GAHCHO KUÉ PROJECT

ENVIRONMENTAL IMPACT STATEMENT

WILDLIFE ECOLOGICAL RISK ASSESSMENT

October 2012 **11-1365-0012**

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1 INTRODUCTION

1.1 PURPOSE AND SCOPE

The wildlife ecological risk assessment (ERA) provides an assessment of the potential toxicological effects to wildlife present near the proposed Gahcho Kué Project (Project) resulting from exposure to metals and polycyclic aromatic hydrocarbons (PAHs) originating from the Project. The assessment focuses on metals and PAHs because they represent the principal chemical exposure pathways for wildlife resulting from the Project.

The risk assessment framework provides a structured approach for evaluating responses of receptors (e.g., wildlife species) to environmental stressors (i.e., metals and PAHs). The approach applied in this ERA is based on the guidance provided by the Canadian Council of Ministers of the Environment (CCME 1996), the United States Environmental Protection Agency (U.S. EPA 1998; Suter 1993), and other applicable guidance documents and manuals.

The scope of this ERA is limited to the effects of chemical (metals and PAHs) to wildlife (birds and mammals). Physical and biological stressors were addressed separately in the various disciplines of the Environmental Impact Statement (EIS). Also, potential risks to other ecological receptors, such as aquatic life, are addressed separately in the EIS (De Beers 2012a).

The timing of potential effects from chemicals assessed in the wildlife ERA includes long-term effects to wildlife health (including caribou), as well as short-term effects to caribou, from potential exposure during the construction and operations periods of the Project. Quantitative exposure and risk predictions were not estimated for the closure and reclamation phase. Effects to wildlife health during and post Project closure will be assessed as part of the Closure Plan.

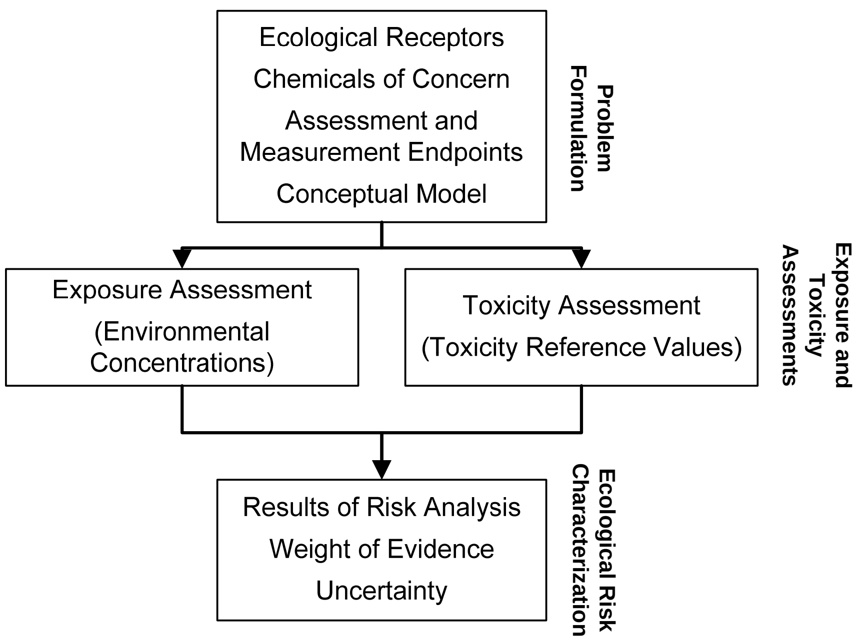
Risk assessment and environmental assessment processes consist of parallel steps, with risk assessment often included within an environmental assessment framework as a focused analysis for certain effects on valued receptors. This wildlife ERA relies on several sections of the EIS for the Project and is intended to be complementary to the EIS analyses.

1.2 ERA PROCESS OVERVIEW

An ERA has four components (Figure 1.2-1):

- problem formulation;
- exposure assessment;
- toxicity assessment; and
- risk characterization.

Figure 1.2-1 Flowchart Depicting Ecological Risk Assessment Components



Problem formulation is a focused form of pathway and linkage analysis that identifies and screens environmental issues of potential concern and evaluate the following:

- key stressors of interest (e.g., chemicals of concern);
- the receptors of concern (e.g., wildlife species or groups);
- ecological attributes (endpoints) that are assessed and measured; and
- potential stressor-receptor exposure pathways (i.e., a conceptual model of how organisms, stressors, and other ecosystem components interact to characterize potential ecological risk).

Problem formulation is widely considered to be the most important stage of an ERA because it sets the stage for all further analyses. Before a risk assessment approach is defined, a historical review of relevant site-specific literature is conducted to frame the ERA needs. Accordingly, the problem formulation included consideration of information from the following sources:

- review of the Report of Environmental Assessment by the Mackenzie Valley Environmental Impact Review Board (MVEIRB 2006) and the Terms of Reference (Gahcho Kué Panel 2007);
- review of the project description (Section 3 of the 2012 EIS Supplement; De Beers 2012a), particularly aspects relating to effects and perturbations of aquatic and terrestrial habitats; and
- review of baseline studies (Annexes D, F and I of the 2010 EIS; De Beers 2010) , pathway analyses, and environmental assessments for water quality (Sections 8 and 9 of the 2011 EIS Update and 2012 EIS Supplement [De Beers 2011, 2012a]), aquatic health (Sections 8 and 9 of the 2012 EIS Update), air quality and deposition rates (2012 Updated Air Quality Assessment; De Beers 2012b), and wildlife (Sections 7, 11.10, 11.11, and 11.12 of the 2010 EIS [De Beers 2010], and the 2011 Wildlife Supplemental Monitoring Report [De Beers 2012]).

This information was integrated to formulate assessment endpoints (i.e., management/protection goals that convey the environmental values being protected) and measurement endpoints (attributes that are formally evaluated or measured to estimate risks).

Exposure and toxicity assessments describe the possible exposure that a receptor (e.g., caribou) may have to a stressor (e.g., aluminum) and the ability of each stressor to elicit responses in the receptors. Information obtained from the exposure and toxicity analyses is synthesized and interpreted during the subsequent risk characterization stage.

Risk characterizations for wildlife often entail the calculation of hazard quotients (i.e., the ratio between estimated exposure of an individual organism to a chemical and an established toxicological benchmark for the chemical). To augment the hazard quotient results, the ecological relevance of estimated risks is discussed in terms of the magnitude, scale, frequency, and duration of the effect. These ecological relevance attributes provide context to the magnitude of hazard quotients calculated for individual organisms, and help to convey the uncertainty associated with the risk assessment procedure.

1.3 KEY LINES OF INQUIRY AND SUBJECTS OF NOTE

The specification of receptors and pathways of concern in an ERA is determined, in part, from an assessment of human values with respect to the relative importance of ecosystem components. The *Terms of Reference for the Gahcho Kué Environmental Impact Statement* (Terms of Reference) issued on October 5, 2007, were based on based on input from the public and regulators which identified seven key lines of inquiry representing the highest priority issues to be assessed (Gahcho Kué Panel 2007). The key lines of inquiry facilitate a comprehensive analysis of the Project-related issues that engendered significant public concern. The wildlife ERA specifically addresses the potential effects of chemical stressors on the key line of inquiry, caribou.

The Terms of Reference also identified eighteen subjects of note. Though not considered to have priority equal to the key lines of inquiry, the subjects of note are still important and require consideration in the ERA. The wildlife ERA specifically addresses the potential effects of chemical stressors on the following subjects of note from the 2010 EIS (De Beers 2010):

- Carnivore Mortality (Section 11.10);
- Other Ungulates (Section 11.11); and
- Species at Risk and Birds (Section 11.12).

The 2010 EIS, 2011 EIS Update, 2012 EIS Supplement, and 2012 Updated Air Quality Assessment (De Beers 2010, 2011, 2012a,b) findings for the following additional key lines of inquiry and subjects of note are also applied in the ERA as part of the exposure assessment:

- Water Quality and Fish;
- Air Quality; and
- Mine Rock and Processed Kimberlite Storage.

1.4 SUMMARY OF PATHWAY ANALYSES

Each key line of inquiry and subject of note includes a pathway analysis that identifies and screens the linkages between individual Project components or activities and the specific valued components (VCs). The wildlife ERA is intended to address pathways affecting the VCs identified in Section 1.3; the ERA provides a line of evidence for the EIS. It focuses primarily on exposure pathways to the endpoints of survival, growth, and reproduction of wildlife (i.e., caribou, carnivores, other ungulates, and species at risk and birds). The potential exposure pathways include dust deposition, dietary uptake, and runoff:

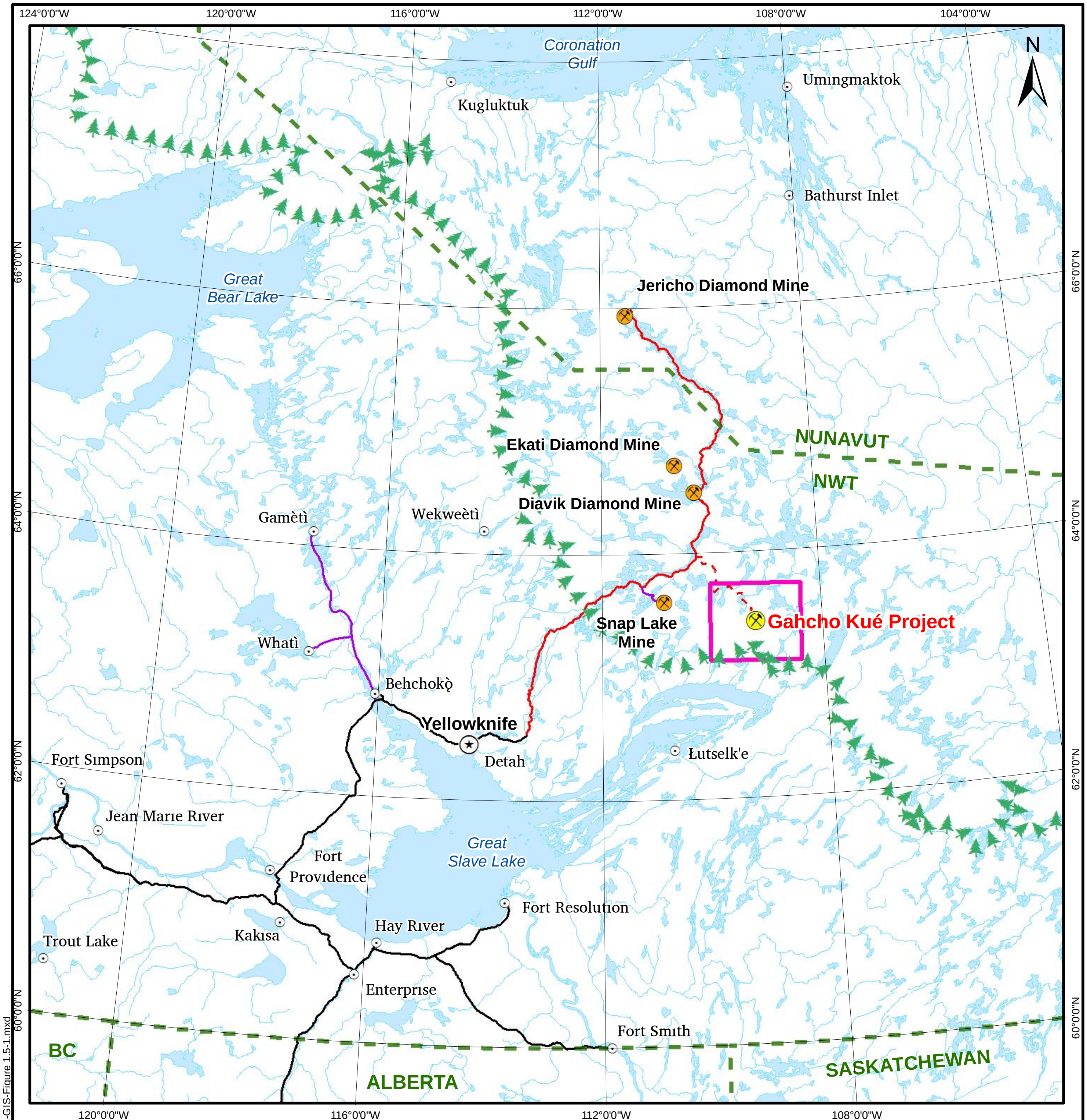
- **Fugitive dust deposition.** Settlement may change the chemical content of soil, vegetation, water, and air near the Project, along the winter access road, and along the Tibbitt-to-Contwoyto Winter Road.
- **Dietary uptake.** Incidental ingestion of exposed sediments and dietary foraging on exposed riparian or aquatic vegetation will result in chemical exposures to wildlife.
- **Runoff and Discharges.** Release of surface water runoff and water releases (discharges) may change water chemistry, resulting in exposures via drinking water (direct pathway) or via bioaccumulation in aquatic prey items (indirect pathway).

Primary sources of chemicals considered for the wildlife ERA include fugitive dust, air emissions, exposed mine rock, exposed processed kimberlite, and Project-related discharges and runoff to waterbodies. The health of wildlife could be influenced by resulting changes to concentrations of metals in exposure media (secondary sources), including surface water, soil, sediment, plant tissue, fish tissue, and animal tissue. Further details of linkages between chemical sources and changes to exposure media concentrations are provided in the Conceptual Model (Section 2.4).

1.5 ENVIRONMENTAL SETTING

The proposed Project is a diamond mine located at Kennady Lake, approximately 280 kilometres (km) northeast of Yellowknife and 140 km north-northeast of the First Nation community of Łutselk'e (Figure 1.5-1). The regional landscape is flat, with substrate consisting mainly of bedrock with morainal, glaciofluvial, and organic deposits. Kennady Lake is situated within the Western Taiga Shield Ecozone in the high subarctic ecoclimatic region. Dominant vegetation types are heath tundra and peat bog. The Project site will be located at the southern limit of continuous permafrost, and within the transition zone between the tundra and the treeline. Species characteristic of both habitat types are found in the region.

Although the wildlife ERA is focused on potential risks within the local study area (LSA), which includes the anticipated Project footprint, much of the understanding of the ecology of the LSA has been gained from broader baseline studies of the regional study area (RSA). The baseline RSA, which is approximately 5,600 square kilometres (km^2) in size, was defined to capture the large-scale direct and indirect effects of the Project on wildlife VCs including those with wide distributions. Figure 1.5-2 depicts the boundaries of the LSA and the RSA from the wildlife baseline studies.



LEGEND

- Gahcho Kué Project
- Existing Mine
- Territorial Capital
- Populated Place
- Highway
- Existing Winter Road
- Tibbitt-to-Contwoyto Winter Road
- Winter Access Road
- Watercourse
- Waterbody
- Territorial/Provincial Boundary
- Treeline
- Regional Study Area

NOTES

Base data source: The Atlas of Canada

GAHCHO KUÉ PROJECT

Location of the Gahcho Kué Project

PROJECTION:	DATUM:
Canadian Lambert Conf. Conic	NAD83

Scale: 1:5,000,000

100 50 0 100

Kilometres

DE BEERS CANADA

FILE No:			DATE:
B2011-Wild-001-GIS-Figure 1.5-1			August 7, 2012
JOB NO:	REVISION NO:		
11-1365-0001	1		
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GOLD-CAL	DC	JV	Figure 1.5-1

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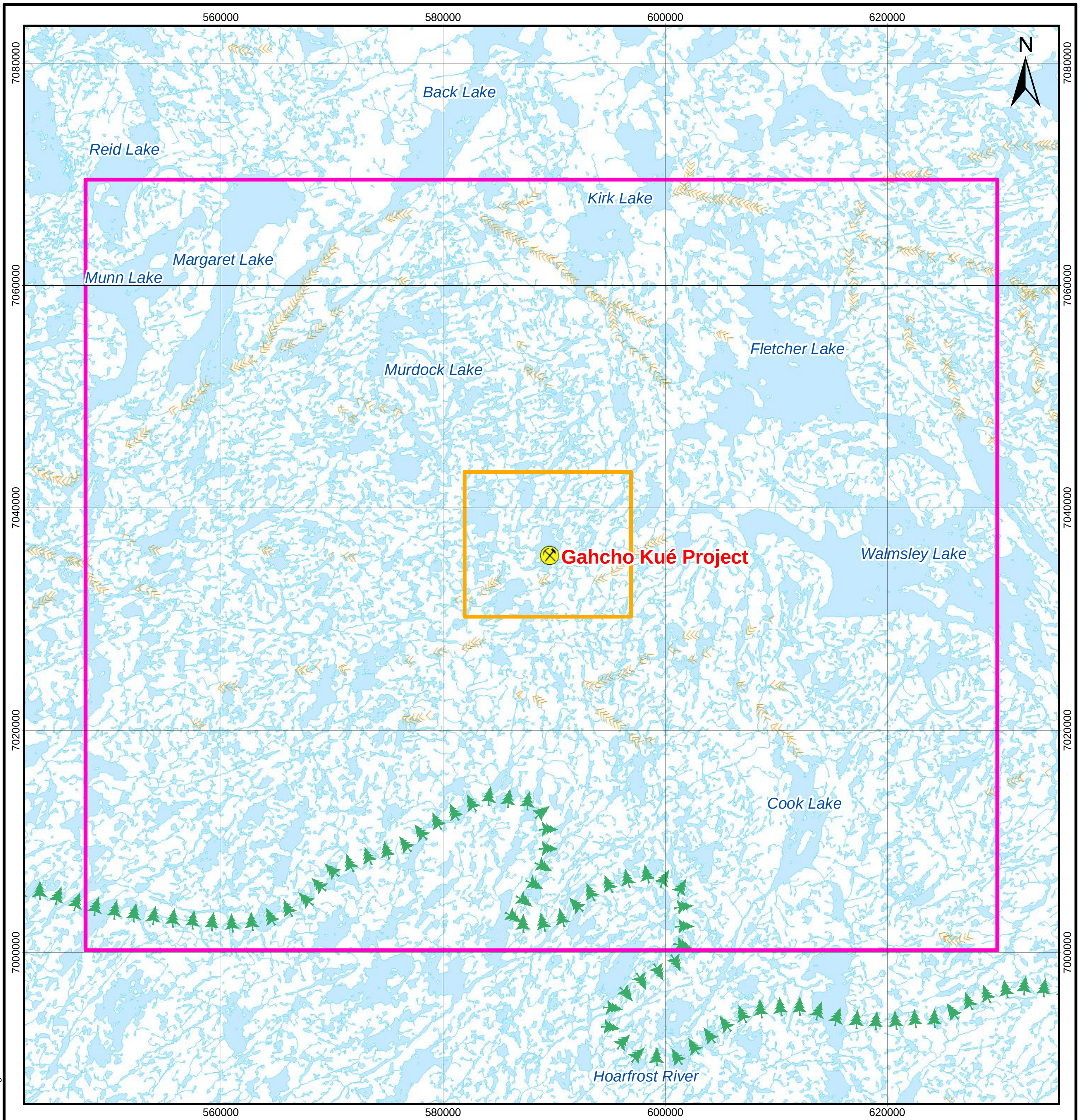

