HQs were calculated for individuals who consume all food items at low, moderate and heavy consumption rates. Risk from combined consumption was determined by summing HQs for the individual food items (caribou meat, caribou kidney, caribou liver, Canada goose meat). Values were calculated for the onsite and external reference study areas. Table 5-9 summarizes values that were > 0.2 (see Appendix D for all values).

The combined consumption analyses produced no additional scenarios (consumption rate/COPC combinations) under which potentially unacceptable risk may occur.

Table 5-9. HQs for combined consumption of caribou meat, caribou kidney, caribou liver and Canada goose meat at low, moderate and heavy consumption rates. Only values > 0.2 are shown.

COPC	Receptor	Consumption Scenario	Onsite	External Reference
Chromium	Adult	Heavy	2.8	1.3
		Moderate	1.3	0.6
		Low	0.4	0.2
	Toddler	Heavy	5.1	2.5
		Moderate	2.4	1.2
		Low	0.4	0.2
Lead	Adult	Heavy	0.9	0.7
		Moderate	0.4	0.3
	Toddler	Heavy	1.6	1.2
		Moderate	0.8	0.6
Thallium	Adult	Heavy	2.2	4.1
		Moderate	1.1	2.0
		Low	0.3	0.4
	Toddler	Heavy	1.3	2.4
		Moderate	0.6	1.2
Zinc	Toddler	Heavy	0.3	0.3

5.2 INCREMENTAL LIFETIME CANCER RISK

For carcinogenic substances (inorganic arsenic), risk was determined assuming lifetime exposure (no amortization) at adult consumption rates. Incremental lifetime cancer risk (ILCR), calculated as:

$$ILCR = LADD \times SL$$

Where:

ILCR = incremental lifetime cancer risk

LADD = estimated lifetime average daily dose from country foods; ug/kg bw/day

SL = slope factor; $(ug/kg/day)^{-1}$

Based on recommendations in Health Canada (2010a) for single-substance exposure, cancer risk is found to be "essentially negligible" (*de minimis*) when ILCR ≤ 1×10^{-5}.

ILCR values for all food items and all locations were < 1×10^{-5} (see Appendix D for values), indicating essentially negligible risk as a result of exposure to arsenic from consumption of country foods.

5.3 UNCERTAINTY ASSESSMENT

Assumptions included in each section of the assessment are discussed here, along with implications for over- or under-estimating risk. Because of the conservative assumptions included at this level of

assessment, there is generally considered to be a high degree of certainty associated with results indicating negligible risk.

5.3.1 COPC Identification

Projected concentrations of metals in four dust sources (roads, waste rock and tailings) that exceeded the 90th centile of baseline soil concentrations or the CCME guidelines (CCME 1999, 2001) were included as COPCs, as well as five metals regulated under MMER (arsenic, copper, lead, nickel and zinc; regardless of projected concentrations) and mercury due to general public concerns. These methods resulted in a comprehensive list of COPCs and are consistent with Health Canada (2012) guidance.

5.3.2 Receptor Characteristics

Receptor characteristics such as body weight were obtained from Canadian sources that indicated they were representative of the target population.

Consumption rates were adjusted in this assessment based on a review of the literature, and the updated values incorporate local and regional surveys in several cases. As a result, consumption rates are considered to more closely reflect the target population than federal guidance values. For example, assessed consumption rates for caribou meat are up to nearly 2x the value presented for consumption of wild game in Health Canada (2012). In addition, low, moderate and heavy consumption scenarios were assessed to represent a range of preferences, reducing uncertainty in the assessment.

5.3.3 Contaminant Concentrations

The number of samples collected for onsite, near-site and external reference study areas (15-20 each) is considered adequate for characterizing metals concentrations in environmental media for PQRA. The number of samples collected for the AWAR study location (5) is recognized to be low, and thus associated with higher uncertainty, but this site was included to conduct supplementary screening, and is not a component of the regular monitoring plan outlined in Meadowbank's Terrestrial Ecosystem Management Plan and Wilson (2006).

Maximum measured concentrations for each study area were used in the assessment, which is considered appropriate for PQRA (Health Canada, 2012) and provides conservative estimates of exposure since in reality animals are more likely exposed to a range of concentrations.

Concentrations of COPCs in country food items were modeled from environmental media, and assumptions of the model are discussed in the associated WSLRA. Overall, when assumptions were used they were estimated to be conservative, in order to avoid underestimating risk. As described in Health Canada (2010a), factors affecting contaminant uptake by biota are highly variable, and as a result, components of food chain models (such as biotransfer factors) are generally biased towards maximizing tissue concentrations. Where species-specific values were not available in the food chain model, they were typically taken from beef or poultry studies (e.g. feed-to-muscle transfer factors). Although lower tiers of assessment such as this may not commonly consider accumulation in certain tissues such as organs, this assessment incorporated muscle-to-organ transfer factors specifically for caribou, resulting in greater confidence in tissue concentrations for these food items.

This assessment does not consider any effects of food handling or preparation, which may affect COPC speciation in food items.

5.3.4 Toxicity

As described in Wilson (2006), estimates of “safe” levels of exposure published by regulatory agencies are generally very conservative and incorporate safety factors. Since TDIs and cancer slope factors are not commonly derived from human-based studies, these safety factors are meant to be protective. In addition, TRVs are typically derived from laboratory studies, where bioavailability of the contaminant is higher than may occur in the environment, resulting in another level of conservatism. However it should be recognized that TDIs and cancer slope factors are not definitive values, but should generally be considered to be within one order of magnitude of the true value.

6 CONCLUSIONS

This preliminary quantitative HHRA evaluated the risks to humans from contaminant exposure through consumption of country foods sourced in and around the Meadowbank site during year 8 of operation.

Overall, calculated hazard quotients were the same as or lower than the previous assessment in 2014, which used identical methods, indicating that excess risk is not occurring as a result of accumulation of chemical contaminants due to mining.

Additional important findings are as follows:

Caribou Meat (Muscle)

- Negligible risk (HQ ≤ 0.2) is associated with the consumption of caribou muscle (meat) for most COPCs. For chromium, lead, thallium, and zinc, HQ values exceeded 0.2 for some consumption scenarios at all study areas, including the external reference site, which also occurred in previous assessments.
    - For zinc, the exceedance only occurred for heavy consumption by toddlers, and was the same (0.3) for all sites, indicating no incremental risk as a result of mining activities.
    - For chromium, lead, and thallium, onsite or AWAR HQs exceeded the corresponding external reference value under some consumption scenarios.
        - The difference in HQ values between impacted and reference sites was not expected to be significant in any case, based on analyses of background variability for each COPC/food item combination.
        - Furthermore, in all cases, HQ values were lower than those observed in 2014, indicating excess risk is not occurring as a result of accumulation of chemical contaminants due to mining.
        - These results indicate that incremental risk as a result of mining activities is not distinguishable from background.

Caribou Kidney

- Negligible risk (HQ ≤ 0.2) is associated with the consumption of caribou kidney from all study locations for all COPCs except thallium. The HQ value for thallium was 0.3 for the onsite study area for heavy consumption by toddlers, and was 0.2 for the AWAR and external reference locations.

    - This difference is not expected to be significant, considering that HQ values are low and tolerable daily intakes are typically considered to be within an order of magnitude of true values. As a result, incremental risk of the project associated with this COPC is not expected to be significant.

Caribou Liver

- Negligible risk (HQ ≤ 0.2) is associated with the consumption of caribou liver from onsite, AWAR, and external reference study areas for all COPCs except lead, which had HQs > 0.2 for all study areas, including the external reference site under some scenarios (maximum HQ of 0.6).
    - Although HQ values for lead were higher at onsite or AWAR locations compared to the reference site under some consumption scenarios, differences were marginal (0.1). This difference is not expected to be significant, considering that HQ values are low and tolerable daily intakes are typically considered to be within an order of magnitude of true values. As a result, incremental risk of the project associated with this COPC is not expected to be significant.

Canada Goose Meat

- Negligible risk (HQ ≤ 0.2) is associated with the consumption of Canada goose meat from onsite, near-site, AWAR and external reference study areas for all COPCs except chromium, for which the HQ value for heavy consumption by toddlers was 0.3 for both onsite and reference areas indicating no incremental risk as a result of the project.

Combined Consumption

- The combined consumption analysis produced no additional scenarios under which adverse health effects may potentially occur.

Overall, this analysis indicated that mining activities do not appear to be contributing significant incremental risk from COPCs to consumers of country food items sourced in and around the Meadowbank area. This is consistent with the baseline assessment (2005) which concluded that based on projected concentrations of COPCs in environmental media (soil and water), risk to persons consuming country foods would not increase appreciably following mine development. Since HQ values between the assessments are not directly comparable due to changes in various reference parameters, a comparison of projected and current concentrations of COPCs in soil was performed to assess quantitative impact predictions. Measured concentrations of COPCs in soil in 2017 did not exceed concentrations projected to occur in the Project's Final Environmental Impact Statement (Cumberland, 2006), with the exception of beryllium (see 2017 Wildlife Screening Level Risk Assessment). A minor increase in the 90th centile of measured concentrations for beryllium in soil occurred, from 0.52 (baseline) to 0.57 (2017) mg/kg. While any trends in concentrations of beryllium will continue to be monitored as described in the Terrestrial Ecosystem Monitoring Plan, no increased risk to wildlife from consumption of beryllium was calculated (in fact, hazard quotients were lower than historical values for this compound). Therefore overall, impacts predicted in the baseline SLRA are not being exceeded.

REFERENCES

Andersen S, Boeskov E, Laurberg P. 2005. Ethnic Differences in Bone Mineral Density Between Inuit and Caucasians in North Greenland Are Caused by Differences in Body Size. Journal of Clinical Densitometry 8:409-414.

Areva, 2011. Kiggavik Project Environmental Impact Statement – Technical Appendix 9A. Socio-Economic Baseline. Areva Resources Canada, Inc. December, 2011.

ATSDR, 2005. Toxicological profile for tin and tin compounds. US Department of Health and Human Services, Public Health Service, Agency for Toxic Substance and Disease Registry.

Azimuth, 2006. Wildlife Screening Level Risk Assessment for the Meadowbank Site. Prepared by Azimuth Consulting Ltd. for Cumberland Resources Ltd. 2006.

CCME (Canadian Council of Ministers of the Environment), 1999. Canadian environmental quality guidelines (with 2004 and 2005 Soil and Water Quality Revisions). Winnipeg, Manitoba Branch.

Chan, L., Receveur, O., Sharp, D., Schwartz, H., Ing, I and Tikhonov, C., 2011. First Nation Food, Nutrition and Environment Study (FNFNES): Results from British Colombia (2008/2009). Prince George, BC: University of Northern British Colombia. 2011.

Chan, L., Receveur, O., Sharp, D., Schwartz, H., Ing, A., Fediuk, K., Black, A., and Tikhonov, C., 2012. First Nations Food, Nutrition and Environment Study (FNFNES): Results from Manitoba (2010).

Crete, M. and Nault, R., 1989. Variation in cadmium content of caribou tissues from Northern Quebec. The Science of the Total Environment. 80: 103-112.

Dauphine, T.C. Jr., 1976. Biology of the Kaminuriak population of barren-ground caribou: Part 4. Report Series No. 38, Canadian Wildlife Service.

Gamberg, M., 2008. Contaminants in Arctic Moose and Caribou – 2006. Technical Report. June, 2008.

Gamberg, M., 2012. Caribou muscle-to-organ transfer factors for metals. Unpublished. Personal communication (mary.gamberg@gmail.com). February 28, 2012.

GNBS, 2014. Government of Nunavut Bureau of Statistics. Population Estimates. Available at: http://www.stats.gov.nu.ca/en/Population%20estimate.aspx. Accessed February, 2015.

Golder Associates Ltd., 2005. Report on Static Test Results for Overburden, Mine Site Infrastructure Rock, Pit Rock and Tailings, Meadowbank Gold Project, Nunavut. Report prepared for Cumberland Resources Ltd.

HC (Health Canada), 2002. Toxicological Reference Doses for Organic Contaminants. Last updated 20 August 2002. Developed by Food Directorate of Health Canada, Ottawa, Ontario.

HC (Health Canada) 2004a. Federal Contaminated Site Risk Assessment in Canada – Part I: Guidance on Human Health Preliminary Quantitative Risk Assessment (PQRA) and Part II: Health Canada Toxicological Reference Values (TRVs). Environmental Health Assessment Services, Safe Environments Programme, Health Canada, Ottawa, Ontario.

Health Canada, 2004b. Canadian Handbook on Health Impact Assessment. Volume 3: The Multidisciplinary Team. Health Canada, Ottawa, Ontario.

Health Canada, 2010a. Federal Contaminated Site Risk Assessment in Canada – Supplemental Guidance on Human Health Risk Assessment for Country Foods (HHRAFoods). Contaminated Sites Division, Safe Environments Directorate, Health Canada, Ottawa, Ontario.

Health Canada, 2010b. Federal Contaminated Site Risk Assessment in Canada - Part II: Toxicological Reference Values (TRVs). Environmental Health Assessment Services, Safe Environments Programme, Health Canada, Ottawa, Ontario.