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LEGEND

- Gahcho Kué Project
- Watercourse
- Waterbody
- Esker
- Treeline
- Local Study Area
- Regional Study Area

NOTES

Base data source: National Topographic Base Data (NTDB) 1:250,000

GAHCHO KUÉ PROJECT

Wildlife Study Area Boundaries

PROJECTION: UTM Zone 12	DATUM: NAD83
Scale: 1:500,000 (10 5 0 10 Kilometres)	
FILE No: B2011-Wild-006-GIS-Figure 1.5-2	DATE: August 7, 2012
JOB NO: 11-1365-0001	REVISION NO: 1
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DE BEERS CANADA

Figure 1.5-2

Shrubs of willow and birch occur in drainages; in some areas, they may reach over 2 metres (m) in height. Heath tundra covers most upland areas, particularly in the LSA. Conifer stands occur in patchy distribution north of the treeline, in lowland sheltered areas, and in riparian habitats. Conifer stands are found within the RSA as far north as Kirk Lake (Figure 1.5-2). An extensive esker system stretches from Margaret Lake in the northwest, across the northern portion of the RSA, and beyond the eastern boundary. Numerous smaller esker complexes and glaciofluvial deposits such as kames and drumlins are scattered throughout the RSA. The LSA contains habitat that is characteristic of regional habitat conditions, including eskers and other glaciofluvial deposits, wetlands, riparian habitats, lakes, and vegetation typical of the tundra environment.

Kennady Lake discharges to the north by a series of interconnected small lakes into Kirk Lake and subsequently into the Lockhart River, which drains through Clinton-Golden Lake and Artillery Lake into the north-eastern arm of Great Slave Lake, approximately 340 km downstream. Kennady Lake is ice-covered for seven to eight months of the year, with a short period of open water (four to five months). Ten fish species inhabit Kennady Lake with the most abundant species being round whitefish (*Prosopium cylindraceum*), lake trout (*Salvelinus namaycush*), lake chub (*Couesius plumbeus*), Arctic grayling (*Thymallus arcticus*), northern pike (*Esox lucius*), and burbot (*Lota lota*). Common forage fish found in littoral areas are ninespine stickleback (*Pungitius pungitius*) and slimy sculpin (*Cottus cognatus*) (Section 9.3 of the 2011 EIS Update [De Beers 2011]).

1.6 PROJECT SUMMARY

1.6.1 Site Infrastructure

A small advanced exploration camp is currently located at the proposed Project site. The necessary Project infrastructure will be established on the site prior to the start of mining. The following major facilities will be required:

- processing plant;
- accommodations complex and administrative offices;
- maintenance complex and warehouse;
- electrical power and heating;
- storage for oil, fuel, and glycol;
- production and storage of explosives;
- winter access road;

- site roads;
- traffic management;
- airstrip; and
- sewage treatment.

Most of the Project infrastructure will be constructed on a peninsula that extends into Kennady Lake, although the airstrip will be located southeast of the plant site (Figure 1.6-1). The ammonium nitrate storage areas, emulsion plant, and explosives storage magazines are sited to the north of the main plant site, with separation distances in accordance with the guidelines set out in the *Quantity-Distance Principles User's Manual* published by the Explosives Regulatory Division of Natural Resources Canada.

1.6.2 Mining and Processing

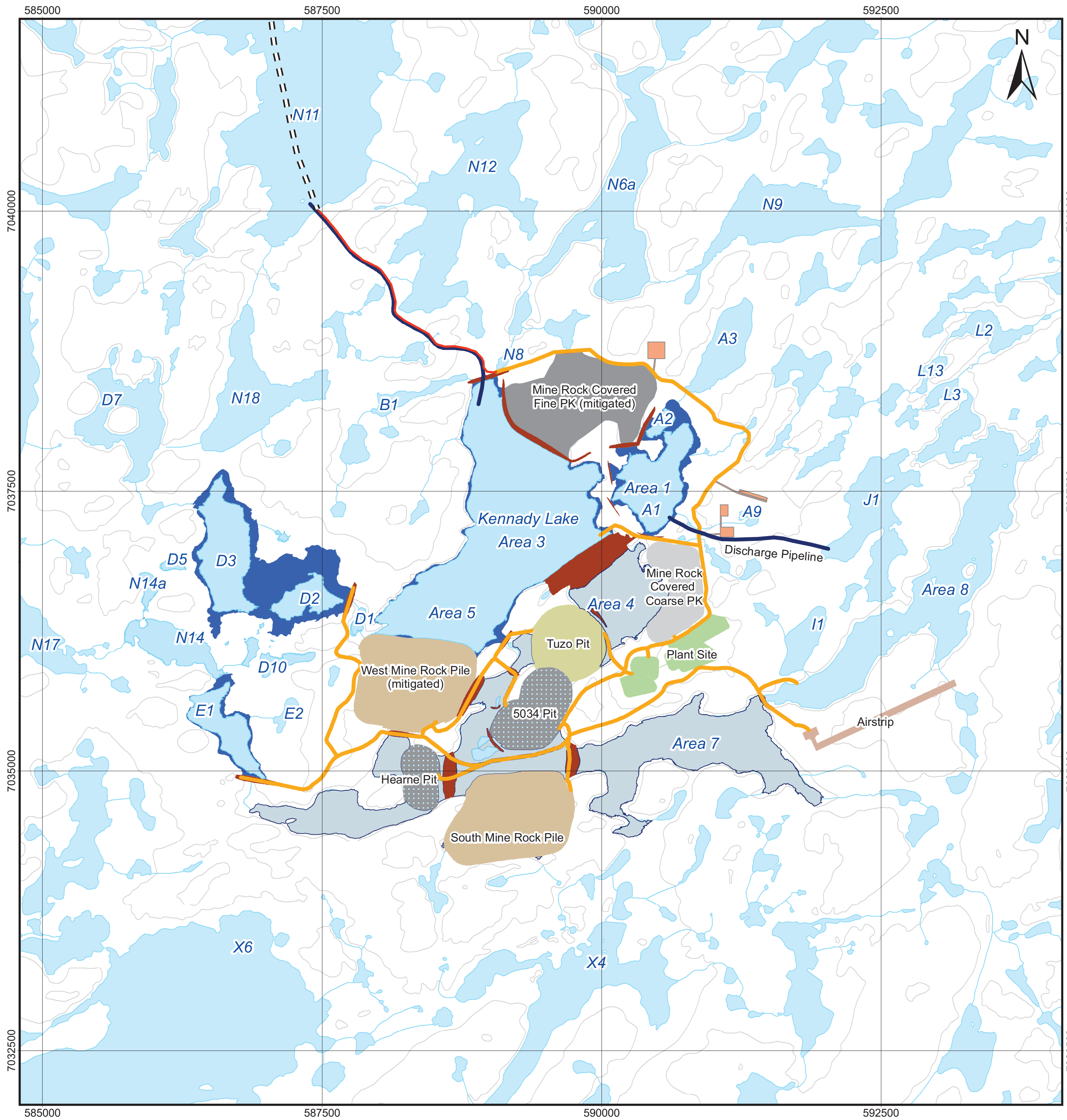
The diamond-bearing kimberlite occurs in vertical pipes located mainly beneath Kennady Lake. Ore from three ore bodies (5034, Hearne, and Tuzo) will be extracted by open pit mining (Figure 1.6-1). Pit closures, including backfilling the 5034 and Hearne pits, will occur progressively as each pit is mined out.

Kimberlite extracted from the mine will be processed on-site. The process plant will be designed to process the 3.0 million tonnes (Mt) of kimberlite per year produced by the mine. Kimberlite ore will be crushed, cleaned, and screened to a specific size range. Then the ore will be mixed with ferrosilicon and water, and diamonds will be separated using a difference in density. In the recovery plant, x-ray machines and a grease diamond recovery system will separate diamonds from the concentrate.

1.6.3 Waste Management

Five major types of waste will be produced and managed on-site:

- lake-bed sediment and overburden from pre-stripping above the ore bodies;
- mine rock that has been excavated from the open pit mines;
- barren (non-diamondiferous) kimberlite rock;
- processed kimberlite; and
- general domestic, industrial, and hazardous waste produced as part of normal Project operations.



LEGEND

	Waterbody	**Project Footprint**			Dyke or Berm
	Watercourse		Service Road		Fine PK Containment Facility
N12	Lake Identifier		Site Road		Flooded Area
	Contour (10m interval)		Water Pipeline		Mine Rock Pile
= =	Proposed Winter Access Road		Airstrip		Open Pit
			Back-filled Pit		Plant Site
			Building		Water
			Coarse PK Pile		
			De-watered Lake Bed		

NOTES
Source: adapted from Figure 1.3-2 of De Beers 2010
Base data source: National Topographic Base Data (NTDB) 1:50,000
PK = Processed Kimberlite

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GAHCHO KUÉ PROJECT

Revised Project Footprint

PROJECTION: UTM Zone 12	DATUM: NAD83
Scale: 1:50,000 (500 250 0 500 Metres)	DE BEERS CANADA
FILE No: E2011-Perm-001-GIS	DATE: February 7. 2012
JOB NO: 11-1365-0001	REVISION NO: 1
OFFICE: GOLD-CAL	DRAWN: AD
CHECK: JF	

Figure 1.6-1

An estimated 226.4 Mt of mine rock and 3.3 million cubic metres (m^3) of overburden will be produced during the operational phase of the Project. Overburden will be used for constructing dykes and for regrading the lake-bed. Excess overburden material will be deposited in the designated areas of the mine rock piles.

Mine rock will be used for construction of roads, dykes, and reclamation of the Coarse Processed Kimberlite (PK) Pile and Fine Processed Kimberlite Containment (PKC) Facility. The mine rock will primarily be composed of granite (95%). Most of the mine rock from the excavation of open pits will be stored in one of the following locations:

- mine rock piles in and adjacent to Areas 5 and 6; and
- mined-out 5034 Pit.

Waste management plans are in place to reduce acid rock drainage and metal leaching. Also, geochemical testing of mine rock will occur throughout the operational period (Section 3 of the 2012 EIS Supplement [De Beers 2012a]). Only non-reactive mine rock will be placed on the upper and outer surfaces of the mine rock pile. Standard best practices for management of other types of solid waste will be followed. Food wastes and non-toxic combustible wastes will be burned in approved oil-fired incinerators. Non-combustible items will be placed in the designated landfill area or recycled if practical. Hazardous materials will be sorted in sealed steel or plastic drums in the waste transfer area before being shipped to an approved off-site hazardous waste disposal location.

A modular sewage treatment system adequate for 432 workers will be installed as part of the initial construction. The sewage treatment system will be housed in a building adjacent to the accommodations complex. Treated liquid effluent from the sewage treatment system will be discharged to Area 3 of Kennady Lake initially and then later in operations directed to the process plant for disposal with the fine PK stream. The sewage sludge will be dewatered and disposed of in the landfill on-site. If possible, the sludge may be composted or used as a soil treatment.

1.6.4 Water Management

Water management is a key component of the Project because the diamond bearing kimberlite pipes are mainly located under Kennady Lake. The Project footprint created by the Water Management Plan will consist of eight major sub-watershed areas: Area 1 is located northeast of Kennady Lake and includes Lakes A1, A2, A3, and A9, while Areas 2 to 8 are within Kennady Lake

(Figure 1.6-2). Areas 2 to 7 will form the controlled area for water management purposes. Area 8 is a sub-watershed of Kennady Lake, but it is outside the controlled area boundary. The objective of the dewatering program will be to dewater Areas 2 to 7 of Kennady Lake to the maximum extent possible to safely access and mine the ore bodies. After the initial dewatering, Areas 6 and 7 will be isolated and mostly drained into Areas 2 to 5.

Before dewatering can take place, Areas 2 to 7 will be isolated. Various dykes will be built to both divert the upper watersheds from Kennady Lake and close the outlet of Area 7. The isolation of Areas 2 to 7 establishes the controlled area, which will retain water affected by the Project (Section 3.9.2 of the 2012 EIS Supplemental [De Beers 2012a]). A critical activity during the initial construction will be the construction of Dyke A at the narrows separating Area 7 and Area 8. Area 8 represents the eastern section of Kennady Lake that will remain at the existing lake elevation (Figure 1.6-2). As the level of water in Areas 2 to 7 decreases, the sills separating the northwest portions of the lake (Areas 2 to 5) from the areas above the 5034 and Hearne ore bodies (Areas 6 and 7) will be exposed. Internal water retention dykes will be constructed isolating the northern portion of the lake (Area 2 to 5) from the southern portion of the lake (Areas 6 and 7), effectively splitting the partially dewatered lake into two major sections and allowing the complete drainage of the remaining water from Areas 6 and 7 into the northern part of the basin.

During the first phase of dewatering, the lake water would be pumped via pipelines to two principal locations simultaneously:

- Area 8 of Kennady Lake, which is the natural outlet for Kennady Lake; and
- Lake N11 in the N watershed (Figure 1.6-2).

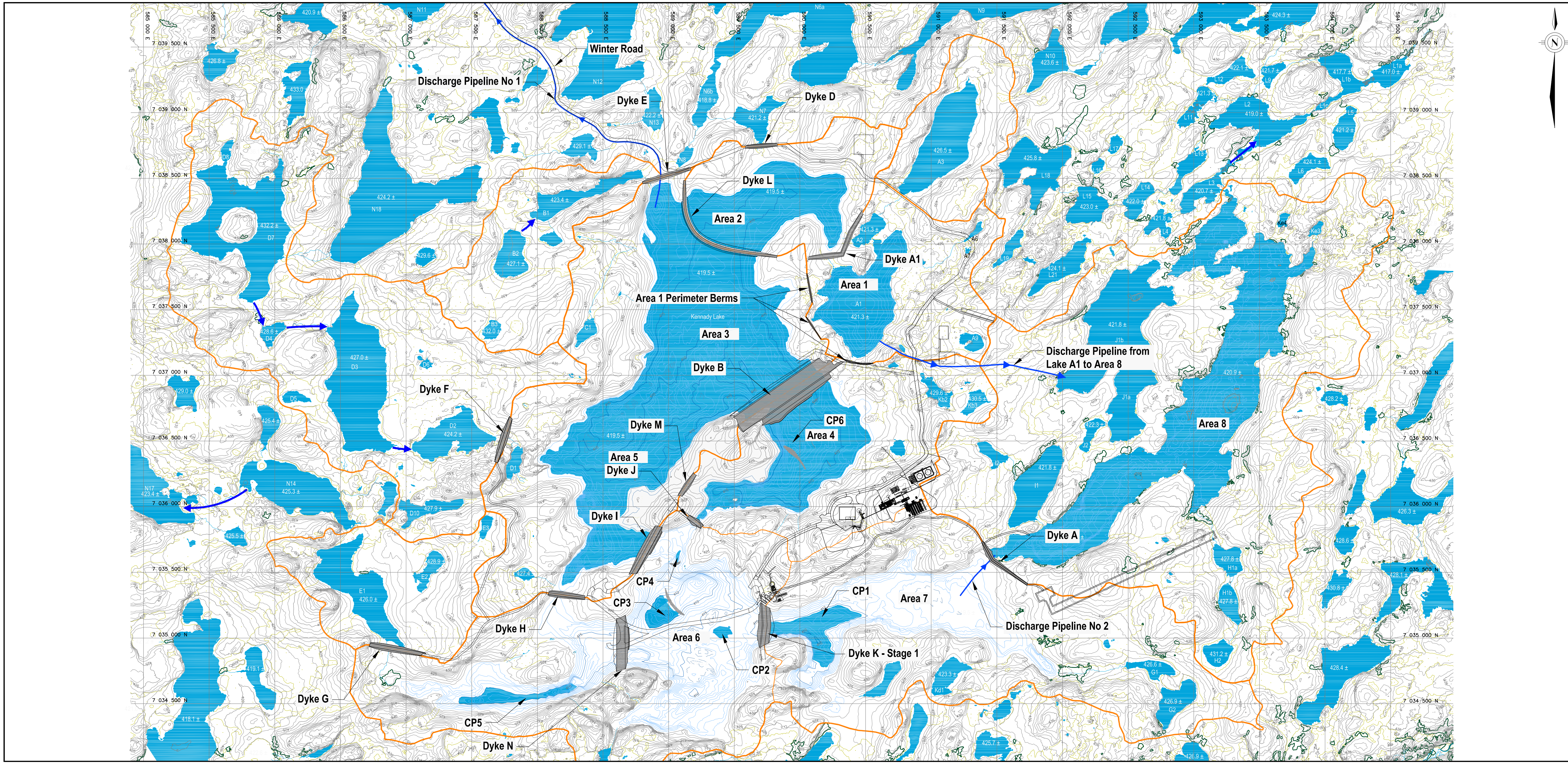
Later, as the water level in Kennady Lake is lowered, sediment from the lake bottom could become suspended due to wave action on the exposed shorelines. Areas 2, 3, and 5 will be dewatered to the maximum extent possible before suspension of lake-bottom sediments result in TSS levels in Areas 2, 3, and 5 that are too high to discharge to Lake N11. Lake dewatering discharge will be sampled regularly to monitor for compliance with TSS discharge limits to be specified by the Mackenzie Valley Land and Water Board in the water license. Monitoring data will be used to identify the water level in the lake needed to minimize the suspension of lake-bottom suspended solids

As the water level decreases, the sills separating the northwest portions of the lake (Areas 2 to 5) from the areas containing the 5034 and Hearne ore bodies (Areas 6 and 7) would be exposed. Construction of small dykes at these points will separate Areas 6 and 7 from the remainder of the basin and allow the complete drainage of the remaining water from Areas 6 and 7 into the northern part of the basin consisting of Areas 2 to 5. Areas 3 and 5 will serve as the water management pond (WMP) for the Project. If necessary, water in Areas 6 and 7 will be treated in-line as it is pumped to the WMP (Areas 3 and 5) for flocculation and settled in the WMP before being subsequently discharged to Lake N11. Between Year 4 and Year 6, a dyke will be constructed allowing the area near the Tuzo Pit to be dewatered so that the Tuzo Pit can be mined.

During operations, groundwater will flow into the open pits; however, to allow uninterrupted mining all water entering the active open pits will be transferred to the WMP.

At the completion of mine operations, the Hearne Pit will have been partially backfilled with fine PK; the 5034 Pit will be backfilled with fine PK and mine rock, while the Tuzo Pit will be open and empty. Area 2 will be filled with fine PK and reclaimed with a cover layer that will be comprised of mine rock, and coarse PK depending on material availability. The water elevation in Areas 3 and 5 at the end of operations is expected to be approximately 422.0 m; however Area 4 will be drained, as this area is adjacent to the Tuzo Pit. Also, Area 7 will have been filled to a water elevation of 420.3 m with natural runoff water.

Following closure, the temporary diversion dykes will be removed to restore the Upper A, B, D, and E watershed boundaries of Kennady Lake. These watersheds will be returned to their natural drainage patterns. During closure, a large proportion of the water within the controlled area, especially the WMP and Area 6, will be transferred to Tuzo pit in advance of refilling Kennady Lake. Natural runoff into the watershed and supplemental pumping from Lake N11 will be used to refill Kennady Lake and all pits. The estimated time required to refill Kennady Lake back to the original levels is eight to nine years.



LEGEND

430	Existing Ground Contours 5m Index - 1m Intermediate
415	Bathymetry Contours 5m Index - 1m Intermediate
CP	Collection Pond
	Winter Road
	Marsh Area
	Scrub
	Sub-watershed Boundary
	Drainage Flow Direction
	Discharge Pipeline
	Lake/Pond

NOTES
Base data source: EBA Figure 4.2 - Stage 1 - Initial Lake Dewatering (June-July, 2013)
Source: Adapted from Figure 3.9-1 of De Beers 2010

GAHCHO KUÉ PROJECT

Water Management Areas, Dykes, Collection Ponds, and Lakes Associated with the Project

PROJECTION: UTM Zone 12	DATUM: NAD83
SCALE: 500 0 500 METRES	DE BEERS CANADA
FILE No: P2011-Other-001-CAD	DATE: March 3, 2012
JOB No: 11-1365-0001	REVISION No: 4
OFFICE: GOLD - SAS	DRAWN: BDS/TAH · CHECK: JF

Figure 1.6-2

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1.6.5 Site Access

The site will be accessible by air for mine staff, supplies, and emergency transport. To provide seasonal overland access, a 120 km winter access road will be constructed from Kennady Lake to the north end of MacKay Lake and will intersect the Tibbitt-to-Contwoyto Winter Road at kilometre 271. The winter road will be in operation from late January or early February through March and, under favourable conditions, into early April.

1.6.6 Project Schedule

Following necessary environmental assessment and regulatory approvals, a construction period will be required to install the infrastructure and to dewater part of Kennady Lake prior to production mining. Construction activities will take place over two years (Year -2 to -1). After the water above the ore bodies has been drained to an acceptable level, pre-stripping of the first open pit and initial production mining will begin (Year 1) will commence after commissioning is complete in the last quarter of construction (Year -1).

The construction period will be followed by an eleven-year operational period (Year 1 to 11), during which the kimberlite will be mined and processed. Most of the site infrastructure will be removed and the Project site decommissioned two years after the completion of mining (i.e., by the end of Year 13, assuming mining is completed by Year 11). Final closure of the site will take place over an extended period (Year 14 to 19). All remaining site infrastructure (e.g., airstrip and reclamation camp) will be removed after the water level in the planned reclamation areas of Kennady Lake has been restored. Monitoring of the Project site will continue after lake refilling until it is shown that the Project site and Kennady Lake meets all regulatory closure objectives.

2 PROBLEM FORMULATION

2.1 RECEPTORS OF POTENTIAL CONCERN

The LSA is inhabited by a wide range of wildlife species including ungulates, large and medium-sized carnivorous mammals, migratory and resident birds, water birds and waterfowl, and small mammals (herbivores, omnivores, and carnivores). Depending on the nature and objectives of an ERA, receptors of potential concern (ROPCs) can consist of individual species, functional groups (e.g., trophic levels), or communities. Selection of ROPCs for the Wildlife ERA focused on receptors identified in the key line of inquiry (e.g., caribou) and subjects of note (carnivorous mammals, other ungulates, and birds) by the Terms of Reference (Gahcho Kué Panel 2007). Some additional ROPCs (e.g., small herbivorous mammals) that were not identified in the Terms of Reference are also included because impairment of populations of these receptors could affect prey availability for carnivores identified in the subjects of note. Table 2.1-1 summarizes the ROPCs for the ERA.

Conservative assumptions were made for all ROPCs so that the receptor parameters (e.g., weight and feeding rate) were sufficiently protective of all abundant species within a feeding guild. Further details are provided in Appendix II.

2.1.1 Caribou

Barren-ground caribou (*Rangifer tarandus groenlandicus*) have a high social, cultural, and economic importance for the people and communities living in the Canadian Arctic. First Nation people in the Northwest Territories (NWT) have a strong connection with caribou, and rely on the animals for food, clothing, and cultural wellness. Caribou are also an important species because they influence the landscape through their movements and feeding, and provide food for predators and scavengers including wolves, grizzly bears, wolverines, and foxes. The barren-ground caribou, with the exception of the Dolphin and Union herds, are listed as *sensitive* by the Working Group on General Status of NWT Species (GNWT 2006). The Bathurst, Ahiak, and Beverly herds are not listed federally by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC 2007, internet site).

Table 2.1-1 Summary of Receptors of Potential Concern

Valued Component	Species Potentially Present in RSA	Receptor(s) of Potential Concern
Caribou	caribou	caribou
Carnivores (i.e., large and medium-sized mammalian carnivores)	grizzly bear wolf wolverine Arctic fox red fox	large omnivore large carnivore medium-sized carnivore
Other ungulates	moose muskoxen	large herbivore
Upland breeding birds	about 30 species	small upland insectivore medium-sized upland carnivore large upland carnivore small upland omnivore medium-sized upland omnivore small upland herbivore medium-sized upland herbivore
Water birds	about 27 species	small insectivore medium-sized carnivore large carnivore medium-sized herbivore large herbivore medium-sized omnivore
Raptors	about 12 species	hawks, owls and falcons eagles
Other species (i.e., species not identified in the Terms of Reference)	other mammalian species	medium-sized herbivore small herbivore small carnivore small insectivore (shrew) small omnivore

RSA = Regional Study Area.

Caribou migrate through the study area during spring and fall.

Given their cultural and ecological importance and territorial *sensitive* status, caribou are treated as individual ROPCs in the wildlife ERA.

2.1.2 Other Ungulates

Other ungulates, including muskoxen (*Ovibos moschatus*) and moose (*Alces alces*), are a subject of note in the Terms of Reference (Gahcho Kué Panel 2007).

The muskoxen are currently listed as *secure* within the NWT (GNWT 2006); this species is not listed federally because populations appear to be increasing (COSEWIC 2007, internet site). From 1995 to 2003, eight observations of muskoxen were recorded within the RSA during aerial surveys of caribou. In 2004 and 2005, muskoxen were relatively common (15 observations in total) and were observed within the RSA during all aerial surveys. Esker surveys completed in the RSA in 2007 indicated muskoxen signs at a density of 0.14 signs per kilometre surveyed.

Moose populations in the NWT are listed as *secure* by the Working Group on General Status of NWT Species (GNWT 2006), and this species is not listed federally (COSEWIC 2007, internet site). Traditional knowledge and baseline surveys indicate that moose are not common to the RSA, but they have occasionally been observed.

Given their confirmed presence in the RSA, muskoxen were retained as a ROPC for the ERA. Because moose are not expected to be common in the RSA and because they are considered secure in the NWT, they were not retained as a ROPC for the ERA. Muskoxen and moose occupy a similar ecological niche (i.e., large ungulates feeding exclusively on vegetation); therefore, the risk assessment conclusions for muskoxen are also likely to be applicable to moose.

2.1.3 Large and Medium-sized Carnivores

Carnivores identified in the subject of note on carnivore mortality in the 2010 EIS (De Beers 2010, Section 11.10) included barren-ground grizzly bear (*Ursus arctos richardsoni*), gray wolf (*Canis lupus* ssp.), red fox (*Vulpes vulpes*), Arctic fox (*Alopex lagopus*), and wolverine (*Gulo gulo*).

Grizzly bears in the NWT are listed as *sensitive* by the Working Group on General Status of NWT Species (GNWT 2006), and as a *species of special concern* by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC 2007, internet site). Two bears are known to maintain den sites near the RSA and bear signs were documented in the RSA from 1999 to 2005. In 2004, eight different grizzly bears (five adults and three cubs) were observed within the RSA and a minimum of six different grizzly bears were present in 2005.

Most sightings occurred during the spring, with observations decreasing during the late summer and fall.

The abundance of wolves within the RSA is expected to vary annually and seasonally in response to factors such as prey availability and suitability of den habitat. Wolves in the NWT are listed as *secure* by the Working Group on General Status of NWT Species (GNWT 2006), and are considered *not at risk* by COSEWIC (2007, internet site). Wolves are present near the Project seasonally from March through October; their presence is correlated to caribou migration. Wolves north of the tree line follow the migrating herds and prey almost exclusively on caribou. Wolves also are known to den in the RSA, and the surrounding area has been identified as a key den location (Annex F Wildlife Baseline [De Beers 2010], and 2011 Wildlife Supplemental Monitoring Report [De Beers 2012]). Wolf tracks have been observed in the LSA and wolves are expected to use eskers in the LSA and RSA for den sites, foraging, and travel.

Wolverine presence is also correlated to caribou presence. Wolverines are an important cultural and economic resource for the people of the NWT. Traditional knowledge indicates that wolverines were harvested primarily for their fur, although historically, they were sometimes used as an emergency food source. Wolverines are annual residents in the RSA; they are listed as a *species of special concern* by COSEWIC (2007, internet site) and *sensitive* by the Working Group on General Status of NWT (GNWT 2006). This species currently has no status under the federal *Species at Risk Act* (SARA; Government of Canada 2006, internet site). From 2005 to 2006, the presence of 34 wolverines (20 females and 14 males) was documented in the LSA and parts of the RSA.

The Arctic fox and red fox are the most abundant carnivores in the Arctic tundra and are listed as *secure* in the NWT by the Working Group on General Status of NWT Species (GNWT 2006). Neither Arctic fox nor red fox are listed federally (COSEWIC 2007, internet site). The ranges of Arctic fox and red fox potentially overlap in a relatively narrow strip in the southern arctic regions. During the course of baseline wildlife surveys, no Arctic foxes were observed within the RSA, as the study area is located at the southern margin of this species' home range. However, red foxes are relatively common year-round residents within the RSA. Track count surveys completed within the LSA in May 2004 recorded 114 fox tracks, and red foxes are known to den in the RSA with high site fidelity (see also Annex F Wildlife Baseline [De Beers 2010]).

Barren-ground grizzly bear and wolf were retained as individual ROPCs for the ERA. A composite medium-sized carnivore receptor was developed to represent wolverine, red fox, and Arctic fox.

2.1.4 Upland Breeding Birds

Upland breeding birds (passerines, ptarmigans, and upland-breeding shorebirds) were identified by the Gahcho Kué Panel (2007) in the subject of note related to species at risk and birds in the 2010 EIS (De Beers 2010, Section 11.12). Approximately thirty species of upland breeding birds have been identified as inhabiting, or potentially inhabiting, both the RSA and LSA.

The following species of upland breeding birds, all known or expected to occur in the RSA, are listed in the NWT as *sensitive* by the Working Group on General Status of NWT Species (GNWT 2006):

- least sandpiper (*Calidris minutilla*);
- semipalmated sandpiper (*Calidris pusilla*);
- lesser yellowlegs (*Tringa flavipes*);
- American pipit (*Anthus rubescens*);
- boreal chickadee (*Poecile hudsonica*);
- blackpoll warbler (*Dendroica striata*);
- American tree sparrow (*Spizella arborea*);
- Harris' sparrow (*Zonotrichia querula*); and
- American golden plover (*Pluvialis dominica*).

The rusty blackbird (*Euphagus carolinus*) *may be at risk* in the NWT (GNWT 2006), and is also listed as a *species of special concern* federally (COSEWIC 2007, internet site). It currently has no status under SARA (Government of Canada 2006, internet site). The rusty blackbird was the only federal listed *species of special concern* (COSEWIC 2007, internet site) observed during baseline bird surveys. The lesser yellowlegs and boreal chickadee were the only *sensitive* species not documented during the surveys.

Lapland longspurs (*Calcarius lapponicus*) were the most common birds observed in heath tundra and sedge wetlands, and savannah sparrows (*Passerculus sandwichensis*), Harris' sparrows, and American tree sparrows were also abundant. Sedge wetlands contained more shorebird species than other habitats, including four species detected only in wetlands: pectoral sandpiper (*Calidris melanotos*), short-billed dowitcher (*Limnodromus griseus*), semi-palmated sandpiper, and white-rumped sandpiper (*Calidris fuscicollis*). One shorebird species, the semipalmated plover (*Charadrius semipalmatus*), was detected in the heath tundra. Additional species that have been observed or that are potentially present in the RSA and LSA are described in Annex F Wildlife Baseline of the 2010 EIS (De Beers 2010).

Because of the large number of upland breeding bird species expected to inhabit the RSA and LSA, and the similarity of life history, exposure and effects profiles within groupings of bird species, it was neither feasible nor necessary to assess risks to each species individually. Instead, composite ROPCs were developed to represent the following size-specific and diet-specific guilds of upland breeding birds:

- small insectivorous upland birds;
- medium-sized carnivorous upland birds;
- large carnivorous upland birds;
- small omnivorous upland birds;
- medium-sized omnivorous upland birds;
- small herbivorous upland birds; and
- medium-sized herbivorous upland birds.

2.1.5 Water Birds

Water birds (e.g., ducks, geese, grebes, loons) have been identified in the subject of note on species at risk and birds by the Gahcho Kué Panel (2007). Approximately 27 species of water birds have been identified as inhabiting or potentially inhabiting both the RSA and LSA.

Geese, ducks, and loons are important to First Nations. According to Traditional Knowledge, geese and ducks are a preferred food source for communities, and the feathers are used for making blankets and pillows (LKDFN 2001). The yellow rail (*Coturnicops noveboracenis*) is the only species listed under Schedule 1 of SARA that is known to reside within the RSA. In addition, the following s*ensitive* species of water birds may breed within or near the RSA:

- red-necked phalarope (*Phalaropus lobatus*);
- northern pintail (*Anas acuta*);
- lesser scaup (*Aythya affinis*);
- white-winged scoter (*Melanitta fusca*);
- black scoter (*M. nigra*);
- surf scoter (*M. perspicillata*);

- black tern (*Chlidonias niger*);
- Caspian tern (*Hydroprogne caspia*);
- Hudsonian godwit (*Limosa haemastica*);
- American bittern (Botaurus lentiginosus);
- pied-billed grebe (*Podilymbus podiceps*); and
- long-tailed duck (*Clangula hyemalis*).