Health Canada, 2012. Federal Contaminated Site Risk Assessment in Canada – Part I: Guidance on Human Health Preliminary Quantitative Risk Assessment (PQRA). Revised 2012. Environmental Health Assessment Services, Safe Environments Programme, Health Canada, Ottawa, Ontario.

HC (Health Canada), 2014. Letter from Nicole Cote, Safe Environments Directorate, Health Canada. To: info@nirb.ca. Subject: Health Canada's review of the additional information provided regarding the 2011-2012 Annual Monitoring Report for the Meadowbank Gold Project, 2012 (NIRB File No. 03MN107). January 27, 2014.

IHS, 2012. 2007-2008 Inuit Health Survey – Contaminant Assessment in Nunavut. Prepared by Laurie Chan, UNBC Staff Members and Graduate Students, and the Nunavut Steering Committee of the International Polar Year Inuit Health Survey. August 2011. Revised and reprinted February, 2012.

IM (Institute of Medicine), 2001. Dietary Reference Intakes for Vitamin A, Vitamin K, Arsenic, Boron, Chromium, Copper, Iodine, Iron, Manganese, Molybdenum, Nickel, Silicon, Vanadium and Zinc. Food and Nutrition Board, Institute of Medicine. National Academy Press, Washington, DC. Available online: http://www.nap.edu/openbook.php?record_id=10026&page=525

ITER, 2012 International Toxicity Estimates for Risk (ITER) database. Bethesda, MD, National Institutes of Health, National Library of Medicine, Toxicology Data Network (TOXNET) (http://toxnet.nlm.nih.gov. Accessed March, 2012.

Larter N.C. and J.A. Nagy. 2000. A comparison of heavy metals levels in the kidneys of High Arctic and mainland caribou populations in the Northwest Territories of Canada. Science of the Total Environment 246: 109-119.

Motzer, W.E. and T. Engineers. 2004. Chemistry, geochemistry, and geology of chromium and chromium compounds. Chapter 2 from Chromium(VI) Handbook. Edited by J. Guertin, C.P. Avakian, and J.A. Jacobs. CRC Press 2004. Pages 23-91.

Mowbray, T.B., Ely, C.R., Sedinger, J.S., and Trost, R.E. 2002. Canada goose Branta Canadensis. In: A. Poole and F. Gill (eds.). The Birds of North America. No. 682. Philadelphia: The Academy of Natural Sciences; Washington, D.C.: The American Ornithologists' Union.

Richardson, G.M. 1997. Compendium of Canadian Human Exposure Factors for Risk Assessment. Ottawa: O'Connor Associates Environmental Inc.

Ritter, L., Solomon, K., Sibley, P., Hall, K., Keen, P., Mattu, G. and Linton, B. 2002. Sources, pathway, and relative risks of contaminants in surface water and groundwater: A perspective prepared for the Walkerton Inquiry. Journal of Toxicology and Environmental Health, Part A, 65:1-142.

RIVM. 2001. Re-evaluation of human-toxicological maximum permissible risk levels. National Institute of Public Health and the Environment, Bilthoven, The Netherlands, March 2001.

Schoof R.A., Yost L.J., Eickhoff J., Crecelius E.A., Cragin D.W., Meacher D.M.,and D.B. Menzel DB. 1999. A market basket survey of inorganic arsenic in food. Food Chemistry and Toxicology 37:839–846

Schuster, R.C., Gamberg, M., Dickson, C. and Chan, H.M. Assessing risk of mercury exposure and nutritional benefits of consumption of caribou (*Rangifer tarandus*) in the Ventut Gwitchin First Nation community of Old Crow, Yukon, Canada. Environmental Research, 111:881-887.

Schroeder, H.A. Balassa, J.J., and I.H. Tipton. 1961. Abnormal trace metals in man. Journal of Chronic Diseases 15: 491-462.

Senes Consultants Ltd. 2008. Final Report – Screening Level Environmental Effects Assessment Proposed Kiggavik Project. Report prepared for Areva Rsources Canada Inc. July 2008.

Tracy, B.L. and Kramer, G.H. 2000. A method for estimating caribou consumption by Northern Canadians. Arctic. 53(1):42-52.

USEPA. 2006, 2012a and 2015. Integrated Risk Information System (IRIS). US Environmental Protection Agency, Washington, DC.

USEPA 2011. Exposure Factors Handbook: 2011 Edition. Office of Research and Development, National Center for Environmental Assessment. United States Environmental Protection Agency. EPA /600/R-090/052F. Washington, DC.

USEPA 2012 a, 2015, 2018. Integrated Risk Information System. United States Environmental Protection Agency. Online. https://www.epa.gov/iris Accessed January 8, 2018.

USEPA. 2012b. Provisional Peer-Reviewed Toxicity Values for Thallium and Compounds - Final. Superfund Health Risk Technical Support Center, National Center for Environmental Assessment, Office of Research and Development. US Environmental Protection Agency. Cincinnati, OH 45268. October 25, 2012.

Wilson Scientific Consulting Inc. (Wilson). 2006. Human Health Risk Assessment of Consumption of Country Foods for the Meadowbank Gold Project. Prepared for Cumberland Resources Ltd.

Appendix A

Example Calculation

Exposure to Pb in Caribou Kidney (onsite; heavy consumption)

Following the submission of the 2011 PQRA, Health Canada requested examples of calculations. The following examples are provided and describe the calculation of the hazard quotient for exposure of adults to lead, based on the heavy consumption of caribou kidney from animals spending 33% of their time in the onsite study area, and 67% of their time at the external reference study area. Note that final values may differ slightly due to rounding.

Exposure Assessment

Muscle concentrations (C_M) were calculated as:

$$C_M = EDI_C \times W_C \times BTF$$

Where:

C_M = Concentration in muscle tissue (meat); mg/kg ww

EDI_C = estimated daily intake of COPC by caribou; mg/kg ww/d (see accompanying wildlife SLRA for calculations)

W_C = caribou weight; kg

BTF = biotransfer factor (feed to muscle; beef); d/kg ww

Example:

C_M (mg/kg ww) = 0.184 mg/kg ww/d x 75 kg x 0.0004 d/kg ww

= 0.00552

Kidney concentrations (C_K) and liver concentrations (C_L) were calculated as:

$$C_K \text{ or } C_L = C_M \times BTF$$

Where:

C_K = concentration of COPC in caribou kidney; mg/kg ww

C_L = concentration of COPC in caribou liver; mg/kg ww

C_M = concentration of COPC in caribou muscle; mg/kg ww

BTF = transfer factor (muscle to organ; caribou)

Example:

C_K (mg/kg ww) = 0.00516 mg/kg ww x 33.19

= 0.184

Human exposure concentrations through consumption were calculated as:

$$Dose = C_F \times IR_F \times RAF_{ORAL} / BW$$

Where:

Dose = estimated daily intake of COPC from consumption of food item; ug/kg bw/day

C_F = concentration of COPC in food item; mg/kg ww

IR_F = consumption rate of food item; g/day

RAF_{ORAL} = relative absorption factor (assumed to be 1)

BW = body weight of person; kg

Example:

Dose (ug/kg bw/d) = 0.184 mg/kg ww x 2.9 g/d x 1 / 70.7 kg

= 0.0075

Risk Characterization

HQ = Dose (ug/kg ww/d) / TDI (ug/kg bw/d)**

= 0.0075 / 0.1

= 0.07 (rounded to 0.1 in assessment)

**see values in Appendix D

Appendix B

Transfer Factors

Transfer Factors

Feed-to-muscle transfer factors were obtained from the following sources. For caribou, all values are for beef, with the exception of selenium, which is for pig. All muscle-to-organ factors were obtained from Gamberg, 2012. All values for Canada goose are for chicken.

COPC	Caribou				Canada Goose	
	Feed-to-Muscle (d/kg)	Source	Muscle-to-Kidney	Muscle-to-Liver	Feed-to-Muscle (d/kg)	Source
Antimony	0.0012	IAEA 2010	1.17	0.82	0.006	Staven et al. 2003
Arsenic	0.002	USEPA 2005	6.45	0.64	0.83	Staven et al. 2003
Barium	0.00014	IAEA 2010	40.9	2.66	0.019	IAEA 2010
Beryllium	0.001	USEPA 2005	2.33	0.87	0.4	Staven et al. 2003
Cadmium	0.0058	IAEA 2010	2049	287	1.75	IAEA 2010
Chromium	0.0055	USEPA 2005	0.52	0.78	0.8	Staven et al. 2003
Cobalt	0.00043	IAEA 2010	10.5	18.6	0.97	IAEA 2010
Copper	0.01	RAIS 2012	2.06	13.7	0.5	Staven et al. 2003
Lead	0.0007	IAEA 2010	33.2	250	0.8	IAEA 2010
Manganese	0.0005	IAEA 2010	0.85	0.68	0.05	IAEA 2010
Mercury (inorganic)	0.00609	NCRP 1989	105	15.0	0.03	IAEA 2010
Mercury (methyl)	0.00078	USEPA 2005	105	15.0	0.03	Staven et al. 2003
Molybdenum	0.001	IAEA 2010	44.2	153	0.18	IAEA 2010
Nickel	0.006	USEPA 2005	1.68	1.21	0.001	Staven et al. 2003
Selenium	0.32	IAEA 2010	19.3	2.28	9.7	IAEA 2010
Strontium	0.008	IAEA 2010	5.27	1.28	0.08	Staven et al. 2003
Thallium	0.04	USEPA 2005	14.9	2.51	0.8	Staven et al. 2003
Tin	0.001	RAIS 2012	3.88	9.44	0.8	IAEA 2010
Uranium	0.00039	IAEA 2010	3.23	2.61	0.75	IAEA 2010
Vanadium	0.0025	RAIS 2012	4.33	5.85	2	Staven et al. 2003
Zinc	0.16	IAEA 2010	0.95	1.11	0.47	IAEA 2010

References

IAEA, 2010. Handbook of parameter values for the prediction of radionuclide transfer in terrestrial and freshwater environments. International Atomic Energy Agency. Technical reports series, ISSN 0074–1914; No. 47. Vienna, Austria.

Gamberg, M., 2012. Caribou muscle-to-organ transfer factors for metals. Unpublished. Personal communication (mary.gamberg@gmail.com). February 28, 2012.

NCRP. 1989. Screening Techniques for Determining Compliance with Environmental Standards. Releases of Radionuclides to the Atmosphere. National Council on Radiation Protection and Measurements, Bethesda, Maryland.

RAIS, 2012. Chemical Specific Parameters. The Risk Assessment Information System. University of Tennesee. Available at: http://rais.ornl.gov/cgi-bin/tools/TOX_search?select=chem_spef. Accessed March, 2012.

Staven, L.H., Rhoads, K., Napier, B.A. and D.L. Strenge. 2003. A Compendium of Transfer Factors for Agricultural and Animal Products. Pacific Northwest National Laboratory. PNNL-13421. Prepared for the U.S. Department of Energy. June, 2003.

USEPA, 2005. The Hazardous Waste Companion Database. Human Health Risk Assessment Protocol (HHRAP) for Hazardous Waste Combustion Facilities, Final. United States Environmental Protection Agency. Available at: http://www.epa.gov/wastes/hazard/tsd/td/combust/risk.htm. Accessed March, 2012.

Appendix C

Measured and Estimated COPC Concentrations in Soil, Plants, Insects and Water

Measured and Estimated COPC Concentrations
Onsite Location - 2017
(table based on Azimuth, 2006)

	Units	Moisture Content[1] (%)	COPC Concentrations										
			Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Lead	Manganese	Total Mercury
Soil (measured)													
Maximum	mg/kg dw	-	0.280	32.700	66.500	0.730	0.180	147.000	16.000	25.800	18.400	472.000	0.056
Lake Water (measured)													
Maximum	mg/L	-	0.000	0.000	0.005	0.000	0.000	0.000	0.000	0.002	0.000	0.004	0.000
Sedges (measured)													
Maximum	mg/kg ww	29.50%	0.008	0.743	32.700	0.019	0.076	7.730	0.673	2.900	1.070	336.000	0.012
Lichen (measured)													
Maximum	mg/kg ww	16.80%	0.045	5.250	26.400	0.189	0.166	81.100	3.660	7.610	5.830	248.000	0.222
Berries (measured)													
Maximum	mg/kg ww	86.20%	0.001	0.027	1.050	0.001	0.011	0.195	0.025	0.874	0.014	17.700	0.001
Insects (predicted)[3]													
Maximum	mg/kg dw		0.280	2.211	66.500	0.730	0.509	147.000	16.000	18.683	1.505	472.000	0.056
	mg/kg ww	65.00%	0.098	0.774	23.275	0.256	0.178	51.450	5.600	6.539	0.527	165.200	0.020

Notes:

[1] Moisture content for plants represents average of available site-specific data; moisture content for insects based on Azimuth (2006)

[2] Assumed fractions of MeHg in exposure media (see text for details)

Soil (soilmeHg)	0.01	
Plants (plantmeHG)	0.34	
Invertebrates	0.17	
Water	0	Assumed to be zero

[3] Predicted using soil concentration and insect BAF; see Azimuth, 2006)

Measured and Estimated COPC Concentrations
Onsite Location - 2017
(table based on Azimuth, 2006)