Sensitive waterfowl species observed during baseline surveys included the northern pintail, greater scaup (*Aythya marila*), lesser scaup, surf scoter, white-winged scoter, black scoter, and the long-tailed duck. The most common species of large water birds recorded were snow geese (*Chen caerulescens*), greater white-fronted geese (*Anser albifrons*), and Canada geese (*Branta canadensis*). Geese, ducks, and loons are all expected to breed in the RSA.

Because of the large number of water bird species expected to inhabit the RSA and LSA, and the similarity of life history, exposure and effects profiles within groupings of bird species, it was neither feasible nor necessary to assess risks to each species individually. Instead, composite ROPCs were developed to represent size-specific and diet-specific guilds of waterfowl:

- small insectivorous water birds;
- medium-sized carnivorous water birds;
- large carnivorous water birds;
- medium-sized herbivorous water birds;
- large herbivorous water birds; and
- medium-sized omnivorous water birds.

2.1.6 Raptors

Raptors are birds of prey, and include falcons, eagles, hawks, and owls. Ravens are technically corvids, but were grouped with the raptors for this wildlife ERA. Vulnerable raptor species known, or expected, to occur within the RSA include the short-eared owl (*Asio flammeus*), peregrine falcon (*Falco peregrinus*), and the golden eagle (*Aquila chrysaetos*). The short-eared owl and the peregrine falcon are both listed under Schedule 3 of SARA, and are *species of special concern* under COSEWIC (2007, internet site). These species, in addition to the golden eagle, are also listed as *sensitive* in the NWT (GNWT 2006).

The most common species observed within the RSA in the 2004 survey were peregrine falcon, northern harrier (*Circus cyaneus*), common raven (*Corvus corax*), rough-legged hawk (*Buteo lagopus*), gyrfalcon (*Falco rusticolus*), and bald eagle (*Haliaeetus leucocephalus*). Only a limited number of sightings of short-eared owls, golden eagles, northern hawk owls (*Surnia ulula*), snowy owls (*Bubo scandiacus*), and merlins (*Falco columbarius*) were documented in the RSA. Ten active raptor nests, including 22 nestbound chicks, and 17 unoccupied nests were observed in 2004 and 2005. Of the 27 raptor nests identified within the RSA, 15 were falcon nests, including 4 gyrfalcon and 11 peregrine falcon nests.

Raptors were grouped by size and feeding preferences (guilds) to develop composite ROPCs including:

- hawks, owls and falcons (e.g., northern harrier); and
- eagles (i.e., bald eagle and golden eagle).

Falcons have been identified as a receptor that feeds mainly on other bird species; however, uptake factors for metals to bird tissues are generally not available in the literature. Therefore, exposure predictions for metals to falcons could not be calculated and a quantitative evaluation of the assessment endpoint was not conducted for this species. Instead, falcons were grouped with hawks and owls which feed upon small mammals, which inhabit a niche similar to the bird species that would be consumed by falcons and for which metal-to-tissue uptake could be predicted.

2.1.7 Other Species

The Terms of Reference focus on large ungulates, medium and large carnivores and omnivores, and most bird species potentially inhabiting the LSA and RSA. In addition to these species groups, a range of small to medium-sized mammals (including herbivores, omnivores, and carnivores) inhabit the LSA and RSA. The latter have not been identified in a key line of inquiry or subject of note; however, these lower trophic level mammals can be useful indicators of possible toxicological risks to receptors in the LSA. These organisms feed at trophic levels that are in closer contact with media (water, soil, and vegetation) that may be affected by the Project. Furthermore, potential impairment of mammals from changes to lower trophic levels (via reduced population size or biomass) would reduce the food supply for larger carnivores, resulting in energetic and ecological effects.

Based on these considerations, the following mammalian ROPCs were also included for the ERA (example species in parentheses):

- medium-sized herbivore (e.g., Arctic ground squirrel [*Spermophilus parryi*], snowshoe hare [*Lepus americanus*], arctic hare [*Lepus arcticus*]);
- small herbivore (meadow vole [*Microtus pennsylvanicus*], collared lemming [*Dicrostonyx groenlandicus*]);
- small carnivore (e.g., ermine or least weasel [*Mustela erminea*], mink [*Mustela vison*], marten [*Martes americana*]);
- small insectivore (masked shrew [*Sorex cinereus*]); and
- small omnivore (deer mouse [*Peromyscus maniculatus*]).

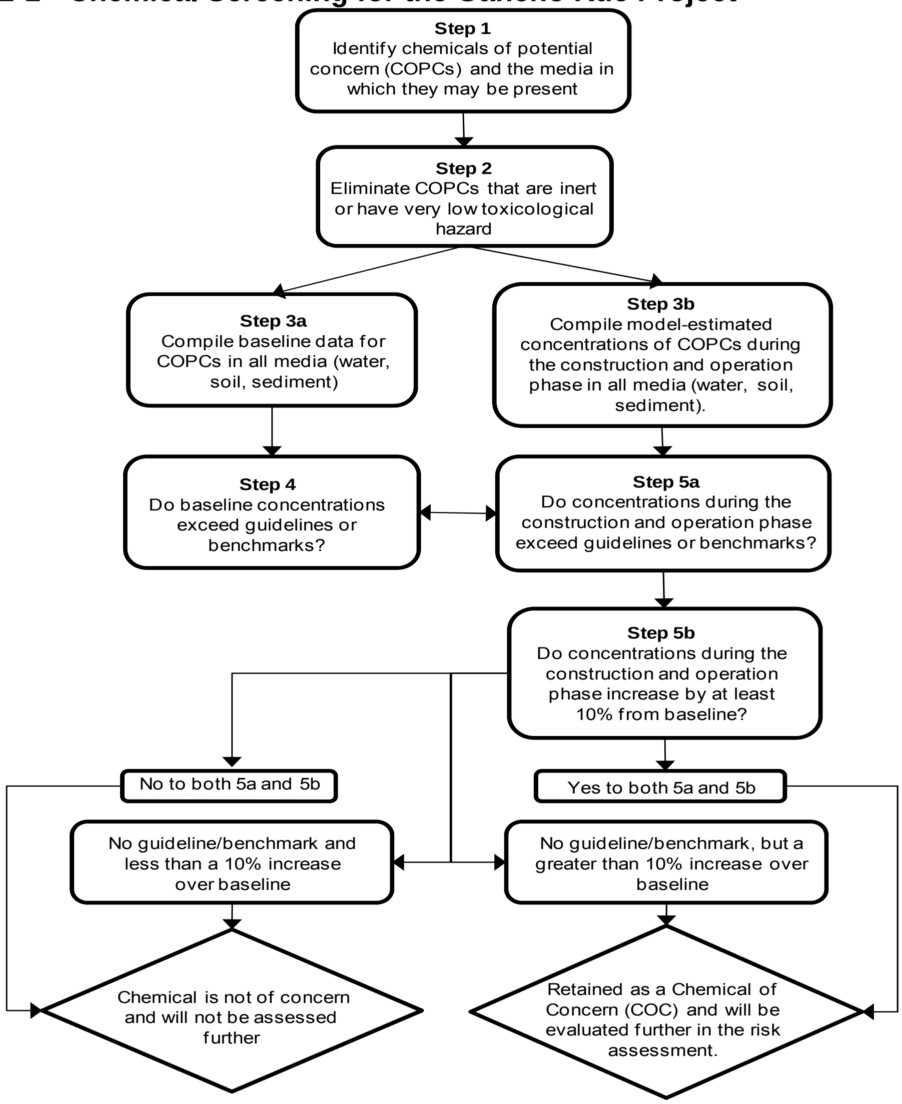
2.2 CHEMICALS OF POTENTIAL CONCERN

2.2.1 Chemical Screening Process

A formal screening process was used to evaluate the chemicals of potential concern (COPCs) to derive a final list of chemicals of concern (COC) to be carried through the ERA[1]. The screening process followed a step-wise approach described in Figure 2.2-1.

[1] The term COPC is used to represent all substances of potential interest in the ERA, whereas COC represents only those remaining following the screening procedure presented in Figure 2.2-1.

Figure 2.2-1 Chemical Screening for the Gahcho Kué Project



2.2.1.1 Step 1. Identification of Chemicals of Concern

The COCs were determined for chronic exposure by wildlife receptors (including caribou) using data for soil, sediment, and surface water and predictions of changes of metal and PAHs concentrations in soil and surface water in the LSA. In addition, a separate COC screening of granite and kimberlite mine rock was conducted for caribou due to their tendency to consume high amounts of soil at salt lick sites. This screening identified COCs for an acute binge ingestion scenario to address the possibility that caribou might be attracted to granite or kimberlite mine rock as a salt lick site.

2.2.1.2 Step 2. Elimination of Non-hazardous Chemicals

Some metals and essential minerals are commonly analyzed in environmental samples (as part of the standard suite of metals treated by the analytical method) but generally have low toxicological hazard at environmentally realistic concentrations, even at industrial sites such as a diamond mine. Many of these substances are present in parent rock and soil materials and are present in a toxicologically inert form, and some are essential micro- and macro-nutrients. Although the following metals and essential minerals are known to be present in soil, water, sediment, mine rock, or processed kimberlite from the Project site, they were excluded from further consideration in the COC screening process based on their expected low toxicological hazard:

- essential minerals (calcium, magnesium, phosphorus, potassium, sodium); and
- trace elements (bromine, gallium, gold, indium, lanthanum, lithium palladium, rubidium, scandium, silicon, thorium, tungsten, yttrium, and zirconium).

The rationale for excluding these COCs from further consideration is described below.

Calcium, sodium, potassium, magnesium, and phosphorus are all essential minerals that serve a variety of biochemical, intracellular, and ion balance purposes in animal tissues. All of these minerals are naturally abundant. Regulatory (compensatory) mechanisms within birds and mammals render toxic responses from dietary exposure to these minerals rare, except in extreme cases that are not representative of possible environmental exposure (Puls 1994).

Bromine, gallium, gold, indium, lanthanum, lithium, palladium, rubidium, scandium, silicon, thorium, tungsten, yttrium, and zirconium are trace mineralogical parameters and therefore not commonly assessed in risk assessment.

2.2.1.3 Step 3. Compilation of Chemical Concentrations

Chemical concentrations in various media (e.g., soil, water, sediment, and mine rock) were screened against relevant regulatory guidelines and benchmarks. Screening included concentrations from two sources:

- baseline sampling surveys conducted from 1999 through 2011; and
- estimated chemical concentrations in media during the Project (i.e., construction, operations and closure phases).

Soil concentrations during the Project were estimated by summing:

- the baseline maximum concentrations; plus
- incremental increases in concentrations estimated from dust deposition rates based on the results of the 2012 Updated Air Quality Assessment (De Beers 2012b).

Surface water concentrations of COCs for baseline conditions and during the construction and operations phases of the Project were predicted from water quality models. Maximum surface water concentrations in Lakes 410 and N11 during the Project as summarized in Section 9 of the 2012 EIS Supplement (De Beers 2012a) were used for screening purposes. Baseline water quality was considered as a long-term average concentration. Sediment COC concentrations from Kennady Lake, Kirk Lake, Lake 410, and Control Lake were reported from grab samples collected in 1999, 2004, 2005, 2010 and 2011.

For more information regarding the sediment sampling methods and results, consult the 2010 EIS Annex I Water Quality Baseline, Addendum II Additional Water Quality Baseline Information, and 2011 Water Quality and Sediment Quality Supplemental Monitoring Report (De Beers 2010; Golder 2012a).

For mine rock and kimberlite samples, only baseline data were available. The maximum concentration was used for screening purposes (Tables II-5 and II-6 of Appendix II) and the data are presented in Annex D of the 2010 EIS as well as Appendix 8.III of the 2012 EIS supplement (De Beers 2012).

2.2.1.4 Step 4. Comparison of Baseline Concentrations to Guidelines

Multiple candidate guidelines and benchmark values exist for use in the screening of chemicals. The following guidelines were used to screen soil, water and sediment data:

- Soil concentrations were screened against the Canadian Environmental Soil Quality Guidelines derived for agricultural land use (CCME 1999a, updates to 2011, internet site). For some substances, the guideline is subdivided into categories based on relevant exposure pathways for the protection of human health and the environment. Applicable environmental exposure pathways for this assessment included soil contact and soil and food ingestion. The generic Canadian Council of Ministers of the Environment (CCME) interim guidelines were used in the absence of a matrix derived guideline. The lowest agricultural guideline available for the applicable exposure pathways was used. Soil concentrations were also screened against the U.S. Environmental Protection Agency (U.S. EPA) Ecological Soil Screening Levels (Eco-

SSL) for protection of avian and mammalian wildlife (U.S. EPA 2010, internet site).

- Water concentrations were screened against Canadian Water Quality Guidelines for the protection of freshwater aquatic life (CCME 1999b, updates to 2012, internet site), Canadian Water Quality Guidelines for the protection of agricultural uses (livestock; CCME 1999c, updates to 2006, internet site). Where a CCME freshwater aquatic life guideline was not available, then the applicable U.S. EPA Region III benchmark for freshwater (U.S. EPA 2006a, internet site) was applied.
- Sediment concentrations were screened against Canadian Sediment Quality Guidelines for the protection of freshwater aquatic life (CCME 1999d, updates to 2002, internet site) and U.S. EPA Region III Freshwater Sediment Screening Benchmarks (U.S. EPA 2006b, internet site).
- Granite and kimberlite mine rock concentrations were screened using the same guidelines as soil (see above).

Exceedances of baseline concentrations were identified for each medium by comparison of the maximum baseline concentrations to relevant regulatory guidelines.

2.2.1.5 Step 5a. Comparison of Project Concentrations to Guidelines

Predicted project concentrations (construction and operation phases) were screened using the same regulatory guidelines/benchmarks used for the baseline data screening. Maximum predicted concentrations of COCs in soil, and water. The soil data include the addition of metals and PAHs estimated from the depositional scenarios described in 2012 Updated Air Quality Assessment (De Beers 2012b).

Sediment metals concentrations were expected to remain similar to baseline concentrations during the Project (as outlined in Section 8 of the 2011 EIS Update [De Beers 2011]) and therefore where the baseline concentration in sediments for any parameter exceeded a guideline, the parameter was retained as a COC.

For granite and kimberlite, only baseline concentrations were available and these concentrations were assumed to represent the type of mine rock that caribou might ingest under the acute binge ingestion scenario. Therefore, where the baseline concentration in granite/kimberlite for any parameter exceeded a guideline, the parameter was retained as a COC for the acute binge ingestion scenario.

2.2.1.6 Step 5b. Comparison of Project Concentrations to Baseline

For media where both baseline and predicted Project concentrations were available, Project concentrations were compared to baseline concentrations to identify any chemicals that indicated an increase greater than 10% relative to baseline. Increases of less than 10% relative to baseline are considered to represent negligible changes to soil or water quality; these small differences are not considered to be toxicologically significant and differences of this magnitude are expected due to natural background variability (Chapman and Anderson 2005).

If a chemical exceeds the applicable regulatory guideline/benchmark and the concentration is greater than 10% over baseline, the chemical was considered to be a COC. If there was no guideline/benchmark for a chemical, but there was at least a 10% change over baseline, the chemical was also retained as a COC, unless there was a reasonable rationale for not including the chemical as a COC (i.e., for essential elements of low toxicological concern), in which case, additional discussion was provided

2.2.2 Chemical Screening Results

The baseline screening tables are presented in Appendix II. A summary table of the metals exceeding the applicable screening criteria for baseline soil, water, and sediment concentrations is shown in Table 2.2.-1.

Table 2.2-1 Summary of Baseline Exceedances of Metals in Soil, Water, and Sediment

Parameter	Soil	Water	Sediment
Antimony	-	-	-
Arsenic	-	-	√
Barium	-	-	-
Boron	√	-	-
Cadmium	√	-	√
Chromium	√	-	√
Cobalt	-	-	-
Copper	√	-	√
Iron	-	-	√
Lead	-	-	-
Manganese	-	-	√
Molybdenum	-	-	-
Nickel	√	-	√
Selenium	-	-	√
Thallium	-	-	-
Vanadium	√	-	-
Zinc	-	-	√

Notes: For the following metals, applicable screening criteria were not available: Soil (Al, Fe, Sr, Ti), Sediment (Al, Ba, Be, B, Mo, Sr, Tl, U, V).
√ = concentration exceeded the applicable screening criteria (see Appendix II for more detail)
- = chemical did not exceed environmental guideline in that media.

The screening process for the Project (i.e., Steps 1 through 5) identified nine metals as COCs for wildlife receptors from sediments and two metals from water; no COCs were identified for soil. Screening for sediments used baseline data because sediment concentrations are not expected to change as a result of the Project (refer to Section 8 of the 2011 EIS Update [De Beers 2011]).

Screening of mine rock/kimberlite and water for the caribou exposure profile identified eighteen metals as COCs in mine rock. Only baseline concentration data were available for mine rock and kimberlite; therefore all exceedances of baseline concentrations (above applicable screening criteria) plus any parameters without screening criteria were carried forward in the risk assessment. The full results of the Project screening are presented in Appendix II and a summary of COCs is provided in Tables 2.2-2 and 2.2-3.

Table 2.2-2 Summary of Project (Construction, Operations and Closure) Exceedances of Metals in Soil, Water, and Sediment

Chemical of Concern[(a)]			
COC	**Soil**	**Surface Water**	**Sediment**
Arsenic	-	-	√
Cadmium	-	√	√
Chromium	-	-	√
Copper	-	√	√
Iron	-	-	√
Manganese	-	-	√
Nickel	-	-	√
Selenium	-	-	√
Zinc	-	-	√

(a) A conservative multi-media approach was used; specifically, if a COC was screened into the risk assessment on the basis of one medium, it was automatically assessed in all other media in which it was present. In this manner, all potential exposure pathways were considered if any pathway suggested potential for concern.

Table 2.2-3 Summary of Chemical of Concern for Caribou Binge Soil Ingestion

Parameter	Kimberlite/Granite
Aluminum	√
Antimony	√
Barium	√
Bismuth	√
Boron	√
Cadmium	√
Chromium	√
Cobalt	√
Copper	√
Iron	√
Lead	√
Molybdenum	√
Nickel	√
Selenium	√
Strontium	√
Thallium	√
Titanium	√
Vanadium	√
Zinc	√

✓= chemical exceeds environmental guideline in that medium and is greater than 10 percent over baseline therefore was retained for further assessment. For granite and kimberlite the screening is only based on baseline data.

- = chemical did not exceed environmental guideline in that media.

2.3 ASSESSMENT AND MEASUREMENT ENDPOINTS

Assessment endpoints are valued characteristics of the ecosystem that may potentially be affected by the Project, expressed explicitly as statements of the actual environmental values that are to be protected (Suter 1990; U.S. EPA 1992; Warren-Hicks et al. 1989). Considerations in the selection of assessment endpoints include ecological relevance, policy goals, future land use, societal values, susceptibility to the stressors, and the ability to define the endpoint in operational terms. Generally, four components constitute an assessment endpoint: an entity (e.g., receptor of concern); a location (site, local landscape, region); an attribute (e.g., survival, growth rate, a reproductive parameter); and a degree of protection afforded.

In most situations an assessment endpoint cannot be measured in a direct and literal fashion, and therefore surrogate measurements of an assessment endpoint must be used. These are termed *measurement endpoints*. Measurement endpoints represent “an effect on an ecological component that can be measured and described in some quantitative fashion” (CCME 1996); they are selected to address one or more assessment endpoints and to be consistent with the site conceptual model. Measurement endpoints provide qualitative or quantitative information on the condition of an attribute (e.g., survival, growth, reproductive fitness) identified for an assessment endpoint (e.g., caribou health).

The key line of inquiry and subjects of note from the Terms of Reference (Gahcho Kué Panel 2007) were used to identify candidate assessment endpoints specific to each ROPC. The candidate assessment endpoints were evaluated in terms of: (1) potential measurement endpoints (i.e., direct measures, surrogate measures, or modeled relationships); and (2) data available for use in the analysis and characterization phases of the risk assessment.

For some receptors, no taxa-specific measurement endpoints were available. In these cases, assessment relied on extrapolation from other lines of evidence. These receptors were either addressed as a member of a broader taxonomic group or trophic level (e.g., falcons were grouped with hawks and owls), or were assessed qualitatively based on the findings for other ROPC.

2.3.1 Assessment of Individuals versus Populations

Although ecological risk assessments commonly focus on effects to populations, much confusion exists regarding the definition of the term *population*. The term *assessment population* has been defined as the component of the biological population or meta-population that is directly exposed to the stressors of potential concern (Barnthouse et al. 2007). This operational definition reflects public perspective on protection goals, in that the threshold of concern for charismatic species may be different from the biological threshold of the minimum viable population. As the perceived value or vulnerability of a species increases, the tolerance for effects to individual organisms decreases.

The ERA guidance (e.g., U.S. EPA 1998) typically recommends that risk analysis focus at the population-level with respect to survival, growth, and reproduction. Healthy populations (i.e., populations whose individuals can survive, grow, and reproduce) are considered resilient to low-level disturbance and can withstand some effects to individuals within the population as long as the spatial and temporal scales, and magnitude of effects does not push the population beyond its viability threshold. However, for species identified as being *of special concern, sensitive, threatened, at risk* or *endangered*[2], it is typically

[2] Designations vary depending on the level of vulnerability and legislation or policy.

recommended that protection focus on individuals within a population since the vulnerable status of the species already indicates concern for populations as a whole, and effects to individuals could exacerbate existing population stress.

Accordingly, the assessment endpoints for wildlife potentially affected by the Project (which are described in the following sections) applied a higher level of protection for receptor groups containing species with designations *of special concern, sensitive, or at risk*[3, 4]. The protection goal for receptors with designated species focused on the health of individuals whereas the protection goal for receptors that are considered secure (or with no designated species) focused on the health of populations and not individuals that constitute those populations.

In typical ERA practice, exposure is estimated for individuals and it is not always feasible to distinguish population effects from individual effects when establishing toxicity reference values. However, it is possible to derive toxicity reference values (TRVs) that offer higher or lesser degrees of protection, and this was accomplished in the risk assessment through the use of "upper-TRVs" and "lower-TRVs" as described in Section 4. The higher level of protection offered by the lower-TRVs was generally considered appropriate for receptors with vulnerable species. The degree of uncertainty and conservatism in exposure predictions was also considered when examining the ecological relevance of potential risks, and the need for follow-up monitoring or mitigation.

2.3.2 Endpoints for Receptors Considered to be Vulnerable

The receptor groups containing species designated as *of special concern, sensitive,* or *at risk* included caribou, large omnivore, medium-sized carnivore (includes wolverine), some composite groups of upland birds (i.e., small carnivores, and small and medium-sized omnivores), some composite groups of water birds (i.e., small and medium-sized carnivores, and medium-sized omnivores), hawks and owls, eagles, and falcons. The formal expressions of assessment endpoints for these receptors reflect the cultural, ecological, and economic value and the potential vulnerability of these species and groups:

- entity – individual animals occupying the LSA;
- attributes – survival, growth, reproductive fitness;
- location – exposure at or near the LSA; effects immediate (on-site) or delayed (especially for reproductive effects); and

[3] Threatened or endangered species have not been identified as inhabiting the baseline LSA or RSA.
[4] For discussion purposes, the summary term "vulnerable" is used to refer to "special concern, sensitive, or at risk".

- time – baseline and Project (construction, operations, and closure) phases.

Restated in the form of a question, this becomes:

Are the COCs from Project activities (individually and collectively) expected to impair survival, growth, or reproductive fitness of individual animals occupying the Project site (LSA) at any time during the Project life cycle?

Measurement endpoints are summarized in Table 2.3-1. The measurement endpoints for wildlife species typically entailed comparison of daily ingested doses for site COCs (calculated using a food chain model) to a "safe" daily dose from the scientific literature, using a hazard quotient approach. Comparisons were made between baseline, and project phases to distinguish between existing baseline potential risks and the estimated incremental increase in potential risks as a result or the Project. Closure and reclamation phases were assessed qualitatively based on the findings of the project phases.

For caribou, "binge" soil ingestion (i.e., the conservative assumption scenario) was also assessed (separate from chronic exposures from long-term feeding patterns) in order to represent the potential use of mine rock and processed kimberlite as a salt lick.

Table 2.3-1 Summary of Assessment Endpoints, Effect Hypotheses, Measurement Endpoints, and Data or Prediction Needs

Receptor or Group	Assessment Endpoint	Effect Hypothesis	Measurement Endpoints	Data or Prediction Needs
Caribou	Question: *Are the COCs from Project activities (individually and collectively) expected to impair survival, growth, or reproductive fitness of individual caribou occupying the Project site at any time during the Project life cycle?*	Caribou may be exposed to and adversely affected by COCs in consumed vegetation, drinking water, and soil.	Comparison of daily ingested doses for site COCs (calculated using a food chain model) in food to a “safe” daily dose from the scientific literature. Separate comparisons for baseline and construction and operation phases to estimate the incremental increase in exposure and potential risks as a result of the Project. Consideration of individual-level protection for interpretation of uncertainty, ecological relevance, and need for follow-up actions.	Measured or predicted concentrations of COCs in water, soil, dust, and vegetation from the Project site under baseline, and construction and operation scenarios. Benchmark values representing safe daily doses.
		Caribou may be exposed to and adversely affected by COCs in soil, processed kimberlite, or mine rock that is consumed directly under acute “binge” consumption (i.e., use as a “salt-lick”)	Comparison of the acute ingested dose for site COCs (calculated using a food chain model) from normal food sources and processed kimberlite, and mine rock to acute toxicity values from the scientific literature. Separate comparisons for baseline soils, processed kimberlite, and mine rock, to estimate the incremental increase in exposure and potential risks as a result of the Project.	Measured or predicted concentrations of COCs in exposed processed kimberlite and mine rock from the Project site under the construction and operation phases. Benchmark values representing acute exposure to COCs.
Other Receptors With Vulnerable[a] Species (large omnivore; medium-sized carnivores [includes wolverine]; small insectivorous, and small and medium-sized omnivorous upland birds; small and medium-sized carnivorous, and medium-sized omnivorous water birds)		Mammals and birds may be exposed to, and adversely affected by, COCs in consumed food and drinking water.	Comparison of daily ingested doses for site COCs (calculated using a food chain model) in food to a “safe” daily dose from the scientific literature. Separate comparisons for baseline, and construction and operation phases to estimate the incremental increase in exposure and potential risks as a result of the Project. Consideration of individual-level protection for interpretation of uncertainty, ecological relevance, and need for follow-up actions.	Measured or predicted concentrations of COCs in water, soil, dust, vegetation, invertebrates, and fish from the Project site under baseline and construction and operation phases. For carnivores and omnivores, predicted concentrations of COCs in prey mammal species under baseline, and construction and operation phases. Benchmark values representing safe daily doses.
Falcons		Falcons may be exposed to, and adversely affected by, COCs in consumed food and drinking water.	Assessed qualitatively considering the measurement endpoint findings for other bird species (including other raptors) under baseline, and construction and operation phases. Consideration of individual-level protection for interpretation of uncertainty, ecological relevance, and need for follow-up actions.	Measurement endpoints for upland breeding birds, water birds, and raptors.
Receptors Considered Secure (Wolf; Muskox; medium-sized and large carnivorous, and small and medium-sized herbivorous upland birds; medium-sized and large herbivorous, and large carnivorous water birds; and all groups of small and medium-sized mammals)		Mammals may be exposed to, and adversely affected by, COCs in consumed food and drinking water.	Comparison of daily ingested doses for site COCs (calculated using a food chain model) in food to a “safe” daily dose from the scientific literature. Separate comparisons for baseline and construction and operation phases to estimate the incremental increase in exposure and potential risks as a result of the Project. Consideration of population-level protection for interpretation of uncertainty, ecological relevance, and need for follow-up actions.	Measured or predicted concentrations of COCs in water, soil, dust, vegetation, invertebrates and fish from the Project site under baseline, and construction and operation phases. For carnivores and omnivores, predicted concentrations of COCs in mammal species under baseline, and construction and operation phases. Benchmark values representing safe daily doses.

[a] Species of Special Concern, Sensitive or At Risk Species.

COCs = chemicals of concern; LSA = Local Study Area.

2.3.3 Endpoints for Receptors That Are Not Considered Vulnerable

Receptors that were considered secure (or with no designated species) included wolf, muskoxen, some composite groups of upland birds (i.e., small and medium-sized herbivores, and large carnivores), some composite groups of water birds (i.e., medium-sized and large herbivores, and large carnivores), and all composite groups of medium-sized and small mammals that were not required in the Terms of Reference. The assessment endpoints for these receptors reflect their overall population health in NWT and expected resilience to low-level effects while still considering the cultural, ecological, and economic value of certain species in the NWT:

- entity – populations occupying the LSA;
- attributes – survival, growth, reproductive fitness;
- location – exposure at or near the Project; effects immediate (on-site) or delayed (especially for reproductive effects); and
- time – baseline and projects phases.

Restated in the form of a question, this becomes:

Are the COCs from Project activities (individually and collectively) expected to impair survival, growth, or reproductive fitness to an extent to which local populations occupying the Project site (LSA) are adversely affected at any time during the Project life cycle?

Measurement endpoints for wildlife are summarized in Table 2.3-1. The measurement endpoints for wildlife species typically entailed comparison of daily ingested doses for site COCs (calculated using a food chain model) to a "safe" daily dose from the scientific literature, using a hazard quotient approach. Comparisons were made between baseline, and constructions and operations scenarios to distinguish between existing baseline potential risks and the estimated incremental increase in potential risks as a result of the Project. Closure and reclamation phases were assessed qualitatively based on the findings of the project phase.

2.4 CONCEPTUAL MODEL

Figure 2.4-1 depicts the linkages between Project activities and potential alterations to the aquatic and terrestrial environments of the LSA and RSA during baseline, and Project phases.

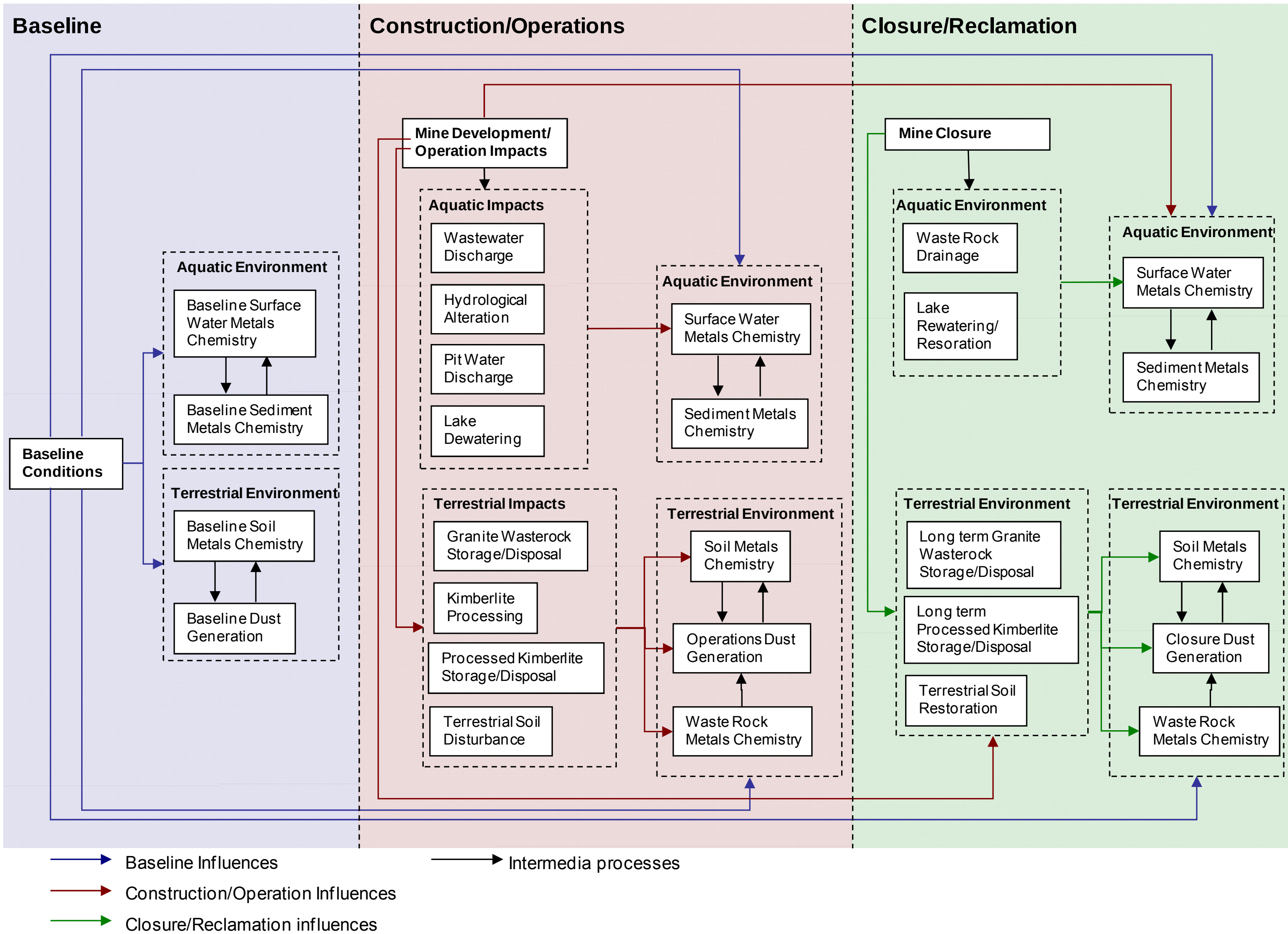
For baseline conditions, natural processes are assumed to be responsible for the observed water quality, sediment quality, soil quality, and dust generation conditions. Wildlife in the LSA and RSA would be exposed to naturally occurring COCs as a result of baseline conditions. During the Project phases, some alterations to the aquatic and terrestrial environments are expected. Changes to water could result from dewatering and early operational dischargeand hydrological changes. The Project is not expected to alter sediment quality in waterbodies of the LSA (refer to Section 8 of the 2011 EIS Update [De Beers 2011]). For the terrestrial environment, changes to soil quality and dust generation could be caused by mine rock storage and containment, mining and kimberlite processing, processed kimberlite storage and containment, and native soil disturbance.

Although endpoints have not been formulated to specifically address potential risks to wildlife during closure and reclamation, this phase of the Project has been included in the conceptual model to demonstrate how recovery of the LSA will proceed at the end of mine life. Because the Project will no longer be operating, the degree of effect to the terrestrial and aquatic environments is expected to be less than during operations. The following factors will lead to a decrease in COC exposures post-closure:

- A decrease in fugitive dust emissions. During the project phase dust will be generated by vehicle traffic, mining activities, kimberlite processing, and processed kimberlite and mine rock storage. Post-closure, dust generation would be from mine rock storage only. Therefore, deposition of COCs to soils and vegetation will decrease.
- A decrease in COC concentrations in Lakes N11 and 410 surface water (refer to Section 9 of the 2012 EIS Supplement [De Beers 2012a]).