		COPC Concentrations										
	Units	Inorg-Hg[2]	MeHg[2]	Molybdenum	Nickel	Selenium	Strontium	Thallium	Tin	Uranium	Vanadium	Zinc
Soil (measured)												
Maximum	mg/kg dw	0.055	0.001	1.250	78.100	0.100	17.000	0.181	1.000	4.320	29.800	53.200
Lake Water (measured)												
Maximum	mg/L	0.000	0.000	0.000	0.001	0.000	0.020	0.000	0.000	0.000	0.000	0.004
Sedges (measured)												
Maximum	mg/kg ww	0.008	0.004	1.160	4.440	0.020	10.100	0.006	0.034	0.152	1.340	20.600
Lichen (measured)												
Maximum	mg/kg ww	0.147	0.075	1.260	27.600	0.141	19.000	0.067	0.075	1.060	11.600	26.000
Berries (measured)												
Maximum	mg/kg ww	0.000	0.000	0.259	0.005	0.429	0.000	0.063	0.006	0.026	1.680	2.760
Insects (predicted)[3]												
Maximum	mg/kg dw	0.055	0.001	1.250	78.100	0.100	17.000	0.181	1.000	4.320	29.800	191.386
	mg/kg ww	0.019	0.000	0.438	27.335	0.035	5.950	0.063	0.350	1.512	10.430	66.985

Notes:

[1] Moisture content for plants represents average of available site-specific data; moisture content for insects based on Azimuth (2006)

[2] Assumed fractions of MeHg in exposure media (see text for details)

Soil (soilmeHg)	0.01	
Plants (plantmeHG)	0.34	
Invertebrates	0.17	
Water	0	Assumed to be zero

[3] Predicted using soil concentration and insect BAF; see Azimuth, 2006)

Measured and Estimated COPC Concentrations
Near-site Locations - 2017
(table based on Azimuth, 2006)

	Units	Moisture Content[1] (%)	COPC Concentrations										
			Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Lead	Manganese	Total Mercury
Soil (measured)													
Maximum	mg/kg dw	-	0.050	24.500	54.900	0.540	0.163	101.000	10.500	18.200	13.100	331.000	0.077
Lake Water (measured)													
Maximum	mg/L	-	0.000	0.000	0.003	0.000	0.000	0.000	0.000	0.001	0.000	0.001	0.000
Sedges (measured)													
Maximum	mg/kg ww	33.90%	0.006	0.316	21.100	0.028	0.027	5.320	0.342	1.910	0.277	196.000	0.009
Lichen (measured)													
Maximum	mg/kg ww	23.10%	0.099	7.680	45.600	0.389	0.147	72.300	2.580	5.960	5.700	177.000	0.238
Berries (measured)													
Maximum	mg/kg ww	86.00%	0.003	0.015	2.150	0.001	0.026	0.145	0.016	0.795	0.011	25.500	0.001
Insects (predicted)[3]													
Maximum	mg/kg dw		0.050	1.690	54.900	0.540	0.479	101.000	10.500	16.767	1.186	331.000	0.077
	mg/kg ww	65.00%	0.018	0.592	19.215	0.189	0.168	35.350	3.675	5.869	0.415	115.850	0.027

Notes:

[1] Moisture content for plants represents average of available site-specific data; moisture content for insects based on Azimuth (2006)

[2] Assumed fractions of MeHg in exposure media (see text for details)

Soil (soilmeHg)	0.01	
Plants (plantmeHG)	0.34	
Invertebrates	0.17	
Water	0	Assumed to be zero

[3] Predicted using soil concentration and insect BAF; see Azimuth, 2006)

Measured and Estimated COPC Concentrations
Near-site Locations - 2017
(table based on Azimuth, 2006)

		COPC Concentrations										
	Units	Inorg-Hg[2]	MeHg[2]	Molybdenum	Nickel	Selenium	Strontium	Thallium	Tin	Uranium	Vanadium	Zinc
Soil (measured)												
Maximum	mg/kg dw	0.076	0.001	1.410	45.100	0.100	16.800	0.192	1.000	5.010	28.600	46.100
Lake Water (measured)												
Maximum	mg/L	0.000	0.000	0.000	0.000	0.000	0.019	0.000	0.000	0.000	0.000	0.002
Sedges (measured)												
Maximum	mg/kg ww	0.006	0.003	0.862	2.600	0.021	7.040	0.006	0.010	0.173	0.573	18.200
Lichen (measured)												
Maximum	mg/kg ww	0.157	0.081	0.647	24.100	0.181	15.400	0.047	0.102	1.380	6.460	32.200
Berries (measured)												
Maximum	mg/kg ww	0.000	0.000	0.316	0.005	0.520	0.000	0.062	0.004	0.028	2.240	1.870
Insects (predicted)[3]												
Maximum	mg/kg dw	0.076	0.001	1.410	45.100	0.100	16.800	0.192	1.000	5.010	28.600	185.449
	mg/kg ww	0.027	0.000	0.494	15.785	0.035	5.880	0.067	0.350	1.754	10.010	64.907

Notes:

[1] Moisture content for plants represents average of available site-specific data; moisture content for insects based on Azimuth (2006)

[2] Assumed fractions of MeHg in exposure media (see text for details)

Soil (soilmeHg)	0.01	
Plants (plantmeHG)	0.34	
Invertebrates	0.17	
Water	0	Assumed to be zero

[3] Predicted using soil concentration and insect BAF; see Azimuth, 2006)

Measured and Estimated COPC Concentrations
Onsite+Near-site Locations - 2017
(table based on Azimuth, 2006)

	Units	Moisture Content[1] (%)	COPC Concentrations										
			Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Lead	Manganese	Total Mercury
Soil (measured)													
Maximum	mg/kg dw	-	0.280	32.700	66.500	0.730	0.180	147.000	16.000	25.800	18.400	472.000	0.077
Lake Water (measured)													
Maximum	mg/L	-	0.000	0.000	0.005	0.000	0.000	0.000	0.000	0.002	0.000	0.004	0.000
Sedges (measured)													
Maximum	mg/kg ww	30.90%	0.008	0.743	32.700	0.028	0.076	7.730	0.673	2.900	1.070	336.000	0.012
Lichen (measured)													
Maximum	mg/kg ww	19.50%	0.099	7.680	45.600	0.389	0.166	81.100	3.660	7.610	5.830	248.000	0.238
Berries (measured)													
Maximum	mg/kg ww	86.10%	0.003	0.027	2.150	0.001	0.026	0.195	0.025	0.874	0.014	25.500	0.001
Insects (predicted)[3]													
Maximum	mg/kg dw		0.280	2.211	66.500	0.730	0.509	147.000	16.000	18.683	1.505	472.000	0.077
	mg/kg ww	65.00%	0.098	0.774	23.275	0.256	0.178	51.450	5.600	6.539	0.527	165.200	0.027

Notes:

[1] Moisture content for plants represents average of available site-specific data; moisture content for insects based on Azimuth (2006)

[2] Assumed fractions of MeHg in exposure media (see text for details)

Soil (soilmeHg)	0.01	
Plants (plantmeHG)	0.34	
Invertebrates	0.17	
Water	0	Assumed to be zero

[3] Predicted using soil concentration and insect BAF; see Azimuth, 2006)

Measured and Estimated COPC Concentrations
Onsite+Near-site Locations - 2017
(table based on Azimuth, 2006)

		COPC Concentrations										
	Units	Inorg-Hg[2]	MeHg[2]	Molybdenum	Nickel	Selenium	Strontium	Thallium	Tin	Uranium	Vanadium	Zinc
Soil (measured)												
Maximum	mg/kg dw	0.076	0.001	1.410	78.100	0.100	17.000	0.192	1.000	5.010	29.800	53.200
Lake Water (measured)												
Maximum	mg/L	0.000	0.000	0.000	0.001	0.000	0.020	0.000	0.000	0.000	0.000	0.004
Sedges (measured)												
Maximum	mg/kg ww	0.008	0.004	1.160	4.440	0.021	10.100	0.006	0.034	0.173	1.340	20.600
Lichen (measured)												
Maximum	mg/kg ww	0.157	0.081	1.260	27.600	0.181	19.000	0.067	0.102	1.380	11.600	32.200
Berries (measured)												
Maximum	mg/kg ww	0.000	0.000	0.316	0.005	0.520	0.000	0.063	0.006	0.028	2.240	2.760
Insects (predicted)[3]												
Maximum	mg/kg dw	0.076	0.001	1.410	78.100	0.100	17.000	0.192	1.000	5.010	29.800	191.386
	mg/kg ww	0.027	0.000	0.494	27.335	0.035	5.950	0.067	0.350	1.754	10.430	66.985

Notes:

[1] Moisture content for plants represents average of available site-specific data; moisture content for insects based on Azimuth (2006)

[2] Assumed fractions of MeHg in exposure media (see text for details)

Soil (soilmeHg)	0.01	
Plants (plantmeHG)	0.34	
Invertebrates	0.17	
Water	0	Assumed to be zero

[3] Predicted using soil concentration and insect BAF; see Azimuth, 2006)

Measured and Estimated COPC Concentrations
AWAR Locations - 2017
(table based on Azimuth, 2006)

	Units	Moisture Content[1] (%)	COPC Concentrations										
			Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Lead	Manganese	Total Mercury
Soil (measured)													
Maximum	mg/kg dw	-	0.050	2.710	38.500	0.310	0.039	37.500	6.400	11.600	5.730	234.000	0.003
Lake Water (measured)													
Maximum	mg/L	-	0.000	0.000	0.003	0.000	0.000	0.000	0.000	0.001	0.000	0.001	0.000
Sedges (measured)													
Maximum	mg/kg ww	31.00%	0.009	0.602	30.900	0.024	0.063	9.310	1.060	3.760	0.207	467.000	0.009
Lichen (measured)													
Maximum	mg/kg ww	12.60%	0.062	3.520	54.400	0.115	0.243	48.200	5.650	10.500	4.340	724.000	0.137
Berries (measured)													
Maximum	mg/kg ww	86.40%	0.001	0.020	1.290	0.001	0.020	0.145	0.016	0.724	0.008	40.500	0.001
Insects (predicted)[3]													
Maximum	mg/kg dw		0.050	0.218	38.500	0.310	0.200	37.500	6.400	14.582	0.665	234.000	0.003
	mg/kg ww	65.00%	0.018	0.076	13.475	0.109	0.070	13.125	2.240	5.104	0.233	81.900	0.001

Notes:

[1] Moisture content for plants represents average of available site-specific data; moisture content for insects based on Azimuth (2006)

[2] Assumed fractions of MeHg in exposure media (see text for details)

Soil (soilmeHg)	0.01	
Plants (plantmeHG)	0.34	
Invertebrates	0.17	
Water	0	Assumed to be zero

[3] Predicted using soil concentration and insect BAF; see Azimuth, 2006)

Measured and Estimated COPC Concentrations
AWAR Locations - 2017
(table based on Azimuth, 2006)

		COPC Concentrations										
	Units	Inorg-Hg[2]	MeHg[2]	Molybdenum	Nickel	Selenium	Strontium	Thallium	Tin	Uranium	Vanadium	Zinc
Soil (measured)												
Maximum	mg/kg dw	0.002	0.000	0.660	17.300	0.100	22.600	0.103	1.000	2.750	20.300	27.000
Lake Water (measured)												
Maximum	mg/L	0.000	0.000	0.000	0.000	0.000	0.019	0.000	0.000	0.000	0.000	0.002
Sedges (measured)												
Maximum	mg/kg ww	0.006	0.003	2.150	5.390	0.017	15.400	0.004	0.025	0.102	2.060	23.400
Lichen (measured)												
Maximum	mg/kg ww	0.090	0.047	0.487	21.800	0.160	41.000	0.031	0.099	0.844	11.600	46.000
Berries (measured)												
Maximum	mg/kg ww	0.000	0.000	0.386	0.005	0.488	0.000	0.037	0.002	0.030	2.810	2.910
Insects (predicted)[3]												
Maximum	mg/kg dw	0.002	0.000	0.660	17.300	0.100	22.600	0.103	1.000	2.750	20.300	164.858
	mg/kg ww	0.001	0.000	0.231	6.055	0.035	7.910	0.036	0.350	0.963	7.105	57.700

Notes:

[1] Moisture content for plants represents average of available site-specific data; moisture content for insects based on Azimuth (2006)

[2] Assumed fractions of MeHg in exposure media (see text for details)

Soil (soilmeHg)	0.01	
Plants (plantmeHG)	0.34	
Invertebrates	0.17	
Water	0	Assumed to be zero

[3] Predicted using soil concentration and insect BAF; see Azimuth, 2006)

Measured and Estimated COPC Concentrations
External Reference Locations - 2017
(table based on Azimuth, 2006)

	Units	Moisture Content[1] (%)	COPC Concentrations										
			Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Lead	Manganese	Total Mercury
Soil (measured)													
Maximum	mg/kg dw	-	0.120	36.100	37.200	0.400	0.170	150.000	12.800	18.900	13.800	326.000	0.015
Lake Water (measured)													
Maximum	mg/L	-	0.000	0.000	0.002	0.000	0.000	0.005	0.000	0.001	0.000	0.003	0.000
Sedges (measured)													
Maximum	mg/kg ww	36.80%	0.002	0.052	16.700	0.006	0.039	0.905	0.193	1.480	0.143	433.000	0.012
Lichen (measured)													
Maximum	mg/kg ww	8.60%	0.016	0.807	18.900	0.026	0.134	11.200	1.250	1.900	2.970	82.900	0.264
Berries (measured)													
Maximum	mg/kg ww	88.60%	0.001	0.002	1.090	0.001	0.009	0.151	0.011	0.659	0.005	9.320	0.001
Insects (predicted)[3]													
Maximum	mg/kg dw		0.120	2.424	37.200	0.400	0.491	150.000	12.800	16.965	1.230	326.000	0.015
	mg/kg ww	65.00%	0.042	0.848	13.020	0.140	0.172	52.500	4.480	5.938	0.431	114.100	0.005

Notes:

[1] Moisture content for plants represents average of available site-specific data; moisture content for insects based on Azimuth (2006)

[2] Assumed fractions of MeHg in exposure media (see text for details)

Soil (soilmeHg)	0.01	
Plants (plantmeHG)	0.34	
Invertebrates	0.17	
Water	0	Assumed to be zero

[3] Predicted using soil concentration and insect BAF; see Azimuth, 2006)

Measured and Estimated COPC Concentrations
External Reference Locations - 2017
(table based on Azimuth, 2006)

		COPC Concentrations										
	Units	Inorg-Hg[2]	MeHg[2]	Molybdenum	Nickel	Selenium	Strontium	Thallium	Tin	Uranium	Vanadium	Zinc
Soil (measured)												
Maximum	mg/kg dw	0.015	0.000	0.870	71.800	0.100	33.000	0.122	1.000	2.880	31.400	73.300
Lake Water (measured)												
Maximum	mg/L	0.000	0.000	0.001	0.001	0.000	0.010	0.000	0.000	0.000	0.000	0.004
Sedges (measured)												
Maximum	mg/kg ww	0.008	0.004	1.660	7.280	0.021	7.350	0.005	0.010	0.010	0.112	43.900
Lichen (measured)												
Maximum	mg/kg ww	0.174	0.090	0.205	32.700	0.140	8.120	0.014	0.050	0.089	1.560	15.700
Berries (measured)												
Maximum	mg/kg ww	0.000	0.000	0.623	0.005	0.598	0.000	0.050	0.000	0.010	0.970	1.990
Insects (predicted)[3]												
Maximum	mg/kg dw	0.015	0.000	0.870	71.800	0.100	33.000	0.122	1.000	2.880	31.400	205.368
	mg/kg ww	0.005	0.000	0.305	25.130	0.035	11.550	0.043	0.350	1.008	10.990	71.879

Notes:

[1] Moisture content for plants represents average of available site-specific data; moisture content for insects based on Azimuth (2006)

[2] Assumed fractions of MeHg in exposure media (see text for details)

Soil (soilmeHg)	0.01	
Plants (plantmeHG)	0.34	
Invertebrates	0.17	
Water	0	Assumed to be zero

[3] Predicted using soil concentration and insect BAF; see Azimuth, 2006)

Appendix D

Toxicity Reference Values and Hazard Quotient Calculation

HQ Calculations for Consumption of Caribou Muscle
Onsite + Near-site - 2017

(modified from Azimuth, 2006)

Parameter	Dietary Preference		Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Lead
Transfer Factor (beef)			0.0012	0.002	0.00014	0.001	0.0058	0.0055	0.00043	0.01	0.0007
Animal Dose[1]	**Soil**		0.000	0.044	0.090	0.001	0.000	0.198	0.022	0.035	0.025
(mg/kg wet·day)	**Water**		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	Sedges	30%	0.000	0.008	0.341	0.000	0.001	0.081	0.007	0.030	0.011
	Lichens	65%	0.002	0.174	1.031	0.009	0.004	1.834	0.083	0.172	0.132
	Berries	5%	0.000	0.000	0.004	0.000	0.000	0.000	0.000	0.002	0.000
	Insects	0%	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	Total Food	100%	0.002	0.181	1.376	0.009	0.005	1.915	0.090	0.204	0.143
Concentration in Animal Tissue[2] (mg/kg wet)			0.000	0.000	0.010	0.000	0.002	0.416	0.002	0.102	0.006
Human Dose-Adult	*Consumption Rate*										
(ug/kg body weight·day)	**Heavy**		0.001	0.001	0.060	0.002	0.011	2.590	0.014	0.634	0.037
	Moderate		0.000	0.001	0.028	0.001	0.005	1.224	0.007	0.300	0.018
	Low		0.000	0.000	0.009	0.000	0.002	0.383	0.002	0.094	0.005
Human Dose-Toddler	*Consumption Rate*										
(ug/kg body weight·day)	**Heavy**		0.001	0.002	0.111	0.004	0.020	4.772	0.025	1.167	0.069
	Moderate		0.001	0.001	0.052	0.002	0.010	2.255	0.012	0.552	0.032
	Low		0.000	0.000	0.009	0.000	0.002	0.378	0.002	0.093	0.005
TDI (ug/kg bw·day)			0.40	0.30	200	2.0	1.0	1.0	1.4	91	0.10
Hazard Quotients-Adult	*Consumption Rate*										
(unitless)	**Heavy**		0.0	0.0	0.0	0.0	0.0	2.6	0.0	0.0	0.4
	Moderate		0.0	0.0	0.0	0.0	0.0	1.2	0.0	0.0	0.2
	Low		0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.1
Hazard Quotients-Toddler	*Consumption Rate*										
(unitless)	**Heavy**		0.0	0.0	0.0	0.0	0.0	4.8	0.0	0.0	0.7
	Moderate		0.0	0.0	0.0	0.0	0.0	2.3	0.0	0.0	0.3
	Low		0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.1

Notes:

1 - Animal dose per day for onsite area only

2 - Concentration based on time onsite (33%) plus time at external reference (67%). See text.

HQ Calculations for Consumption of Caribou Muscle
Onsite + Near-site - 2017

(modified from Azimuth, 2006)

Parameter	Dietary Preference		Manganese	Inorg Hg	MeHg	Molybdenum	Nickel	Selenium	Strontium	Thallium	Tin
Transfer Factor (beef)			0.0005	0.00609	0.00078	0.001	0.006	0.32	0.008	0.04	0.001
Animal Dose[1]	**Soil**		0.636	0.000	0.000	0.002	0.105	0.000	0.023	0.000	0.001
(mg/kg wet·day)	**Water**		0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000
	Sedges	30%	3.506	0.000	0.000	0.012	0.046	0.000	0.105	0.000	0.000
	Lichens	65%	5.607	0.004	0.002	0.028	0.624	0.004	0.430	0.002	0.002
	Berries	5%	0.044	0.000	0.000	0.001	0.000	0.001	0.000	0.000	0.000
	Insects	0%	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	Total Food	100%	9.158	0.004	0.002	0.041	0.670	0.005	0.535	0.002	0.003
Concentration in Animal Tissue[2] (mg/kg wet)			0.293	0.002	0.000	0.002	0.390	0.116	0.233	0.003	0.000
Human Dose-Adult	*Consumption Rate*										
(ug/kg body weight·day)	**Heavy**		1.825	0.011	0.001	0.014	2.428	0.720	1.453	0.020	0.001
	Moderate		0.863	0.005	0.000	0.007	1.148	0.340	0.687	0.009	0.001
	Low		0.270	0.002	0.000	0.002	0.359	0.106	0.215	0.003	0.000
Human Dose-Toddler	*Consumption Rate*										
(ug/kg body weight·day)	**Heavy**		3.363	0.021	0.001	0.026	4.474	1.327	2.677	0.036	0.003
	Moderate		1.589	0.010	0.001	0.012	2.114	0.627	1.265	0.017	0.001
	Low		0.267	0.002	0.000	0.002	0.355	0.105	0.212	0.003	0.000
TDI (ug/kg bw·day)			136	0.30	0.20	23000	20	6200	600	0.01	300
Hazard Quotients-Adult	*Consumption Rate*										
(unitless)	**Heavy**		0.0	0.0	0.0	0.0	0.1	0.0	0.0	2.0	0.0
	Moderate		0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.9	0.0
	Low		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0
Hazard Quotients-Toddler	*Consumption Rate*										
(unitless)	**Heavy**		0.0	0.1	0.0	0.0	0.2	0.0	0.0	3.6	0.0
	Moderate		0.0	0.0	0.0	0.0	0.1	0.0	0.0	1.7	0.0
	Low		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0

Notes:

1 - Animal dose per day for onsite area only

2 - Concentration based on time onsite (33%) plus time at external reference (67%). See text.

HQ Calculations for Consumption of Caribou Muscle
Onsite + Near-site - 2017

(modified from Azimuth, 2006)

Parameter	Dietary Preference		Uranium	Vanadium	Zinc
Transfer Factor (beef)			0.00039	0.0025	0.16
Animal Dose[1]	**Soil**		0.007	0.040	0.072
(mg/kg wet·day)	**Water**		0.000	0.000	0.000
	Sedges	30%	0.002	0.014	0.215
	Lichens	65%	0.031	0.262	0.728
	Berries	5%	0.000	0.004	0.005
	Insects	0%	0.000	0.000	0.000
	Total Food	100%	0.033	0.280	0.948
Concentration in Animal Tissue[2]			0.001	0.030	11.398
(mg/kg wet)					
Human Dose-Adult	*Consumption Rate*				
(ug/kg body weight·day)	**Heavy**		0.003	0.186	70.937
	Moderate		0.001	0.088	33.534
	Low		0.000	0.028	10.479
Human Dose-Toddler	*Consumption Rate*				
(ug/kg body weight·day)	**Heavy**		0.006	0.343	130.700
	Moderate		0.003	0.162	61.758
	Low		0.000	0.027	10.362
TDI (ug/kg bw·day)			0.60	5.0	480
Hazard Quotients-Adult	*Consumption Rate*				
(unitless)	**Heavy**		0.0	0.0	0.1
	Moderate		0.0	0.0	0.1
	Low		0.0	0.0	0.0
Hazard Quotients-Toddler	*Consumption Rate*				
(unitless)	**Heavy**		0.0	0.1	0.3
	Moderate		0.0	0.0	0.1
	Low		0.0	0.0	0.0

Notes:

1 - Animal dose per day for onsite area only

2 - Concentration based on time onsite (33%) plus time at external reference (67%). See text.

HQ Calculations for Consumption of Caribou Muscle
AWAR Location - 2017

(modified from Azimuth, 2006)

Parameter	Dietary Preference		Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Lead
Transfer Factor (beef)			0.0012	0.002	0.00014	0.001	0.0058	0.0055	0.00043	0.01	0.0007
Animal Dose[1]	**Soil**		0.000	0.004	0.052	0.000	0.000	0.050	0.009	0.016	0.008
(mg/kg wet·day)	**Water**		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	Sedges	30%	0.000	0.006	0.322	0.000	0.001	0.097	0.011	0.039	0.002
	Lichens	65%	0.001	0.080	1.230	0.003	0.005	1.090	0.128	0.237	0.098
	Berries	5%	0.000	0.000	0.002	0.000	0.000	0.000	0.000	0.001	0.000
	Insects	0%	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	Total Food	100%	0.001	0.086	1.555	0.003	0.006	1.187	0.139	0.278	0.100
Concentration in Animal Tissue[2] (mg/kg wet)			0.000	0.000	0.010	0.000	0.002	0.297	0.003	0.115	0.005
Human Dose-Adult	*Consumption Rate*										
(ug/kg body weight·day)	**Heavy**		0.000	0.001	0.063	0.001	0.012	1.849	0.016	0.718	0.031
	Moderate		0.000	0.000	0.030	0.000	0.006	0.874	0.008	0.339	0.015
	Low		0.000	0.000	0.009	0.000	0.002	0.273	0.002	0.106	0.005
Human Dose-Toddler	*Consumption Rate*										
(ug/kg body weight·day)	**Heavy**		0.001	0.001	0.117	0.002	0.023	3.406	0.030	1.323	0.057
	Moderate		0.000	0.001	0.055	0.001	0.011	1.609	0.014	0.625	0.027
	Low		0.000	0.000	0.009	0.000	0.002	0.270	0.002	0.105	0.004
TDI (ug/kg bw·day)			0.40	0.30	200	2.0	1.0	1.0	1.4	91	0.10
Hazard Quotients-Adult	*Consumption Rate*										
(unitless)	**Heavy**		0.0	0.0	0.0	0.0	0.0	1.8	0.0	0.0	0.3
	Moderate		0.0	0.0	0.0	0.0	0.0	0.9	0.0	0.0	0.1
	Low		0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0
Hazard Quotients-Toddler	*Consumption Rate*										
(unitless)	**Heavy**		0.0	0.0	0.0	0.0	0.0	3.4	0.0	0.0	0.6
	Moderate		0.0	0.0	0.0	0.0	0.0	1.6	0.0	0.0	0.3
	Low		0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0

Notes:

1 - Animal dose per day for AWAR area only

2 - Concentration based on time in AWAR area (33%) plus time at external reference (67%). See text.