Based on these factors, it is expected that COC exposures to wildlife will be greatest during the project phase, and show a gradual decrease during closure and reclamation.

Figure 2.4-1 Conceptual Model of Alterations to Terrestrial and Aquatic Environments during Project Phases



Figures 2.4-2 to 2.4-5 depicts potential chemical exposure pathways for wildlife inhabiting the LSA and the RSA. Wildlife may be exposed to metals present in surface water, sediment, soil, mine rock, and processed kimberlite. Project activities could lead to increased dust generation in the LSA and RSA, and an increased contribution of metals in soil, mine rock, and processed kimberlite to dust. Although some areas of lake bed sediments will be exposed following the dewatering of Kennady Lake, it is expected they will form a hardpan crust and therefore will not be a substantial source of dust. Further, most dewatered portions of Kennady Lake will still contain some water covering the lake bed. However, dust from mine activities (fugitive dust) may be inadvertently ingested by grizzly bears and other mammals foraging in this area.

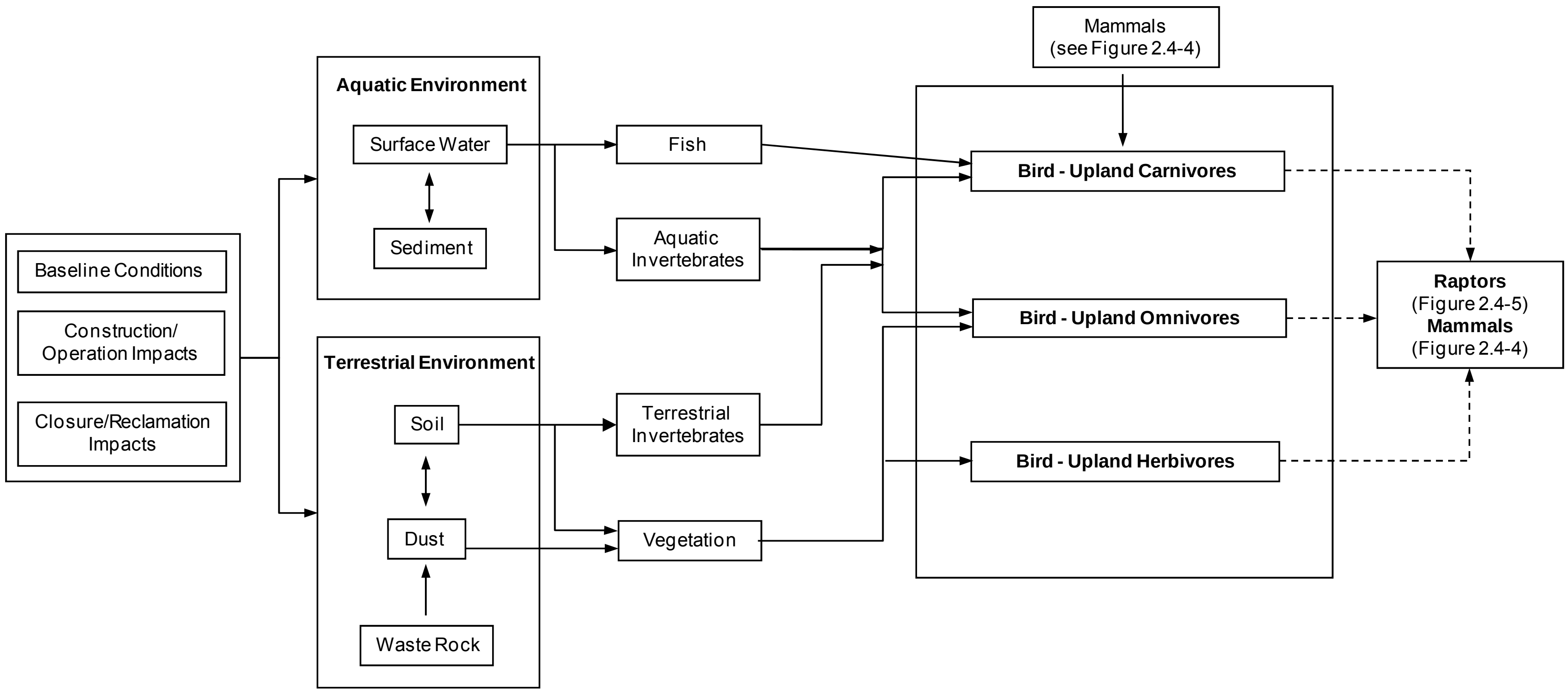
Direct exposure pathways include inhalation of fugitive dust and air emissions, drinking of water, and inadvertent ingestion of soil or sediment while foraging or grooming. Indirect exposure pathways are primarily through consumption of food and prey items that have accumulated metals from water, soil, sediment, mine rock, processed kimberlite, or dust.

Airborne constituents may deposit directly onto the surface of plants or may deposit onto soils and subsequently be accumulated through plant roots (vascular plants) or tissues (lichen), thus providing an exposure pathway to herbivores and omnivores consuming vegetation. Carnivores also consume prey that may have consumed water, sediment, soil, and/or vegetation from the Project or that are in direct contact with soil, water, and sediments from the Project. Because these prey species may accumulate COCs in their tissues, carnivores may subsequently be exposed to these COCs. The following prey species could be a source of metals exposure:

- terrestrial invertebrates (accumulate metals from soil);
- aquatic invertebrates[5] and fish (accumulate metals from surface water);
- herbivores (accumulate metals from vegetation and incidental soil ingestion); and
- omnivores (accumulate metals from vegetation, incidental soil ingestion, and prey).

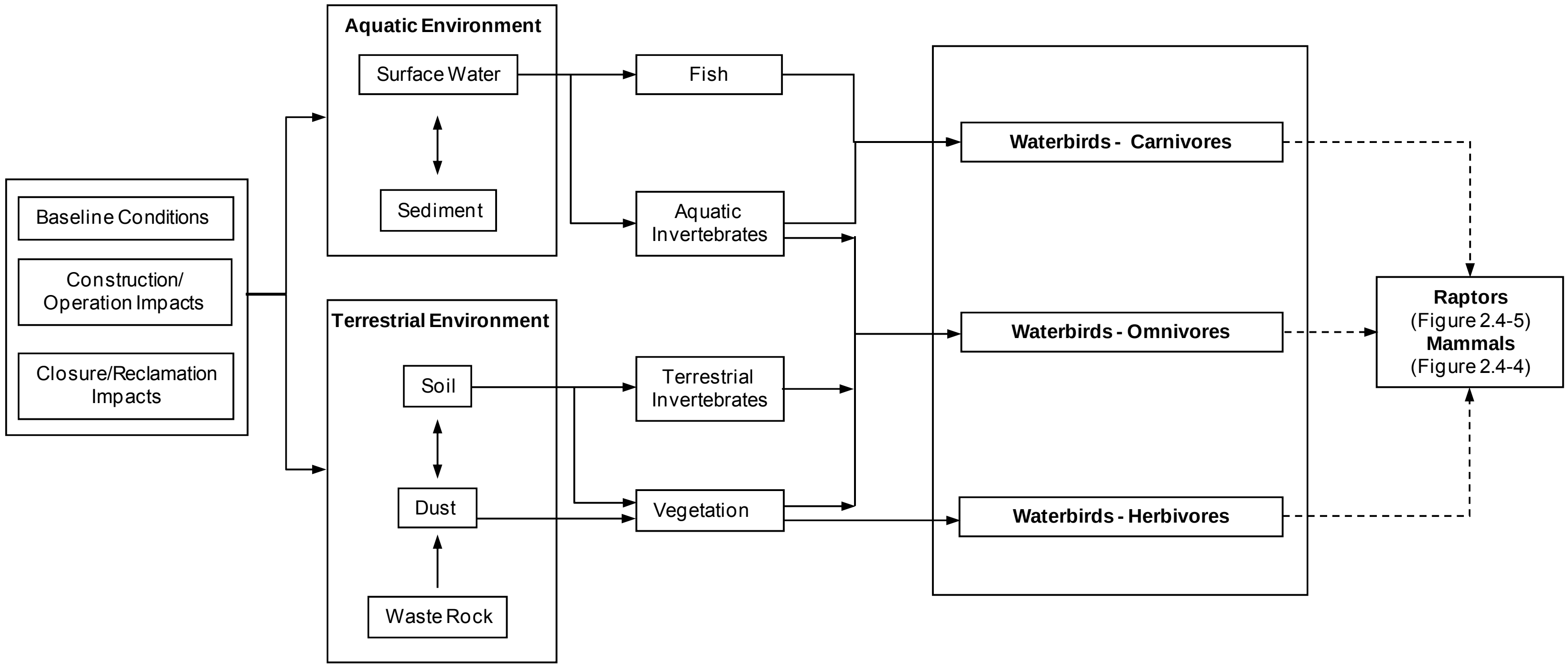
[5] This group includes both pelagic and benthic invertebrates. All aquatic invertebrates were linked to surface water quality in order to examine Project impacts. No Project impacts on sediments are expected for waterbodies in the LSA.

Figure 2.4-2 Conceptual Model of Exposure Media and Pathways for Upland Breeding Birds



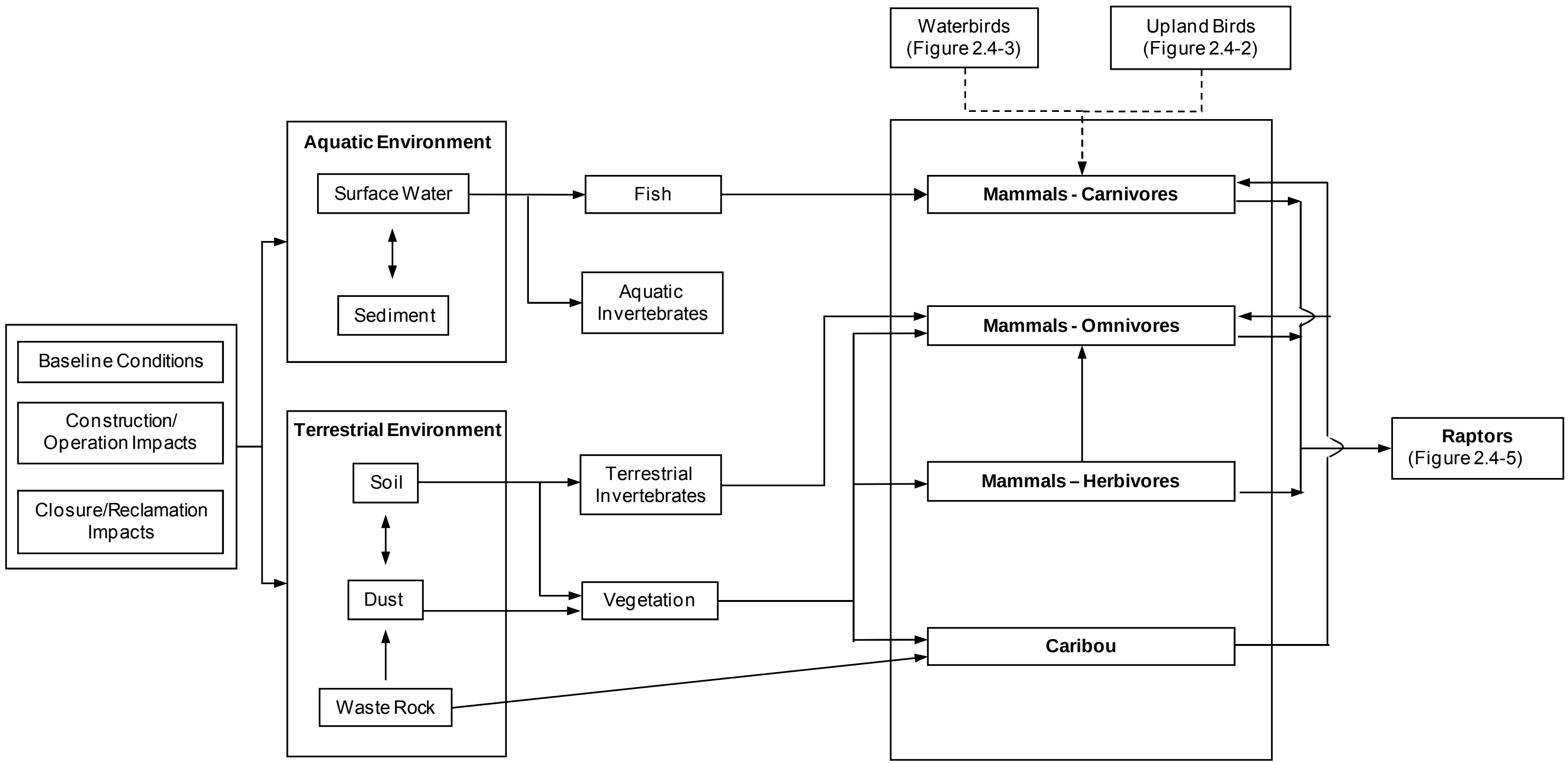
Note: Complete arrows represent pathways considered in the ERA; dashed arrows were not formally evaluated because prediction of COC concentrations in birds was not possible.

Figure 2.4-3 Conceptual Model of Exposure Media and Pathways for Water Birds



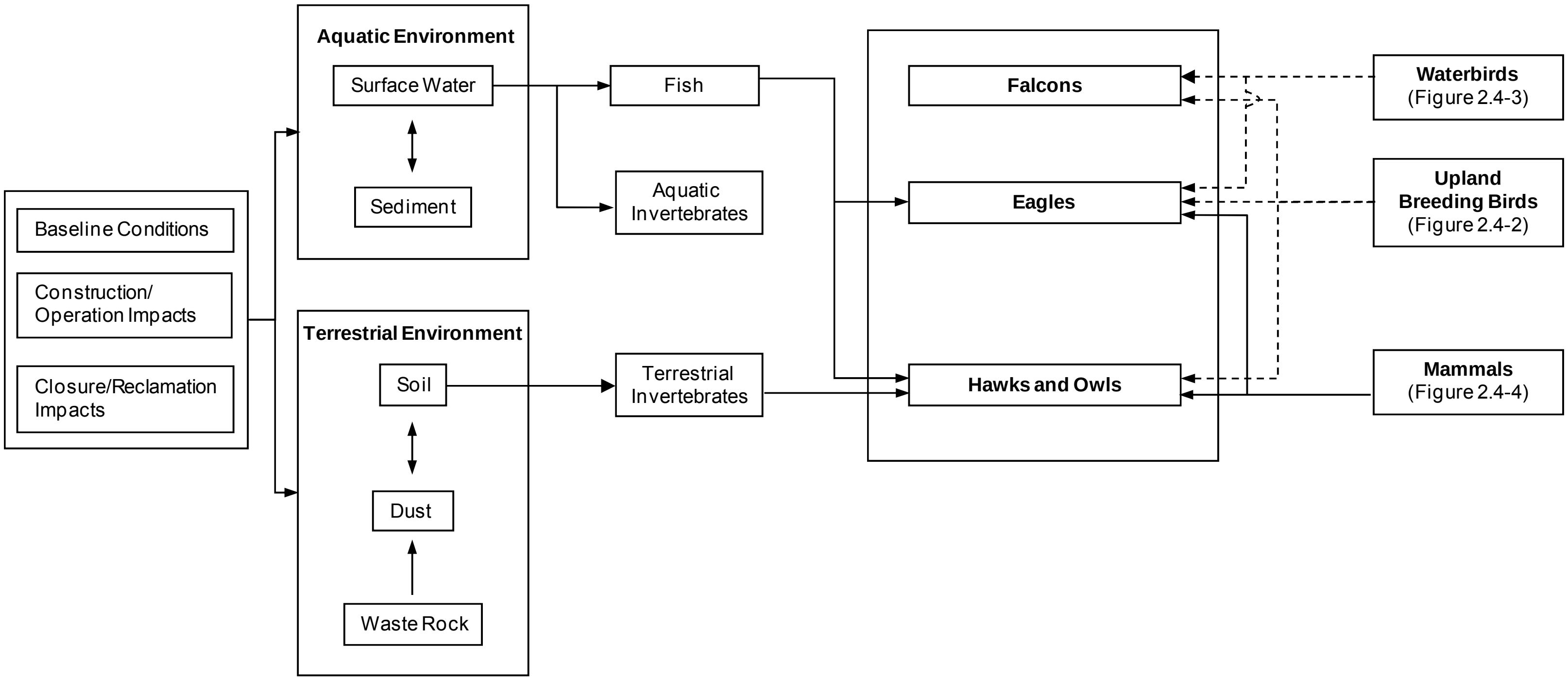
Note: Complete arrows represent pathways considered in the ERA; dashed arrows were not considered because prediction of COC concentrations in birds was not possible.

Figure 2.4-4 Conceptual Model of Exposure Media and Pathways for Mammals



Note: Complete arrows represent pathways considered in the ERA; dashed arrows were not formally evaluated because prediction of COC concentrations in birds was not possible.

Figure 2.4-5 Conceptual Model of Exposure Media and Pathways for Raptors



Note: Complete arrows represent pathways considered in the ERA; dashed arrows were not formally evaluated because prediction of COC concentrations in birds was not possible.