HQ Calculations for Consumption of Caribou Muscle
AWAR Location - 2017

(modified from Azimuth, 2006)

Parameter	Dietary Preference		Manganese	Inorg Hg	MeHg	Molybdenum	Nickel	Selenium	Strontium	Thallium	Tin
Transfer Factor (beef)			0.0005	0.00609	0.00078	0.001	0.006	0.32	0.008	0.04	0.001
Animal Dose[1]	**Soil**		0.315	0.000	0.000	0.001	0.023	0.000	0.030	0.000	0.001
(mg/kg wet·day)	**Water**		0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000
	Sedges	30%	4.873	0.000	0.000	0.022	0.056	0.000	0.161	0.000	0.000
	Lichens	65%	16.369	0.002	0.001	0.011	0.493	0.004	0.927	0.001	0.002
	Berries	5%	0.070	0.000	0.000	0.001	0.000	0.001	0.000	0.000	0.000
	Insects	0%	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	Total Food	100%	21.313	0.002	0.001	0.034	0.549	0.005	1.088	0.001	0.003
Concentration in Animal Tissue[2] (mg/kg wet)			0.440	0.002	0.000	0.002	0.360	0.111	0.344	0.002	0.000
Human Dose-Adult	*Consumption Rate*										
(ug/kg body weight·day)	**Heavy**		2.736	0.010	0.001	0.013	2.240	0.692	2.143	0.014	0.001
	Moderate		1.294	0.005	0.000	0.006	1.059	0.327	1.013	0.006	0.001
	Low		0.404	0.001	0.000	0.002	0.331	0.102	0.317	0.002	0.000
Human Dose-Toddler	*Consumption Rate*										
(ug/kg body weight·day)	**Heavy**		5.042	0.018	0.001	0.024	4.128	1.275	3.949	0.025	0.003
	Moderate		2.382	0.008	0.001	0.011	1.950	0.602	1.866	0.012	0.001
	Low		0.400	0.001	0.000	0.002	0.327	0.101	0.313	0.002	0.000
TDI (ug/kg bw·day)			136	0.30	0.20	23000	20	6200	600	0.01	300
Hazard Quotients-Adult	*Consumption Rate*										
(unitless)	**Heavy**		0.0	0.0	0.0	0.0	0.1	0.0	0.0	1.4	0.0
	Moderate		0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.6	0.0
	Low		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0
Hazard Quotients-Toddler	*Consumption Rate*										
(unitless)	**Heavy**		0.0	0.1	0.0	0.0	0.2	0.0	0.0	2.5	0.0
	Moderate		0.0	0.0	0.0	0.0	0.1	0.0	0.0	1.2	0.0
	Low		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0

Notes:

1 - Animal dose per day for AWAR area only

2 - Concentration based on time in AWAR area (33%) plus time at external reference (67%). See text.

HQ Calculations for Consumption of Caribou Muscle
AWAR Location - 2017

(modified from Azimuth, 2006)

Parameter	Dietary Preference		Uranium	Vanadium	Zinc
Transfer Factor (beef)			0.00039	0.0025	0.16
Animal Dose[1]	**Soil**		0.004	0.027	0.036
(mg/kg wet·day)	**Water**		0.000	0.000	0.000
	Sedges	30%	0.001	0.021	0.244
	Lichens	65%	0.019	0.262	1.040
	Berries	5%	0.000	0.005	0.005
	Insects	0%	0.000	0.000	0.000
	Total Food	100%	0.020	0.289	1.289
Concentration in Animal Tissue[2]			0.000	0.030	12.610
(mg/kg wet)					
Human Dose-Adult	*Consumption Rate*				
(ug/kg body weight·day)	**Heavy**		0.002	0.185	78.480
	Moderate		0.001	0.087	37.100
	Low		0.000	0.027	11.594
Human Dose-Toddler	*Consumption Rate*				
(ug/kg body weight·day)	**Heavy**		0.004	0.340	144.599
	Moderate		0.002	0.161	68.325
	Low		0.000	0.027	11.464
TDI (ug/kg bw·day)			0.60	5.0	480
Hazard Quotients-Adult	*Consumption Rate*				
(unitless)	**Heavy**		0.0	0.0	0.2
	Moderate		0.0	0.0	0.1
	Low		0.0	0.0	0.0
Hazard Quotients-Toddler	*Consumption Rate*				
(unitless)	**Heavy**		0.0	0.1	0.3
	Moderate		0.0	0.0	0.1
	Low		0.0	0.0	0.0

Notes:

1 - Animal dose per day for AWAR area only

2 - Concentration based on time in AWAR area (33%) plus time at external reference (67%). See text.

HQ Calculations for Consumption of Caribou Muscle
External Reference - 2017

(modified from Azimuth, 2006)

Parameter	Dietary Preference		Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Lead
Transfer Factor (beef)			0.0012	0.002	0.00014	0.001	0.0058	0.0055	0.00043	0.01	0.0007
Animal Dose[1]	**Soil**		0.000	0.049	0.050	0.001	0.000	0.202	0.017	0.025	0.019
(mg/kg wet·day)	**Water**		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	Sedges	30%	0.000	0.001	0.174	0.000	0.000	0.009	0.002	0.015	0.001
	Lichens	65%	0.000	0.018	0.427	0.001	0.003	0.253	0.028	0.043	0.067
	Berries	5%	0.000	0.000	0.002	0.000	0.000	0.000	0.000	0.001	0.000
	Insects	0%	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	Total Food	100%	0.000	0.019	0.603	0.001	0.003	0.263	0.030	0.060	0.069
Concentration in Animal Tissue[2] (mg/kg wet)			0.000	0.000	0.007	0.000	0.002	0.192	0.002	0.064	0.005
Human Dose-Adult	*Consumption Rate*										
(ug/kg body weight·day)	**Heavy**		0.000	0.001	0.043	0.001	0.010	1.194	0.010	0.397	0.029
	Moderate		0.000	0.000	0.020	0.000	0.005	0.565	0.005	0.188	0.013
	Low		0.000	0.000	0.006	0.000	0.001	0.176	0.001	0.059	0.004
Human Dose-Toddler	*Consumption Rate*										
(ug/kg body weight·day)	**Heavy**		0.001	0.001	0.079	0.001	0.018	2.201	0.018	0.731	0.053
	Moderate		0.000	0.001	0.037	0.000	0.009	1.040	0.008	0.346	0.025
	Low		0.000	0.000	0.006	0.000	0.001	0.174	0.001	0.058	0.004
TDI (ug/kg bw·day)			0.40	0.30	200	2.0	1.0	1.0	1.4	91	0.10
Hazard Quotients-Adult	*Consumption Rate*										
(unitless)	**Heavy**		0.0	0.0	0.0	0.0	0.0	1.2	0.0	0.0	0.3
	Moderate		0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.0	0.1
	Low		0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0
Hazard Quotients-Toddler	*Consumption Rate*										
(unitless)	**Heavy**		0.0	0.0	0.0	0.0	0.0	2.2	0.0	0.0	0.5
	Moderate		0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.2
	Low		0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0

Notes:

1 - Animal dose per day for external reference area only

2 - Concentration based on time at external reference (100%). See text.

HQ Calculations for Consumption of Caribou Muscle
External Reference - 2017

(modified from Azimuth, 2006)

Parameter	Dietary Preference		Manganese	Inorg Hg	MeHg	Molybdenum	Nickel	Selenium	Strontium	Thallium	Tin
Transfer Factor (beef)			0.0005	0.00609	0.00078	0.001	0.006	0.32	0.008	0.04	0.001
Animal Dose[1]	**Soil**		0.439	0.000	0.000	0.001	0.097	0.000	0.044	0.000	0.001
(mg/kg wet·day)	**Water**		0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000
	Sedges	30%	4.518	0.000	0.000	0.017	0.076	0.000	0.077	0.000	0.000
	Lichens	65%	1.874	0.004	0.002	0.005	0.739	0.003	0.184	0.000	0.001
	Berries	5%	0.016	0.000	0.000	0.001	0.000	0.001	0.000	0.000	0.000
	Insects	0%	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	Total Food	100%	6.409	0.004	0.002	0.023	0.815	0.004	0.260	0.000	0.001
Concentration in Animal Tissue[2] (mg/kg wet)			0.257	0.002	0.000	0.002	0.410	0.109	0.183	0.002	0.000
Human Dose-Adult	*Consumption Rate*										
(ug/kg body weight·day)	**Heavy**		1.598	0.011	0.001	0.011	2.554	0.681	1.140	0.011	0.001
	Moderate		0.756	0.005	0.000	0.005	1.207	0.322	0.539	0.005	0.001
	Low		0.236	0.002	0.000	0.002	0.377	0.101	0.168	0.002	0.000
Human Dose-Toddler	*Consumption Rate*										
(ug/kg body weight·day)	**Heavy**		2.945	0.021	0.001	0.021	4.706	1.255	2.101	0.021	0.002
	Moderate		1.391	0.010	0.001	0.010	2.224	0.593	0.993	0.010	0.001
	Low		0.233	0.002	0.000	0.002	0.373	0.100	0.167	0.002	0.000
TDI (ug/kg bw·day)			136	0.30	0.20	23000	20	6200	600	0.01	300
Hazard Quotients-Adult	*Consumption Rate*										
(unitless)	**Heavy**		0.0	0.0	0.0	0.0	0.1	0.0	0.0	1.1	0.0
	Moderate		0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.5	0.0
	Low		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0
Hazard Quotients-Toddler	*Consumption Rate*										
(unitless)	**Heavy**		0.0	0.1	0.0	0.0	0.2	0.0	0.0	2.1	0.0
	Moderate		0.0	0.0	0.0	0.0	0.1	0.0	0.0	1.0	0.0
	Low		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0

Notes:

1 - Animal dose per day for external reference area only

2 - Concentration based on time at external reference (100%). See text.

HQ Calculations for Consumption of Caribou Muscle
External Reference - 2017

(modified from Azimuth, 2006)

Parameter	Dietary Preference		Uranium	Vanadium	Zinc
Transfer Factor (beef)			0.00039	0.0025	0.16
Animal Dose[1]	**Soil**		0.004	0.042	0.099
(mg/kg wet·day)	**Water**		0.000	0.000	0.000
	Sedges	30%	0.000	0.001	0.458
	Lichens	65%	0.002	0.035	0.355
	Berries	5%	0.000	0.002	0.003
	Insects	0%	0.000	0.000	0.000
	Total Food	100%	0.002	0.038	0.817
Concentration in Animal Tissue[2]			0.000	0.015	10.986
(mg/kg wet)					
Human Dose-Adult	*Consumption Rate*				
(ug/kg body weight·day)	**Heavy**		0.001	0.094	68.370
	Moderate		0.001	0.044	32.320
	Low		0.000	0.014	10.100
Human Dose-Toddler	*Consumption Rate*				
(ug/kg body weight·day)	**Heavy**		0.002	0.173	125.970
	Moderate		0.001	0.082	59.523
	Low		0.000	0.014	9.987
TDI (ug/kg bw·day)			0.60	5.0	480
Hazard Quotients-Adult	*Consumption Rate*				
(unitless)	**Heavy**		0.0	0.0	0.1
	Moderate		0.0	0.0	0.1
	Low		0.0	0.0	0.0
Hazard Quotients-Toddler	*Consumption Rate*				
(unitless)	**Heavy**		0.0	0.0	0.3
	Moderate		0.0	0.0	0.1
	Low		0.0	0.0	0.0

Notes:
1 - Animal dose per day for external reference area only

2 - Concentration based on time at external reference (100%). See text.

HQ Calculations for Consumption of Caribou Kidney
Onsite + Near-site - 2017

(modified from Azimuth, 2006)

Parameter	Dietary Preference		Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Lead
Transfer Factor											
Feed-to-muscle (beef)			0.00004	0.002	0.0002	0.001	0.0004	0.0055	0.0001	0.009	0.0004
Muscle-to-kidney (caribou)			1.17	6.45	40.87	2.33	2049.03	0.52	10.52	2.06	33.19
Animal Dose[1]	**Soil**		0.000	0.044	0.090	0.001	0.000	0.198	0.022	0.035	0.025
(mg/kg wet·day)	**Water**		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	Sedges	30%	0.000	0.008	0.341	0.000	0.001	0.081	0.007	0.030	0.011
	Lichens	65%	0.002	0.174	1.031	0.009	0.004	1.834	0.083	0.172	0.132
	Berries	5%	0.000	0.000	0.004	0.000	0.000	0.000	0.000	0.002	0.000
	Insects	0%	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	Total Food	100%	0.002	0.181	1.376	0.009	0.005	1.915	0.090	0.204	0.143
Concentration in Animal Tissue[2] (mg/kg wet)			0.000	0.001	0.565	0.001	0.250	0.215	0.005	0.189	0.113
Human Dose-Adult	*Consumption Rate*										
(ug/kg body weight·day)	**Heavy**		0.000	0.000	0.023	0.000	0.010	0.009	0.000	0.008	0.005
	Moderate		0.000	0.000	0.010	0.000	0.005	0.004	0.000	0.003	0.002
	Low		0.000	0.000	0.006	0.000	0.002	0.002	0.000	0.002	0.001
Human Dose-Toddler	*Consumption Rate*										
(ug/kg body weight·day)	**Heavy**		0.000	0.000	0.041	0.000	0.018	0.016	0.000	0.014	0.008
	Moderate		0.000	0.000	0.021	0.000	0.009	0.008	0.000	0.007	0.004
	Low		0.000	0.000	0.010	0.000	0.005	0.004	0.000	0.003	0.002
TDI (ug/kg wet·day)			0.40	0.30	200	2.0	1.0	1.0	1.4	91	0.10
Hazard Quotients-Adult	*Consumption Rate*										
(unitless)	**Heavy**		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Moderate		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Low		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hazard Quotients-Toddler	*Consumption Rate*										
(unitless)	**Heavy**		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
	Moderate		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Low		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Notes:

1 - Animal dose per day for onsite+near-site area only

2 - Concentration based on time in onsite+near-site area (33%) plus time at external reference (67%). See text.

HQ Calculations for Consumption of Caribou Kidney
Onsite + Near-site - 2017

(modified from Azimuth, 2006)

Parameter	Dietary Preference		Manganese	Inorg Hg	MeHg	Molybdenum	Nickel	Selenium	Strontium	Thallium	Tin
Transfer Factor											
Feed-to-muscle (beef)			0.0005	0.00609	0.00609	0.001	0.005	0.1	0.008	0.04	0.001
Muscle-to-kidney (caribou)			0.85	104.63	104.63	44.20	1.68	19.25	5.27	14.90	3.88
Animal Dose[1]	**Soil**		0.636	0.000	0.000	0.002	0.105	0.000	0.023	0.000	0.001
(mg/kg wet·day)	**Water**		0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000
	Sedges	30%	3.506	0.000	0.000	0.012	0.046	0.000	0.105	0.000	0.000
	Lichens	65%	5.607	0.004	0.002	0.028	0.624	0.004	0.430	0.002	0.002
	Berries	5%	0.044	0.000	0.000	0.001	0.000	0.001	0.000	0.000	0.000
	Insects	0%	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	Total Food	100%	9.158	0.004	0.002	0.041	0.670	0.005	0.535	0.002	0.003
Concentration in Animal Tissue[2]			0.249	0.188	0.096	0.101	0.546	0.696	1.230	0.047	0.001
(mg/kg wet)											
Human Dose-Adult	*Consumption Rate*										
(ug/kg body weight·day)	**Heavy**		0.010	0.008	0.004	0.004	0.022	0.029	0.050	0.002	0.000
	Moderate		0.005	0.003	0.002	0.002	0.010	0.013	0.023	0.001	0.000
	Low		0.002	0.002	0.001	0.001	0.005	0.007	0.012	0.000	0.000
Human Dose-Toddler	*Consumption Rate*										
(ug/kg body weight·day)	**Heavy**		0.018	0.014	0.007	0.007	0.040	0.051	0.089	0.003	0.000
	Moderate		0.009	0.007	0.003	0.004	0.020	0.025	0.045	0.002	0.000
	Low		0.005	0.003	0.002	0.002	0.010	0.013	0.022	0.001	0.000
TDI (ug/kg wet·day)			136	0.30	0.20	23000	20	6200	600	0.01	300
Hazard Quotients-Adult	*Consumption Rate*										
(unitless)	**Heavy**		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0
	Moderate		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
	Low		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hazard Quotients-Toddler	*Consumption Rate*										
(unitless)	**Heavy**		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0
	Moderate		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0
	Low		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0

Notes:

1 - Animal dose per day for onsite+near-site area only

2 - Concentration based on time in onsite+near-site area (33%) plus time at external reference (67%). See text.

HQ Calculations for Consumption of Caribou Kidney
Onsite + Near-site - 2017

(modified from Azimuth, 2006)

Parameter	Dietary Preference		Uranium	Vanadium	Zinc
Transfer Factor					
Feed-to-muscle (beef)			0.0002	0.0025	0.1
Muscle-to-kidney (caribou)			3.23	4.33	0.95
Animal Dose[1]	**Soil**		0.007	0.040	0.072
(mg/kg wet·day)	**Water**		0.000	0.000	0.000
	Sedges	30%	0.002	0.014	0.215
	Lichens	65%	0.031	0.262	0.728
	Berries	5%	0.000	0.004	0.005
	Insects	0%	0.000	0.000	0.000
	Total Food	100%	0.033	0.280	0.948
Concentration in Animal Tissue[2]			0.001	0.130	6.746
(mg/kg wet)					
Human Dose-Adult	*Consumption Rate*				
(ug/kg body weight·day)	**Heavy**		0.000	0.005	0.277
	Moderate		0.000	0.002	0.124
	Low		0.000	0.001	0.067
Human Dose-Toddler	*Consumption Rate*				
(ug/kg body weight·day)	**Heavy**		0.000	0.009	0.491
	Moderate		0.000	0.005	0.245
	Low		0.000	0.002	0.123
TDI (ug/kg wet·day)			0.60	5.0	480
Hazard Quotients-Adult	*Consumption Rate*				
(unitless)	**Heavy**		0.0	0.0	0.0
	Moderate		0.0	0.0	0.0
	Low		0.0	0.0	0.0
Hazard Quotients-Toddler	*Consumption Rate*				
(unitless)	**Heavy**		0.0	0.0	0.0
	Moderate		0.0	0.0	0.0
	Low		0.0	0.0	0.0

Notes:
1 - Animal dose per day for onsite+near-site area only

2 - Concentration based on time in onsite+near-site area (33%) plus time at external reference (67%). See text.

HQ Calculations for Consumption of Caribou Kidney
AWAR Locations - 2017

(modified from Azimuth, 2006)

Parameter	Dietary Preference		Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Lead	Manganese
Transfer Factor												
Feed-to-muscle (beef)			0.00004	0.002	0.0002	0.001	0.0004	0.0055	0.0001	0.009	0.0004	0.0005
Muscle-to-kidney (caribou)			1.17	6.45	40.87	2.33	2049.03	0.52	10.52	2.06	33.19	0.85
Animal Dose[1]	**Soil**		0.000	0.004	0.052	0.000	0.000	0.050	0.009	0.016	0.008	0.315
(mg/kg wet·day)	**Water**		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	Sedges	30%	0.000	0.006	0.322	0.000	0.001	0.097	0.011	0.039	0.002	4.873
	Lichens	65%	0.001	0.080	1.230	0.003	0.005	1.090	0.128	0.237	0.098	16.369
	Berries	5%	0.000	0.000	0.002	0.000	0.000	0.000	0.000	0.001	0.000	0.070
	Insects	0%	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	Total Food	100%	0.001	0.086	1.555	0.003	0.006	1.187	0.139	0.278	0.100	21.313
Concentration in Animal Tissue[2] (mg/kg wet)			0.000	0.001	0.594	0.000	0.278	0.153	0.006	0.214	0.094	0.374
Human Dose-Adult	*Consumption Rate*											
(ug/kg body weight·day)	**Heavy**		0.000	0.000	0.024	0.000	0.011	0.006	0.000	0.009	0.004	0.015
	Moderate		0.000	0.000	0.011	0.000	0.005	0.003	0.000	0.004	0.002	0.007
	Low		0.000	0.000	0.006	0.000	0.003	0.002	0.000	0.002	0.001	0.004
Human Dose-Toddler	*Consumption Rate*											
(ug/kg body weight·day)	**Heavy**		0.000	0.000	0.043	0.000	0.020	0.011	0.000	0.016	0.007	0.027
	Moderate		0.000	0.000	0.022	0.000	0.010	0.006	0.000	0.008	0.003	0.014
	Low		0.000	0.000	0.011	0.000	0.005	0.003	0.000	0.004	0.002	0.007
TDI (ug/kg wet·day)			0.40	0.30	200	2.0	1.0	1.0	1.4	91	0.10	136
Hazard Quotients-Adult	*Consumption Rate*											
(unitless)	**Heavy**		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Moderate		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Low		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hazard Quotients-Toddler	*Consumption Rate*											
(unitless)	**Heavy**		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
	Moderate		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Low		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Notes:
1 - Animal dose per day for AWAR area only

2 - Concentration based on time in AWAR area
(33%) plus time at external reference (67%).
See text.

HQ Calculations for Consumption of Caribou Kidney
AWAR Locations - 2017

(modified from Azimuth, 2006)

Parameter	Dietary Preference		Inorg Hg	MeHg	Molybdenum	Nickel	Selenium	Strontium	Thallium	Tin	Uranium	Vanadium
Transfer Factor												
Feed-to-muscle (beef)			0.00609	0.00609	0.001	0.005	0.1	0.008	0.04	0.001	0.0002	0.0025
Muscle-to-kidney (caribou)			104.63	104.63	44.20	1.68	19.25	5.27	14.90	3.88	3.23	4.33
Animal Dose[1]	**Soil**		0.000	0.000	0.001	0.023	0.000	0.030	0.000	0.001	0.004	0.027
(mg/kg wet·day)	**Water**		0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000
	Sedges	30%	0.000	0.000	0.022	0.056	0.000	0.161	0.000	0.000	0.001	0.021
	Lichens	65%	0.002	0.001	0.011	0.493	0.004	0.927	0.001	0.002	0.019	0.262
	Berries	5%	0.000	0.000	0.001	0.000	0.001	0.000	0.000	0.000	0.000	0.005
	Insects	0%	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	Total Food	100%	0.002	0.001	0.034	0.549	0.005	1.088	0.001	0.003	0.020	0.289
Concentration in Animal Tissue[2] (mg/kg wet)			0.163	0.083	0.092	0.504	0.669	1.815	0.032	0.001	0.001	0.128
Human Dose-Adult	*Consumption Rate*											
(ug/kg body weight·day)	**Heavy**		0.007	0.003	0.004	0.021	0.027	0.074	0.001	0.000	0.000	0.005
	Moderate		0.003	0.002	0.002	0.009	0.012	0.033	0.001	0.000	0.000	0.002
	Low		0.002	0.001	0.001	0.005	0.007	0.018	0.000	0.000	0.000	0.001
Human Dose-Toddler	*Consumption Rate*											
(ug/kg body weight·day)	**Heavy**		0.012	0.006	0.007	0.037	0.049	0.132	0.002	0.000	0.000	0.009
	Moderate		0.006	0.003	0.003	0.018	0.024	0.066	0.001	0.000	0.000	0.005
	Low		0.003	0.002	0.002	0.009	0.012	0.033	0.001	0.000	0.000	0.002
TDI (ug/kg wet·day)			0.30	0.20	23000	20	6200	600	0.01	300	0.60	5.0
Hazard Quotients-Adult	*Consumption Rate*											
(unitless)	**Heavy**		0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0
	Moderate		0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0
	Low		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hazard Quotients-Toddler	*Consumption Rate*											
(unitless)	**Heavy**		0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0
	Moderate		0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0
	Low		0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0

Notes:
1 - Animal dose per day for AWAR area only

2 - Concentration based on time in AWAR area
(33%) plus time at external reference (67%).
See text.

HQ Calculations for Consumption of Caribou Kidney
AWAR Locations - 2017

(modified from Azimuth, 2006)

Parameter	Dietary Preference		Zinc
Transfer Factor			
Feed-to-muscle (beef)			0.1
Muscle-to-kidney (caribou)			0.95
Animal Dose[1]	**Soil**		0.036
(mg/kg wet·day)	**Water**		0.000
	Sedges	30%	0.244
	Lichens	65%	1.040
	Berries	5%	0.005
	Insects	0%	0.000
	Total Food	100%	1.289
Concentration in Animal Tissue[2] (mg/kg wet)			7.463
Human Dose-Adult	*Consumption Rate*		
(ug/kg body weight·day)	**Heavy**		0.306
	Moderate		0.137
	Low		0.074
Human Dose-Toddler	*Consumption Rate*		
(ug/kg body weight·day)	**Heavy**		0.543
	Moderate		0.271
	Low		0.136
TDI (ug/kg wet·day)			480
Hazard Quotients-Adult	*Consumption Rate*		
(unitless)	**Heavy**		0.0
	Moderate		0.0
	Low		0.0
Hazard Quotients-Toddler	*Consumption Rate*		
(unitless)	**Heavy**		0.0
	Moderate		0.0
	Low		0.0

Notes:
1 - Animal dose per day for AWAR area only

2 - Concentration based on time in AWAR area (33%) plus time at external reference (67%). See text.