The exposure pathways are based on general dietary preferences for receptor organisms; this information has been compiled from life history information for the species or group. The figures indicate where specific predators may feed on upland breeding birds and water birds. As discussed in Section 2.3, it was not possible to model the exposure of predators to metals accumulated in bird tissues; therefore, for modeling exposure in the ERA, birds were excluded from the diet of carnivores (refer to Appendix III for dietary preferences used in the food chain model). These potential bird-to-predator exposure pathways that could not be modeled are indicated by a dashed line in Figures 2.4-2 to 2.4-5.

2.5 APPROACH TO RISK ANALYSIS

The problem formulation sets the stage for all further analysis. It has identified and evaluated the COCs, ROPCs, endpoints, and exposure pathways. This section, which is the last section of the problem formulation, introduces the risk analysis components that lead to the final risk characterization.

The risk analysis approach to address the assessment endpoints described in Section 2.3 follows the general framework described in Figure 1.2-1, consisting of:

- Exposure Assessment (described in Section 3);
- Toxicity Assessment (described in Section 4); and
- Risk Characterization (described in Section 5).

The Exposure Assessment estimates the daily intake of COCs by the ROPCs described in Section 2.1. A food web model is used to integrate exposure to COCs in consumed water, food, and soil or sediment (which are consumed incidentally). Two exposure scenarios are included in the Exposure Assessment including:

- Chronic exposure to COCs by all ROPCs; and
- Acute exposure to COCs by caribou consuming processed kimberlite or granitic mine rock.

Exposure predictions are made for both baseline conditions and the Project phases to facilitate estimation of the potential incremental increase in exposure to COCs as a result of the Project.

The purpose of the Toxicity Assessment is to develop TRVs for the exposure scenarios describe above. The TRVs are benchmarks for the estimated daily intake of COCs that can indicate either no-effect levels or a specified low-effect level. For the chronic exposure scenario, two levels of TRVs are developed to represent the range from known no effect concentrations to concentrations at which effects become possible:

- **Lower TRVs -** Highly conservative benchmarks for the estimated daily intake of COCs below which it can confidently be concluded that risks to wildlife are negligible.
- **Upper TRVs -** Effect-based thresholds above which there is evidence that an effect could occur.

For acute exposure to COCs by caribou, a single TRV was developed for each COC; the available acute toxicity data do not typically allow discernment of differing levels of protection to the degree that is possible with chronic toxicity information. Appendix VI provides describes the acute TRV derivation process.

Risk Characterization involves integration of the Exposure Assessment and Toxicity Assessment results to estimate potential risk to wildlife. For this ecological risk assessment, the primary decision criterion for Risk Characterization involved hazard quotients (HQs). An HQ is the ratio of an exposure (i.e., the estimated daily intake or estimated daily intake [EDI] of a COC) dose to an "acceptable" threshold dose (i.e., a TRV). Hazard quotients greater than one indicate a potential for adverse effects, whereas hazard quotients less than, or equal to, one indicate a negligible potential for adverse effects. Where the HQ value exceeds one, the magnitude of an HQ cannot be used as a reliable indicator of the magnitude of ecological response; for example an HQ of 10 is not indicative of twice the environmental response of an HQ of 5. Rather, the ecological significance of HQ>1.0 must be accessed through evaluation of the technical assumptions and uncertainties underlying the calculation.

HQs are estimated for each COC under the chronic[6] and acute exposure scenarios and, within each scenario, for baseline and Project phases. The potential incremental increase in risks to wildlife is estimated by comparison of baseline and Project phase HQs. Overall risk conclusions for COCs under each scenario consider the magnitude of HQs, the predicted increase in HQ from baseline to Project phases, the number of conservative assumptions made and, in some cases, follow-up analysis.

[6] For each COC in the chronic scenario, both lower-TRV and upper-TRV HQs are calculated.

The risk analysis addresses all exposure pathways identified in Section 2.4, with the exception of dust inhalation and bird tissue consumption pathways. These pathways have not been included in the Exposure Assessment and subsequent Risk Characterization for the following reasons:

1. Dust Inhalation – Dust inhalation by wildlife is not usually assessed in ecological risk assessments. Toxicity reference values for metals that specifically address the inhalation pathway in wildlife are mostly lacking from the literature, and the studies that are available have not typically been designed to distinguish between the inhalation and the dietary components due to deposition (BC MoELP 2000, internet site). Furthermore, extrapolating toxicity data from oral, dermal, or intraperitoneal exposures to the inhalation pathway would be highly uncertain and unlikely to be useful for reaching conclusions about the environmental effect of the Project. As a result, the available risk assessment tools were not considered sufficient for assessing this pathway. In most situations, the dust inhalation pathway is considered negligible relative to the oral ingestion pathway (which includes incidental ingestion of fine particulates) and the amount of exposure excluded by not including inhalation would be small (Sample et al. 1997; BC MoELP 2000, internet site). Long-term influence of dust generation is expected to be captured in the predictions of soil and vegetation quality used in the exposure model for the food chain pathway.

2. Bird Tissue to Predator (either Raptor or Mammal) Metals Exposure – The food chain exposure model relies on bio-uptake factors to predict metals concentrations in tissues based on a measured or predicted oral dose. Defensible bio-uptake factors are available for small mammals, and alternative methods are available for predicting metals concentrations in aquatic prey species. However, defensible bio-uptake factors are not available for bird species that could also be prey for carnivore mammals and raptors. Thus, it is assumed that most carnivore mammals and raptors feed on a combination of fish, small mammals, and, in some cases, invertebrates. Risks to falcons are assessed qualitatively based on the findings for other birds. Metals exposures and potential risks would be represented by other raptors feeding on small mammals and fish, or by their avian prey receptors. Therefore, it was considered reasonable to make this extrapolation.

3 EXPOSURE ASSESSMENT

This section describes the approach and results of the Exposure Assessment for the wildlife ERA. A food web model was used to integrate wildlife exposure to metals and PAHs via oral pathways (water, sediment, soil, and food, including the contributions from aerial deposition and changes in water quality). Exposure calculations were made for the ROPCs described in Section 2.1 under the following phases:

- baseline; and
- Project (combined construction, and operations).

For each scenario, chronic exposure estimates were made for wildlife receptors of concern (i.e., long-term exposure to COCs in media that they may come in contact with). In addition, for caribou, an acute exposure estimate was also made (i.e., caribou ingesting soil, processed kimberlite or granitic mine rock). Quantitative exposure and risk predictions were not estimated for the closure and reclamation phase. Effects to wildlife health during and post Project closure will be assessed as part of the Closure Plan.

Section 3.1 provides an overview of the food web modeling approach. A series of model equations (as described in Appendix III) are used to predict exposure of wildlife to COCs based on wildlife receptor characteristics such as body weight, food intake rate and feeding preferences combined with measured or predicted COC concentrations in consumed food, water, sediment and soil. A subset of equations is applied to predict increases in COC concentrations in food, water, sediment and soil (as applicable) during Project phases.

Section 3.2 summarizes the approach to estimating the Receptor Characteristics that are used in the food web model. As summarized in Table 3.3-1 and Section 3.3, the food chain model relies on baseline data for soil, water, vegetation, sediment, and fish tissue described in the baseline reports, estimates of wet and dry deposition described in the 2012 Updated Air Quality Assessment (De Beers 2012b], and water quality projections described in Sections 8.2.5 and 9.2.5 of De Beers (2012). For certain exposure pathways, the model also uses the measured metals chemistry of processed kimberlite and granitic mine rock reported in Annex D Bedrock Geology, Terrain and Soil Baseline of the 2010 EIS (De Beers 2010). Finally, estimates of bioavailability and metals uptake (Section 3.4) are applied in some cases to estimate COCs in food.

3.1 ASSESSMENT METHOD

Dietary exposures to COCs were modeled using simplified food webs for the wildlife ROPCs identified in the problem formulation. Computational and statistical models were combined in a multi-media food web model to assess exposure-effects relationships for each combination of receptor and COC. A total estimated daily intake (EDI) integrating the dietary exposure from all dietary items was calculated for each COC and ROPC (Equation 1):

$$EDI = \frac{IR_m x C_m x AF}{BW} \ldots$$

Where:

- EDI = estimated daily intake (mg/kg body weight/day)
- IR_m = ingestion rate of prey and media (kg/day dry weight)
- C_m = concentration of chemical in media/food consumed (mg/kg dry weight)
- AF = absorption factor (unitless)
- BW = body weight (kg wet weight)

The estimated daily intake represents the exposure for each COC and ROPC and this measure of exposure is compared to toxicity reference values (i.e., established toxicological benchmarks for each chemical derived from toxicity tests). Toxicity reference values are selected in the toxicity assessment (Section 4) of the ERA.

Concentration values for each COC were derived from measurements taken in the baseline RSA or baseline LSA (for baseline conditions) or represent estimated values based on summing baseline conditions and model-projected increases (for Project phases). The multi-media food web model includes wildlife exposure via food and incidental soil or sediment ingestion. Potential food sources (depending on feeding preferences) include water, vegetation, aquatic invertebrates, soil invertebrates, fish, and terrestrial mammals. Changes to water quality from baseline to the Project phases for Lakes 410 and N11 are based in Section 9 of the 2012 EIS Supplement (De Beers 2012a) and changes to soil quality are estimated from the wet and dry deposition rates for metals described in the 2012 Updated Air Quality Assessment (De Beers 2012b).

Water quality, soil quality, and dust deposition rates were combined with bioaccumulation factors to estimate metals concentrations in vegetation, invertebrate tissues, and fish tissues. Uptake factors or bio-transfer factors were used to estimate the uptake into tissues of small mammals to provide an estimate of the dietary exposure for higher predators. Details of the modeling methods are provided in the following sections and a worked example is provided in Appendix I (caribou exposure to chromium for baseline conditions).

The food web model assumes that individual organisms are always exposed to site-specific COC concentrations in a particular medium (i.e., there is no site-use adjustment made based on home-range size and seasonal migration and movement patterns). This is a highly conservative assumption, as it is highly unlikely to occur, given home range and migratory habits of most species present in the vicinity of the Project.

3.2 RECEPTOR CHARACTERISTICS

Bird and mammal species identified as occurring in the vicinity of the Project (see Annex F Wildlife Baseline of the 2010 EIS [De Beers 2010] and the 2011 Wildlife Supplemental Monitoring Report [Golder 2012b]) were selected as candidate model species representative of the receptor groups. Limited information exists regarding dietary specifics for many species, and the laboratory species used to derive toxicity threshold values are rarely the same as the wildlife species being assessed (i.e., extrapolation to wildlife species is necessary). Project species lists (De Beers 2010, Annex F) were sorted according to broad habitat use characteristics and trophic position. For species that were relatively unique with respect to body size, habitat, and feeding ecology, it was considered appropriate to designate them as individual receptors of concern. Where substantial overlap was observed among species, composite surrogate ROPCs were simulated in the food web model to represent similar species with respect to habitat, feeding preferences, and body mass. The surrogate receptor approach followed the general "clumping" principle described by Holling (1992). Attributes for all species that occurred within a cluster defined by habitat and trophic position were combined. They were used to represent a single generic receptor to represent their respective positions within the food web.

3.2.1 Birds

Bird species identified as occupying the Project area were placed into three habitat-use categories: upland breeding birds, water birds, and raptors. Trophic positions represented within each category were insectivores, carnivores, and herbivores. Omnivores were assumed to have trophic patterns intermediate between those of carnivores and herbivores for comparisons of exposure and toxicity threshold values.

Species-specific data for ingestion rates and toxicity responses are not available for most receptors in the vicinity of the Project. However, data are available for representative species or indicators of the categories and trophic groups listed in Section 2.1.

To evaluate risks for composite receptor groups, composite-specific parameters were calculated for use in estimating dietary exposures to COCs. Ingestion rates of animals for food, water, and soil can be related to body mass (using the equations of Sample et al. [1997]) and feeding guilds can be generalized to carnivores, omnivores, and herbivores.

For generic receptor groups with only one representative species, body mass data for that species were used directly. For generic receptor groups with two or more representative species, the lowest body mass was used for the group along with a representative average diet (to maximize the estimate of dose, as a conservative approach). Further description of the receptor grouping methods is provided in Appendix III.

3.2.1.1 Bird Ingestion Rates

Ingestion rates for bird species were approximated using allometric scaling based on body weight. The equations for food (Equation 2) and water (Equation 3) ingestion rates were obtained from Sample et al. (1997):

$$IR_{food} = 0.0582(Bw)^{0.651}$$

Where:

IR_{food} = food ingestion rate (kg dry weight/day)
BW= body weight (kg)

$$IR_{water} = 0.059(Bw)^{0.67}$$

Where:

IR_{water} = water ingestion rate (L/day)
BW= body weight (kg)

Incidental soil ingestion rates were extrapolated from Beyer et al. (1994) for surrogate species.

3.2.2 Mammals

Because the baseline mammal observations from winter tracking and small mammal studies were limited to presence/absence in various areas (refer to Annex F Wildlife Baseline of the 2010 EIS [De Beers 2010] and the 2011 Wildlife Supplemental Monitoring Report [Golder 2012b]), species-weighted abundance-mass values for mammals were not developed as they were for birds. Also, particular mammalian species were identified in the key line of inquiry and subjects of note. Therefore, species-specific exposure parameters were used for caribou, muskoxen, grizzly bear, and wolf. The masked shrew was used as a surrogate to evaluate exposures for small insectivorous animals that could be important dietary components for carnivores. Generalized exposure parameters were used for other small and medium herbivores, for small and medium carnivores, and small omnivores.

Generic receptor parameters for the small mammalian herbivore were derived using vole and lemming data. For the medium herbivore, data from Arctic ground squirrel, snowshoe hare, and Arctic hare were applied. Generic receptor parameters for the small carnivore were derived from the ermine, mink, and marten. Data for the generic medium-sized carnivorous mammal receptor were derived from wolverine, red fox, and Arctic fox. Data for the generic small omnivore mammal receptor were derived from the deer mouse. Further details of each receptor class and their parameters are provided in Appendix III.

3.2.2.1 Mammalian Ingestion Rates

Ingestion rates for species were approximated using a feeding rate equation based on body weight. The equations for food (Equation 4) and water (Equation 5) were obtained from Sample et al. (1997):

$$IR_{food} = 0.0687(Bw)^{0.822}$$

Where:
IR_{food} = food ingestion rate (kg dry weight/day)
BW = body weight (kg)

$$IR_{water} = 0.099(Bw)^{0.9}$$

Where:
IR_{water} = water ingestion rate (L/day)
BW = body weight (kg)

Incidental soil ingestion rates were extrapolated from Beyer et al. (1994) for surrogate species, and from MacDonald and Gunn (2004) for caribou.

3.2.2.2 Acute "Binge" Ingestion Rate

The acute binge scenario was intended to provide a conservative screening assessment of the potential for acute toxicological risks from trace metals to caribou. A binge scenario would occur if caribou consume a large amount of processed kimberlite or crushed granite over a short time. Based on a study of tailings consumption by caribou at NWT mines (MacDonald and Gunn 2004), individual caribou may be attracted to mine tailings as a source of salt, consuming 20 to 50% of their diet as tailings over short periods of time.

The estimated binge ingestion of COCs in soil, processed kimberlite, or granitic mine rock was estimated assuming 50% of the food intake in one day was ingested as soil or mine rock. Acute COC exposures were estimated for caribou under baseline (i.e., pre-mining) and project conditions for the Project. The baseline represents anticipated exposure conditions at hypothetical natural lick sites and used the baseline soil concentrations that were applied in the chronic exposure modelling.

During Project phases, it is possible that caribou may have contact with either processed kimberlite or granitic mine rock. Contact with processed kimberlite would be limited because processed kimberlite will be contained in a high-traffic, highly disturbed area of the Project, and progressive closure of processed kimberlite containment facilities will begin in Year 3 of the Project. Eventually, all processed kimberlite will be covered by granitic mine rock by Year 8. During closure and reclamation phases, contact would be limited to granitic mine rock that was exposed, disturbed and/or moved during project phases.

3.3 MEDIA DATA SOURCES

Estimates of baseline COC concentrations in soil, vegetation, water, and fish tissue were derived from laboratory analyses of on-site and regional samples (Table 3.3-1). More information on the relevant media are presented in Appendix IV and the baseline studies (De Beers 2010, Annexes D, E, F, J; De Beers 2008, Annex B, I). For soil, sediment, and vegetation, the 95% upper confidence limit of the mean (UCLM), 90th percentile or maximum concentrations of each COC in each medium were used to develop model input concentrations[7]. For water, the long term average concentrations were used; for fish, concentrations were predicted using the baseline water concentration and water-to-fish bioaccumulation factors (BAFs; Appendix IV).

For project phases, deposition, and accumulation equations were applied in the model to predict changes to metals concentrations in soil, vegetation, fish and invertebrate tissue, and small mammal tissue. Changes to water concentrations were based on the water quality modelled projections described in Section 9 of the 2012 EIS Supplement (De Beers 2012a).

[7] If there were at least 10 discrete detected values, then the 95% UCLM was used preferentially if it could be calculated; otherwise the 90th percentile was used. For cases with fewer than 10 discrete detected values, the maximum value was used.