HQ Calculations for Consumption of Caribou Kidney
External Reference - 2017

(modified from Azimuth, 2006)

Parameter	Dietary Preference		Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Lead	Manganese
Transfer Factor												
Feed-to-muscle (beef)			0.00004	0.002	0.0002	0.001	0.0004	0.0055	0.0001	0.009	0.0004	0.0005
Muscle-to-kidney (caribou)			1.17	6.45	40.87	2.33	2049.03	0.52	10.52	2.06	33.19	0.85
Animal Dose[1]	**Soil**		0.000	0.049	0.050	0.001	0.000	0.202	0.017	0.025	0.019	0.439
(mg/kg wet·day)	**Water**		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	Sedges	30%	0.000	0.001	0.174	0.000	0.000	0.009	0.002	0.015	0.001	4.518
	Lichens	65%	0.000	0.018	0.427	0.001	0.003	0.253	0.028	0.043	0.067	1.874
	Berries	5%	0.000	0.000	0.002	0.000	0.000	0.000	0.000	0.001	0.000	0.016
	Insects	0%	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	Total Food	100%	0.000	0.019	0.603	0.001	0.003	0.263	0.030	0.060	0.069	6.409
Concentration in Animal Tissue[2] (mg/kg wet)			0.000	0.001	0.401	0.000	0.226	0.099	0.004	0.118	0.087	0.218
Human Dose-Adult	*Consumption Rate*											
(ug/kg body weight·day)	**Heavy**		0.000	0.000	0.016	0.000	0.009	0.004	0.000	0.005	0.004	0.009
	Moderate		0.000	0.000	0.007	0.000	0.004	0.002	0.000	0.002	0.002	0.004
	Low		0.000	0.000	0.004	0.000	0.002	0.001	0.000	0.001	0.001	0.002
Human Dose-Toddler	*Consumption Rate*											
(ug/kg body weight·day)	**Heavy**		0.000	0.000	0.029	0.000	0.016	0.007	0.000	0.009	0.006	0.016
	Moderate		0.000	0.000	0.015	0.000	0.008	0.004	0.000	0.004	0.003	0.008
	Low		0.000	0.000	0.007	0.000	0.004	0.002	0.000	0.002	0.002	0.004
TDI (ug/kg wet·day)			0.40	0.30	200	2.0	1.0	1.0	1.4	91	0.10	136
Hazard Quotients-Adult	*Consumption Rate*											
(unitless)	**Heavy**		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Moderate		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Low		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hazard Quotients-Toddler	*Consumption Rate*											
(unitless)	**Heavy**		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
	Moderate		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Low		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Notes:

1 - Animal dose per day for external reference area only

2 - Concentration based on time at external reference (100%). See text.

HQ Calculations for Consumption of Caribou Kidney
External Reference - 2017

(modified from Azimuth, 2006)

Parameter	Dietary Preference		Inorg Hg	MeHg	Molybdenum	Nickel	Selenium	Strontium	Thallium	Tin	Uranium	Vanadium
Transfer Factor												
Feed-to-muscle (beef)			0.00609	0.00609	0.001	0.005	0.1	0.008	0.04	0.001	0.0002	0.0025
Muscle-to-kidney (caribou)			104.63	104.63	44.20	1.68	19.25	5.27	14.90	3.88	3.23	4.33
Animal Dose[1]	**Soil**		0.000	0.000	0.001	0.097	0.000	0.044	0.000	0.001	0.004	0.042
(mg/kg wet·day)	**Water**		0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000
	Sedges	30%	0.000	0.000	0.017	0.076	0.000	0.077	0.000	0.000	0.000	0.001
	Lichens	65%	0.004	0.002	0.005	0.739	0.003	0.184	0.000	0.001	0.002	0.035
	Berries	5%	0.000	0.000	0.001	0.000	0.001	0.000	0.000	0.000	0.000	0.002
	Insects	0%	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	Total Food	100%	0.004	0.002	0.023	0.815	0.004	0.260	0.000	0.001	0.002	0.038
Concentration in Animal Tissue[2] (mg/kg wet)			0.193	0.099	0.080	0.575	0.658	0.966	0.028	0.001	0.000	0.065
Human Dose-Adult	*Consumption Rate*											
(ug/kg body weight·day)	**Heavy**		0.008	0.004	0.003	0.024	0.027	0.040	0.001	0.000	0.000	0.003
	Moderate		0.004	0.002	0.001	0.011	0.012	0.018	0.001	0.000	0.000	0.001
	Low		0.002	0.001	0.001	0.006	0.007	0.010	0.000	0.000	0.000	0.001
Human Dose-Toddler	*Consumption Rate*											
(ug/kg body weight·day)	**Heavy**		0.014	0.007	0.006	0.042	0.048	0.070	0.002	0.000	0.000	0.005
	Moderate		0.007	0.004	0.003	0.021	0.024	0.035	0.001	0.000	0.000	0.002
	Low		0.004	0.002	0.001	0.010	0.012	0.018	0.001	0.000	0.000	0.001
TDI (ug/kg wet·day)			0.30	0.20	23000	20	6200	600	0.01	300	0.60	5.0
Hazard Quotients-Adult	*Consumption Rate*											
(unitless)	**Heavy**		0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0
	Moderate		0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0
	Low		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hazard Quotients-Toddler	*Consumption Rate*											
(unitless)	**Heavy**		0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0
	Moderate		0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0
	Low		0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0

Notes:

1 - Animal dose per day for external reference area only

2 - Concentration based on time at external reference (100%). See text.

HQ Calculations for Consumption of Caribou Kidney
External Reference - 2017

(modified from Azimuth, 2006)

Parameter	Dietary Preference		Zinc
Transfer Factor			
Feed-to-muscle (beef)			0.1
Muscle-to-kidney (caribou)			0.95
Animal Dose[1]	**Soil**		0.099
(mg/kg wet·day)	**Water**		0.000
	Sedges	30%	0.458
	Lichens	65%	0.355
	Berries	5%	0.003
	Insects	0%	0.000
	Total Food	100%	0.817
Concentration in Animal Tissue[2]			6.502
(mg/kg wet)			
Human Dose-Adult	*Consumption Rate*		
(ug/kg body weight·day)	**Heavy**		0.267
	Moderate		0.120
	Low		0.064
Human Dose-Toddler	*Consumption Rate*		
(ug/kg body weight·day)	**Heavy**		0.473
	Moderate		0.236
	Low		0.118
TDI (ug/kg wet·day)			480
Hazard Quotients-Adult	*Consumption Rate*		
(unitless)	**Heavy**		0.0
	Moderate		0.0
	Low		0.0
Hazard Quotients-Toddler	*Consumption Rate*		
(unitless)	**Heavy**		0.0
	Moderate		0.0
	Low		0.0

Notes:

1 - Animal dose per day for external reference area only

2 - Concentration based on time at external reference (100%). See text.

HQ Calculations for Consumption of Caribou Liver
Onsite + Near-site - 2017

(modified from Azimuth, 2006)

Parameter	Dietary Preference		Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Lead	Manganese
Transfer Factor												
Feed-to-muscle (beef)			0.00004	0.002	0.0002	0.001	0.0004	0.0055	0.0001	0.009	0.0004	0.0005
Muscle-to-kidney (caribou)			0.82	0.64	2.66	0.87	286.95	0.78	18.59	13.73	250.01	0.68
Animal Dose[1]	**Soil**		0.000	0.044	0.090	0.001	0.000	0.198	0.022	0.035	0.025	0.636
(mg/kg wet·day)	**Water**		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	Sedges	30%	0.000	0.008	0.341	0.000	0.001	0.081	0.007	0.030	0.011	3.506
	Lichens	65%	0.002	0.174	1.031	0.009	0.004	1.834	0.083	0.172	0.132	5.607
	Berries	5%	0.000	0.000	0.004	0.000	0.000	0.000	0.000	0.002	0.000	0.044
	Insects	0%	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	Total Food	100%	0.002	0.181	1.376	0.009	0.005	1.915	0.090	0.204	0.143	9.158
Concentration in Animal Tissue[2] (mg/kg wet)			0.000	0.000	0.037	0.000	0.035	0.323	0.010	1.258	0.854	0.199
Human Dose-Adult	*Consumption Rate*											
(ug/kg body weight·day)	**Heavy**		0.000	0.000	0.002	0.000	0.001	0.013	0.000	0.052	0.035	0.008
	Moderate		0.000	0.000	0.001	0.000	0.001	0.006	0.000	0.023	0.016	0.004
	Low		0.000	0.000	0.000	0.000	0.000	0.003	0.000	0.012	0.008	0.002
Human Dose-Toddler	*Consumption Rate*											
(ug/kg body weight·day)	**Heavy**		0.000	0.000	0.003	0.000	0.003	0.023	0.001	0.092	0.062	0.015
	Moderate		0.000	0.000	0.001	0.000	0.001	0.012	0.000	0.046	0.031	0.007
	Low		0.000	0.000	0.001	0.000	0.001	0.006	0.000	0.023	0.016	0.004
TDI (ug/kg wet·day)			0.40	0.30	200	2.0	1.0	1.0	1.4	91	0.10	136
Hazard Quotients-Adult	*Consumption Rate*											
(unitless)	**Heavy**		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0
	Moderate		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0
	Low		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
Hazard Quotients-Toddler	*Consumption Rate*											
(unitless)	**Heavy**		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.0
	Moderate		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0
	Low		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0

Notes:

1 - Animal dose per day for onsite+near-site area only

2 - Concentration based on time in onsite+near-site area (33%) plus time at external reference (67%). See text.

HQ Calculations for Consumption of Caribou Liver
Onsite + Near-site - 2017

(modified from Azimuth, 2006)

Parameter	Dietary Preference		Inorg Hg	MeHg	Molybdenum	Nickel	Selenium	Strontium	Thallium	Tin	Uranium	Vanadium
Transfer Factor												
Feed-to-muscle (beef)			0.00609	0.00609	0.001	0.005	0.1	0.008	0.04	0.001	0.0002	0.0025
Muscle-to-kidney (caribou)			15.00	15.00	153.49	1.21	2.28	1.28	2.51	9.44	2.61	5.85
Animal Dose[1]	**Soil**		0.000	0.000	0.002	0.105	0.000	0.023	0.000	0.001	0.007	0.040
(mg/kg wet·day)	**Water**		0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000
	Sedges	30%	0.000	0.000	0.012	0.046	0.000	0.105	0.000	0.000	0.002	0.014
	Lichens	65%	0.004	0.002	0.028	0.624	0.004	0.430	0.002	0.002	0.031	0.262
	Berries	5%	0.000	0.000	0.001	0.000	0.001	0.000	0.000	0.000	0.000	0.004
	Insects	0%	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	Total Food	100%	0.004	0.002	0.041	0.670	0.005	0.535	0.002	0.003	0.033	0.280
Concentration in Animal Tissue[2] (mg/kg wet)			0.027	0.014	0.351	0.393	0.083	0.299	0.008	0.002	0.001	0.175
Human Dose-Adult	*Consumption Rate*											
(ug/kg body weight·day)	**Heavy**		0.001	0.001	0.014	0.016	0.003	0.012	0.000	0.000	0.000	0.007
	Moderate		0.000	0.000	0.006	0.007	0.002	0.005	0.000	0.000	0.000	0.003
	Low		0.000	0.000	0.003	0.004	0.001	0.003	0.000	0.000	0.000	0.002
Human Dose-Toddler	*Consumption Rate*											
(ug/kg body weight·day)	**Heavy**		0.002	0.001	0.025	0.029	0.006	0.022	0.001	0.000	0.000	0.013
	Moderate		0.001	0.000	0.013	0.014	0.003	0.011	0.000	0.000	0.000	0.006
	Low		0.000	0.000	0.006	0.007	0.002	0.005	0.000	0.000	0.000	0.003
TDI (ug/kg wet·day)			0.30	0.20	23000	20	6200	600	0.01	300	0.60	5.0
Hazard Quotients-Adult	*Consumption Rate*											
(unitless)	**Heavy**		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Moderate		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Low		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hazard Quotients-Toddler	*Consumption Rate*											
(unitless)	**Heavy**		0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0
	Moderate		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Low		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Notes:

1 - Animal dose per day for onsite+near-site area only

2 - Concentration based on time in onsite+near-site area (33%) plus time at external reference (67%). See text.

HQ Calculations for Consumption of Caribou Liver
Onsite + Near-site - 2017

(modified from Azimuth, 2006)

Parameter	Dietary Preference		Zinc
Transfer Factor			
Feed-to-muscle (beef)			0.1
Muscle-to-kidney (caribou)			1.11
Animal Dose[1]	**Soil**		0.072
(mg/kg wet·day)	**Water**		0.000
	Sedges	30%	0.215
	Lichens	65%	0.728
	Berries	5%	0.005
	Insects	0%	0.000
	Total Food	100%	0.948
Concentration in Animal Tissue[2]			7.896
(mg/kg wet)			
Human Dose-Adult	*Consumption Rate*		
(ug/kg body weight·day)	**Heavy**		0.324
	Moderate		0.145
	Low		0.078
Human Dose-Toddler	*Consumption Rate*		
(ug/kg body weight·day)	**Heavy**		0.574
	Moderate		0.287
	Low		0.144
TDI (ug/kg wet·day)			480
Hazard Quotients-Adult	*Consumption Rate*		
(unitless)	**Heavy**		0.0
	Moderate		0.0
	Low		0.0
Hazard Quotients-Toddler	*Consumption Rate*		
(unitless)	**Heavy**		0.0
	Moderate		0.0
	Low		0.0

Notes:

1 - Animal dose per day for onsite+near-site area only

2 - Concentration based on time in onsite+near-site area (33%) plus time at external reference (67%). See text.

HQ Calculations for Consumption of Caribou Liver
AWAR Location - 2017

(modified from Azimuth, 2006)

Parameter	Dietary Preference		Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Lead	Manganese
Transfer Factor												
Feed-to-muscle (beef)			0.00004	0.002	0.0002	0.001	0.0004	0.0055	0.0001	0.009	0.0004	0.0005
Muscle-to-kidney (caribou)			0.82	0.64	2.66	0.87	286.95	0.78	18.59	13.73	250.01	0.68
Animal Dose[1]	**Soil**		0.000	0.004	0.052	0.000	0.000	0.050	0.009	0.016	0.008	0.315
(mg/kg wet·day)	**Water**		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	Sedges	30%	0.000	0.006	0.322	0.000	0.001	0.097	0.011	0.039	0.002	4.873
	Lichens	65%	0.001	0.080	1.230	0.003	0.005	1.090	0.128	0.237	0.098	16.369
	Berries	5%	0.000	0.000	0.002	0.000	0.000	0.000	0.000	0.001	0.000	0.070
	Insects	0%	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	Total Food	100%	0.001	0.086	1.555	0.003	0.006	1.187	0.139	0.278	0.100	21.313
Concentration in Animal Tissue[2] (mg/kg wet)			0.000	0.000	0.039	0.000	0.039	0.231	0.011	1.426	0.706	0.299
Human Dose-Adult	*Consumption Rate*											
(ug/kg body weight·day)	**Heavy**		0.000	0.000	0.002	0.000	0.002	0.009	0.000	0.058	0.029	0.012
	Moderate		0.000	0.000	0.001	0.000	0.001	0.004	0.000	0.026	0.013	0.005
	Low		0.000	0.000	0.000	0.000	0.000	0.002	0.000	0.014	0.007	0.003
Human Dose-Toddler	*Consumption Rate*											
(ug/kg body weight·day)	**Heavy**		0.000	0.000	0.003	0.000	0.003	0.017	0.001	0.104	0.051	0.022
	Moderate		0.000	0.000	0.001	0.000	0.001	0.008	0.000	0.052	0.026	0.011
	Low		0.000	0.000	0.001	0.000	0.001	0.004	0.000	0.026	0.013	0.005
TDI (ug/kg wet·day)			0.40	0.30	200	2.0	1.0	1.0	1.4	91	0.10	136
Hazard Quotients-Adult	*Consumption Rate*											
(unitless)	**Heavy**		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0
	Moderate		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
	Low		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
Hazard Quotients-Toddler	*Consumption Rate*											
(unitless)	**Heavy**		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0
	Moderate		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0
	Low		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0

Notes:

1 - Animal dose per day for AWAR area only

2 - Concentration based on time in AWAR area (33%) plus time at external reference (67%). See text.

HQ Calculations for Consumption of Caribou Liver
AWAR Location - 2017

(modified from Azimuth, 2006)

Parameter	Dietary Preference		Inorg Hg	MeHg	Molybdenum	Nickel	Selenium	Strontium	Thallium	Tin	Uranium	Vanadium
Transfer Factor												
Feed-to-muscle (beef)			0.00609	0.00609	0.001	0.005	0.1	0.008	0.04	0.001	0.0002	0.0025
Muscle-to-kidney (caribou)			15.00	15.00	153.49	1.21	2.28	1.28	2.51	9.44	2.61	5.85
Animal Dose[1]	**Soil**		0.000	0.000	0.001	0.023	0.000	0.030	0.000	0.001	0.004	0.027
(mg/kg wet·day)	**Water**		0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000
	Sedges	30%	0.000	0.000	0.022	0.056	0.000	0.161	0.000	0.000	0.001	0.021
	Lichens	65%	0.002	0.001	0.011	0.493	0.004	0.927	0.001	0.002	0.019	0.262
	Berries	5%	0.000	0.000	0.001	0.000	0.001	0.000	0.000	0.000	0.000	0.005
	Insects	0%	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	Total Food	100%	0.002	0.001	0.034	0.549	0.005	1.088	0.001	0.003	0.020	0.289
Concentration in Animal Tissue[2] (mg/kg wet)			0.023	0.012	0.320	0.363	0.079	0.441	0.005	0.002	0.000	0.173
Human Dose-Adult	*Consumption Rate*											
(ug/kg body weight·day)	**Heavy**		0.001	0.000	0.013	0.015	0.003	0.018	0.000	0.000	0.000	0.007
	Moderate		0.000	0.000	0.006	0.007	0.001	0.008	0.000	0.000	0.000	0.003
	Low		0.000	0.000	0.003	0.004	0.001	0.004	0.000	0.000	0.000	0.002
Human Dose-Toddler	*Consumption Rate*											
(ug/kg body weight·day)	**Heavy**		0.002	0.001	0.023	0.026	0.006	0.032	0.000	0.000	0.000	0.013
	Moderate		0.001	0.000	0.012	0.013	0.003	0.016	0.000	0.000	0.000	0.006
	Low		0.000	0.000	0.006	0.007	0.001	0.008	0.000	0.000	0.000	0.003
TDI (ug/kg wet·day)			0.30	0.20	23000	20	6200	600	0.01	300	0.60	5.0
Hazard Quotients-Adult	*Consumption Rate*											
(unitless)	**Heavy**		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Moderate		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Low		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hazard Quotients-Toddler	*Consumption Rate*											
(unitless)	**Heavy**		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Moderate		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Low		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Notes:

1 - Animal dose per day for AWAR area only

2 - Concentration based on time in AWAR area (33%) plus time at external reference (67%). See text.

HQ Calculations for Consumption of Caribou Liver
AWAR Location - 2017

(modified from Azimuth, 2006)

Parameter	Dietary Preference		Zinc
Transfer Factor			
Feed-to-muscle (beef)			0.1
Muscle-to-kidney (caribou)			1.11
Animal Dose[1]	**Soil**		0.036
(mg/kg wet·day)	**Water**		0.000
	Sedges	30%	0.244
	Lichens	65%	1.040
	Berries	5%	0.005
	Insects	0%	0.000
	Total Food	100%	1.289
Concentration in Animal Tissue[2] (mg/kg wet)			8.735
Human Dose-Adult	*Consumption Rate*		
(ug/kg body weight·day)	**Heavy**		0.358
	Moderate		0.161
	Low		0.086
Human Dose-Toddler	*Consumption Rate*		
(ug/kg body weight·day)	**Heavy**		0.635
	Moderate		0.318
	Low		0.159
TDI (ug/kg wet·day)			480
Hazard Quotients-Adult	*Consumption Rate*		
(unitless)	**Heavy**		0.0
	Moderate		0.0
	Low		0.0
Hazard Quotients-Toddler	*Consumption Rate*		
(unitless)	**Heavy**		0.0
	Moderate		0.0
	Low		0.0

Notes:

1 - Animal dose per day for AWAR area only

2 - Concentration based on time in AWAR area (33%) plus time at external reference (67%). See text.

HQ Calculations for Consumption of Caribou Liver
External Reference - 2017

(modified from Azimuth, 2006)

Parameter	Dietary Preference		Antimony	Arsenic*	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Lead	Manganese
Transfer Factor												
Feed-to-muscle (beef)			0.00004	0.002	0.0002	0.001	0.0004	0.0055	0.0001	0.009	0.0004	0.0005
Muscle-to-kidney (caribou)			0.82	0.64	2.66	0.87	286.95	0.78	18.59	13.73	250.01	0.68
Animal Dose[1]	**Soil**		0.000	0.049	0.050	0.001	0.000	0.202	0.017	0.025	0.019	0.439
(mg/kg wet·day)	**Water**		0.00000	0.00002	0.00013	0.00000	0.00000	0.00030	0.00000	0.00004	0.00000	0.00019
	Sedges	30%	0.0000	0.0005	0.1743	0.0001	0.0004	0.0094	0.0020	0.0154	0.0015	4.5184
	Lichens	65%	0.000	0.018	0.427	0.001	0.003	0.253	0.028	0.043	0.067	1.874
	Berries	5%	0.00000	0.00000	0.00190	0.00000	0.00002	0.00026	0.00002	0.00115	0.00001	0.01621
	Insects	0%	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	Total Food	100%	0.0004	0.0188	0.6035	0.0007	0.0035	0.2629	0.0303	0.0595	0.0687	6.4089
Concentration in Animal Tissue[2] (mg/kg wet)			0.000	0.000	0.026	0.000	0.032	0.149	0.007	0.788	0.654	0.175
Human Dose-Adult	*Consumption Rate*											
(ug/kg body weight·day)	**Heavy**		0.000	0.000	0.001	0.000	0.001	0.006	0.000	0.032	0.027	0.007
	Moderate		0.000	0.000	0.000	0.000	0.001	0.003	0.000	0.014	0.012	0.003
	Low		0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.008	0.006	0.002
Human Dose-Toddler	*Consumption Rate*											
(ug/kg body weight·day)	**Heavy**		0.000	0.000	0.002	0.000	0.002	0.011	0.000	0.057	0.048	0.013
	Moderate		0.000	0.000	0.001	0.000	0.001	0.005	0.000	0.029	0.024	0.006
	Low		0.000	0.000	0.000	0.000	0.001	0.003	0.000	0.014	0.012	0.003
TDI (ug/kg wet·day)			0.40	0.30	200	2.0	1.0	1.0	1.4	91	0.10	136
Hazard Quotients-Adult	*Consumption Rate*											
(unitless)	**Heavy**		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0
	Moderate		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
	Low		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
Hazard Quotients-Toddler	*Consumption Rate*											
(unitless)	**Heavy**		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0
	Moderate		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0
	Low		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0

Notes:
1 - Animal dose per day for external reference area only

2 - Concentration based on time at external reference (100%). See text.

HQ Calculations for Consumption of Caribou Liver
External Reference - 2017

(modified from Azimuth, 2006)

Parameter	Dietary Preference		Inorg Hg	MeHg	Molybdenum	Nickel	Selenium	Strontium	Thallium	Tin	Uranium	Vanadium
Transfer Factor												
Feed-to-muscle (beef)			0.00609	0.00609	0.001	0.005	0.1	0.008	0.04	0.001	0.0002	0.0025
Muscle-to-kidney (caribou)			15.00	15.00	153.49	1.21	2.28	1.28	2.51	9.44	2.61	5.85
Animal Dose[1]	**Soil**		0.000	0.000	0.001	0.097	0.000	0.044	0.000	0.001	0.004	0.042
(mg/kg wet·day)	**Water**		0.00000	0.00000	0.00003	0.00005	0.00000	0.00063	0.00000	0.00001	0.00000	0.00002
	Sedges	30%	0.0001	0.0000	0.0173	0.0760	0.0002	0.0767	0.0001	0.0001	0.0001	0.0012
	Lichens	65%	0.004	0.002	0.005	0.739	0.003	0.184	0.000	0.001	0.002	0.035
	Berries	5%	0.00000	0.00000	0.00108	0.00001	0.00104	0.00000	0.00009	0.00000	0.00002	0.00169
	Insects	0%	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	Total Food	100%	0.0040	0.0021	0.0230	0.8153	0.0044	0.2603	0.0005	0.0012	0.0021	0.0381
Concentration in Animal Tissue[2] (mg/kg wet)			0.028	0.014	0.279	0.414	0.078	0.235	0.005	0.002	0.000	0.088
Human Dose-Adult	*Consumption Rate*											
(ug/kg body weight·day)	**Heavy**		0.001	0.001	0.011	0.017	0.003	0.010	0.000	0.000	0.000	0.004
	Moderate		0.001	0.000	0.005	0.008	0.001	0.004	0.000	0.000	0.000	0.002
	Low		0.000	0.000	0.003	0.004	0.001	0.002	0.000	0.000	0.000	0.001
Human Dose-Toddler	*Consumption Rate*											
(ug/kg body weight·day)	**Heavy**		0.002	0.001	0.020	0.030	0.006	0.017	0.000	0.000	0.000	0.006
	Moderate		0.001	0.001	0.010	0.015	0.003	0.009	0.000	0.000	0.000	0.003
	Low		0.001	0.000	0.005	0.008	0.001	0.004	0.000	0.000	0.000	0.002
TDI (ug/kg wet·day)			0.30	0.20	23000	20	6200	600	0.01	300	0.60	5.0
Hazard Quotients-Adult	*Consumption Rate*											
(unitless)	**Heavy**		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Moderate		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Low		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hazard Quotients-Toddler	*Consumption Rate*											
(unitless)	**Heavy**		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Moderate		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Low		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Notes:
1 - Animal dose per day for external reference area only

2 - Concentration based on time at external reference (100%). See text.

HQ Calculations for Consumption of Caribou Liver
External Reference - 2017

(modified from Azimuth, 2006)

Parameter	Dietary Preference		Zinc
Transfer Factor			
Feed-to-muscle (beef)			0.1
Muscle-to-kidney (caribou)			1.11
Animal Dose[1]	**Soil**		0.099
(mg/kg wet·day)	**Water**		0.00024
	Sedges	30%	0.4581
	Lichens	65%	0.355
	Berries	5%	0.00346
	Insects	0%	0.000
	Total Food	100%	0.8165
Concentration in Animal Tissue[2]			7.610
(mg/kg wet)			
Human Dose-Adult	*Consumption Rate*		
(ug/kg body weight·day)	**Heavy**		0.312
	Moderate		0.140
	Low		0.075
Human Dose-Toddler	*Consumption Rate*		
(ug/kg body weight·day)	**Heavy**		0.553
	Moderate		0.277
	Low		0.138
TDI (ug/kg wet·day)			480
Hazard Quotients-Adult	*Consumption Rate*		
(unitless)	**Heavy**		0.0
	Moderate		0.0
	Low		0.0
Hazard Quotients-Toddler	*Consumption Rate*		
(unitless)	**Heavy**		0.0
	Moderate		0.0
	Low		0.0

Notes:
1 - Animal dose per day for external reference area only

2 - Concentration based on time at external reference (100%). See text.