Table 3.3-1 Sources of Exposure Concentrations of Chemicals of Concern

Phase	Soil	Water	Sediment	Vegetation	Terrestrial Invertebrates	Fish Tissue	Aquatic Invertebrates	Mammal Prey Tissue	Bird Prey Tissue
Baseline	95%UCLM or 90^{th} percentile or maximum[(a)]	long-term average	95% UCLM or 90^{th} percentile, or maximum[(a)]	95% UCLM or 90^{th} percentile or maximum[(a)]	predicted from baseline soil concentration	predicted from baseline water concentration using site specific BAFs	predicted from baseline water concentration using literature BAFs	predicted using food chain model and literature Biotransfer factors	no prediction made
Project (Construction, Operations and Closure)	predicted from baseline and wet and dry deposition rates	maximum water concentration in Lakes 410 and N11	95%UCLM or 90^{th} percentile or maximum[(a)]	predicted from maximum baseline vegetation concentration wet and dry deposition rates and site-specific soil-to-plant BAFs (applied to project soil concentrations)	predicted from project soil concentration	predicted from project water concentration using site specific BAFs	predicted from project water concentration using literature BAFs	predicted using food chain model and literature Biotransfer factors	no prediction made

(a) If there were at least 10 discrete detected values, then the 95th percentile UCLM was used preferentially if it could be calculated; otherwise the 90^{th} percentile was used. For cases with fewer than 10 discrete detected values, the maximum value was used.

95% UCLM = 95% upper confidence limit of the mean; BAF = bioaccumulation factor.

3.3.1 Soils Kimberlite and Granite Data

Soil data for samples collected throughout the LSA were compiled to determine baseline soil concentrations of metals and PAHs (refer to Figure 3.3-1). The COC concentration data were compiled for kimberlite and granite to represent processed kimberlite and mine rock (see Section 3.3.2) that might be available to caribou.

For the project phase, the incremental increases in soil concentrations in the LSA were estimated using Equation 6:

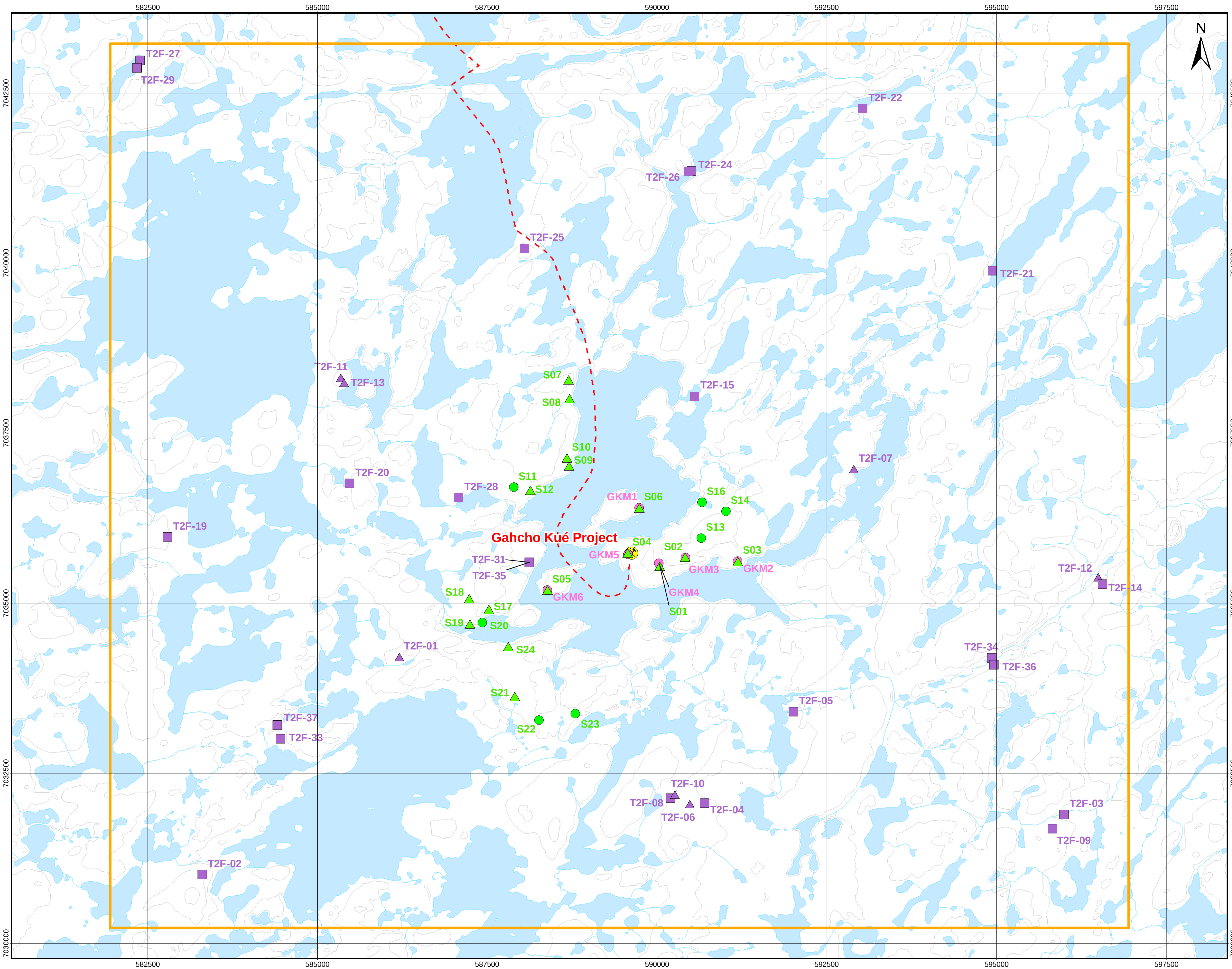
$$Cs = 10{,}000 \times \frac{D_{yd} + D_{yw}}{Z_s \times BD} \times tD \times 1000$$

Where:

Cs = average incremental soil concentration over exposure duration (mg COC/kg soil dry weight)
10000 = conversion factor (cm^2/m^2)
D_{yd} = yearly dry deposition rate of COC (g COC/m^2-yr)
D_{yw} = yearly wet deposition rate of COC (g COC/m^2-yr)
tD = time period over which deposition occurs (yr)
Z_s = soil mixing depth (cm)
BD = soil bulk density (g soil/cm^3 soil)
1000 = conversion factor (mg/g)

Wet and dry deposition rates of COCs were based on the values reported in the 2012 Updated Air Quality Assessment (De Beers 2012b).

The geochemistry characteristics of a large number of processed kimberlite and mine rock (mainly granite) samples from the Project site have been analyzed. Estimates of COC concentrations in processed kimberlite and mine rock for the caribou soil ingestion analysis were based on the 95% UCLM or 90^{th} percentile of the observed values for these mineral matrices (Appendix IV and Appendix 8.III of 2012 EIS Supplement; De Beers 2012).



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LEGEND

- Gahcho Kué Project
- Contour (10m interval)
- Winter Access Road
- Watercourse
- Waterbody
- 2009 ELC/Soil Inspection and Sample Site
- 2009 ELC/Soil Inspection and Sample Site with Total Elemental Analysis
- 2009 Vegetation Baseline Metals Sample Plot Locations
- 2011 Soil Sampling Location
- 2011 Soil and Vegetation Sampling Location
- Local Study Area

NOTES

Base data source: National Topographic Base Data (NTDB) 1:50,000

GAHCHO KUÉ PROJECT

Sample Plot Locations for Soil and Vegetation Baseline Metals Sampling

PROJECTION:	DATUM:	
UTM Zone 12	NAD83	DE BEERS CANADA
Scale: 1:55,000 (1,000 500 0 1,000 Meters)		
FILE No: B2011-Soils-003-GIS		DATE: August 7, 2012
JOB NO: 11-1365-0001	REVISION NO: 1	Figure 3.3-1
OFFICE: GOLD-CAL	DRAWN: DC	CHECK: JF

3.3.2 Vegetation Data

Data from several species of each vegetation type were combined into generic classes. Baseline COC concentration values were established for leaves, grasses/sedges/forbs, berries, and lichens using 95% UCLM or 90th percentile concentrations observed in on-site samples (Figure 3.3-1 presents the sampling locations). These generic classes represent the basic dietary components of bird and mammal receptors in the food web model.

Leaves were collected from northern Labrador tea, scrub birch, dwarf birch and barren ground willow. Grass and sedge species included water sedge, round sedge, northern bog sedge, sheathed cotton grass, bluejoint grass, and fireweed. Berry species included cloudberry, mountain cranberry, crowberry, alpine bearberry, and bog bilberry. Lichen species samples included star-tipped reindeer lichen, grey reindeer lichen, curly snow lichen, and crinkled snow lichen. For all vegetation groups, where a COC was not detected in any of the samples, the analytical detection limit was assumed to represent the baseline COC concentration.

For the project phase, the incremental increase in vegetation incorporated increases due to COC deposition onto plant surfaces and increased accumulation from soils. Deposition on plant surfaces was estimated using Equation 7:

$$P_d = \frac{1000 \times \left[D_{yd} + (F_w \times D_{yw}) \right] \times R_p \times \left[1 - \exp(-kp \times Tp) \right]}{Yp_i \times kp}$$

Where:

- P_d = concentration of pollutant due to direct deposition on the plant group
- 1000 = conversion factor (mg/g)
- D_{yd} = yearly dry deposition rate of COC (g/m^2-yr)
- F_w = fraction of COC wet deposition that adheres to plant surface (0.2 for anions and 0.6 for cations and most organics)
- D_{yw} = yearly wet deposition rate of COC (g/m^2-yr)
- R_p = interception fraction of the edible portion of plant tissue for the plant group
- kp = plant surface loss coefficient (yr^{-1})
- Tp = length of plant exposure to deposition per harvest of the edible portion of the plant group (yr)

Yp = yield or standing crop biomass of the edible portion of the plant productivity (kg/m^2)

Wet and dry deposition rates of COCs were based on the values reported in 2012 Updated Air Quality Assessment (De Beers 2012b). Accumulation of soil COCs in plant tissues was estimated using Equation 8:

$$Pr = C_s \times BAF$$

Where:

Pr = concentration of COCs in plant tissue due to root uptake (mg/kg)
Cs = average soil concentration over exposure duration (mg/kg)
BAF = site-specific bioaccumulation factor (kg soil/kg produce)

The incremental soil COC concentration was estimated using Equation 6, and the site specific soil-to-plant bioaccumulation factor was estimated using Equation 9, with model baseline soil and plant COC concentrations.

Concentrations of the chemical resulting from direct deposition on the plant and root uptake (Pd and Pr in Equations 7 and 8, respectively) were summed to estimate the total COC concentration in plant tissues during the project phase. The calculation was done separately for each type of plant tissue in the model: leaves, berries, lichen, and grasses.

3.3.3 Water and Sediment Data

For Lakes N11 and 410 water quality, the maximum long-term average between the two lakes was used to represent baseline water quality conditions (Appendix IV). Predictions of water quality for the combined project phases are provided in Section 9 of the 2012 EIS Supplement (De Beers 2012a). The maximum concentration of each COC during the entire operations phase in Lakes N11 and 410 (as described in Section 9 of the 2012 EIS Supplement) was assumed to represent water quality conditions during the project phase for exposure modelling.

It is acknowledged that water quality impacts will also occur in Kennady Lake and that these impacts may be of higher magnitude than those observed in Lakes N11 and 410. However, based on the following considerations, water quality changes in Kennady Lake were not deemed an appropriate representation of wildlife exposure:

- A fish removal program will be conducted in the water management areas of Kennady Lake, removing fish in these areas as a food source for piscivorous wildlife.
- Dewatering of the water management areas will result in significant disturbance and alteration of the aquatic habitats, limiting the availability of aquatic invertebrates in these areas to wildlife.
- Kennady Lake will be the actual Mine site and the disturbance and mining activity within the site boundary will be a deterrent for wildlife to access areas of Kennady Lake.
- Although wildlife may occasionally drink water from the water management areas, consumed water typically comprises only a very small fraction of the total dose of chemicals in food chain models.

Total metal concentrations in water were used to estimate the daily intakes of drinking water for birds and mammals, bioaccumulation factors for fish tissues and predict aquatic invertebrate tissue and fish tissue COC concentrations.

For lake bottom sediments in Kennady Lake (grab samples only) the 95% UCLM or 90^{th} percentile of the observed concentrations from 1999 to 2011 were assumed to provide a conservative representation of COC concentrations (Appendix IV). The 95% UCLM or 90^{th} percentile sediment values were used to estimate COC uptake by waterfowl via incidental sediment ingestion, and to estimate COC concentrations in benthic invertebrate tissue. Based on the discussion in Section 8 of the 2011 EIS Update (De Beers 2011), sediment COC concentrations are not expected to increase during the Project phases; therefore, the same COC concentrations were assumed for both baseline conditions, and the Project phases.

3.3.4 Fish Data

Lake trout, round whitefish, and slimy sculpin were collected in Kennady Lake and surrounding lakes in 1996, 1999, and 2004. Lake trout and round whitefish were assumed to provide the best representation of the species that would be consumed by wildlife in and around Kennady Lake. For Kennady Lake metals concentrations in fish tissues, the median values from 1996, 1999, and 2004 (separate averages were calculated for each year) were used as the tissue concentrations to estimate the water-to-fish tissue bioaccumulation factor.

3.4 BIOAVAILABILITY AND METAL UPTAKE

Estimates of bioavailability were used in exposure calculations. The factors used in these calculations are described under the following headings:

- bioconcentration and bioaccumulation factors;
- absorption factors; and
- bio-transfer and bio-uptake factors.

3.4.1 Bioconcentration and Bioaccumulation Factors

Bioaccumulation factors represent the transfer of COC from a medium (e.g., soil, water) to plant or animal tissue via all relevant pathways. A bioaccumulation factor is represented as the equilibrium or steady-state ratio between an exposure medium and the organism tissue (Equation 9):

$$BAF = \frac{C_t}{C_m}$$

Where:

BAF = bioaccumulation factor for an organism (L/kg or kg/kg)
C_t = concentration in tissue (mg/kg dry weight or wet weight[8])
C_m = concentration in abiotic exposure medium (mg/kg or mg/L)

Bioaccumulation factors account for all potential exposure routes (i.e., dermal, root absorption, respiratory, dietary). Bioconcentration factors are also estimated using Equation 9 but represent non-dietary exposure such as respiratory uptake, root absorption, or dermal absorption. For substances that do not accumulate substantively in dietary items, values calculated for bioaccumulation factors and bioconcentration factors are often similar and represent similar accumulation processes. For the wildlife ERA, the term bioaccumulation factor was used to represent the ratio in Equation 9 resulting from all possible exposure routes, regardless of the magnitude of the dietary accumulation pathway.

Site-specific bioaccumulation factors for metals in fish tissue were estimated from the baseline long-term average water COC concentrations and baseline average fish tissue COC concentrations. These site-specific bioaccumulation factors

[8] Both dry weight and wet weight BAFs were used but concentrations were converted to dry weight to estimate the dietary intake.

(summarized in Appendix IV) were combined with predicted water concentrations to estimate fish tissue concentrations during project phases.

Site-specific bioaccumulation factors for metals in plant tissues were estimated from baseline plant COC concentrations and baseline soil COC concentrations and are summarized in Appendix IV. These site-specific bioaccumulation factors were applied in the estimation methods for plant COC concentrations during the project phases (Equation 8).

Accumulation of COCs from soil, sediment, and water to invertebrates was also estimated using bioaccumulation factors. However, due to a lack of baseline COC concentration data for invertebrates, it was necessary to apply bioaccumulation factors recommended in the literature and guidance documents. Standard sources for bioaccumulation factors were used for most COCs (Appendix IV).

3.4.2 Bioavailability and Bioaccessibility

Absorption in animals can be defined as the process by which toxicants enter the bloodstream. Depuration processes through which the body breaks down and excretes substances act concurrently with the absorption processes. Therefore, net absorption of a substance must account for depuration processes. Measuring net absorption is challenging, and few toxicological studies undertake this task. Furthermore, often the most soluble and most bioavailable[9] (or absorptive) form of the chemical is used in toxicity studies (i.e., soluble salts of metals, such as chlorides, are typically used as the exposure substance).

The bioaccessibility[10] and resulting bioavailability of metals, soil, sediment, granitic mine rock and kimberlite is an area of high uncertainty. The compounds used in the toxicity studies of metals are typically in the form of highly soluble salts. In contrast, certain metals present soil, sediment and rock are typically in very low solubility forms and this can limit their bioaccessibility (UK Environment Agency 2005; Grohn and Andersen 2003). For example Grohn and Andersen (2003) summarize data indicating 10 to 60% bioaccessibility of arsenic in soils, 19 to 58% bioaccessibilty of lead in soils, and 5 to 33% bioaccessibility of chromium in soils. Also, iron and aluminum in granitic rock and kimberlite in the LSA are expected to be in the form of aluminum and iron oxides (e.g., Al_2O_3 and

[9]Bioavailability refers to the fraction of the chemical that can be absorbed by the body through the gastrointestinal system (UK Environment Agency 2005).

[10] The fraction of a substance that is released from soil during processes, like digestion into solution (the so called bioaccessible fraction), making it available for absorption (UK Environment Agency 2005). It has an influence on *oral bioavailability* but is also influenced by other factors such as chemical speciation.

Fe_2O_3; refer to Section 8, Appendix 8.III of the 2012 EIS Supplement [De Beers 2012]), which have very low solubility relative to aluminum and iron salts used in toxicity testing. Solubility is known to be a primary determinant in metal toxicity, and the gastrointestinal absorption of metals is expected to be highly dependent on their solubility (Chang et al. 1996). Therefore, the toxicity studies conducted using metal salts are likely to overestimate the potential bioaccessibility and toxicity of metals in soils, sediment and rock that is directly consumed by wildlife. MacDonald and Gunn (2004) identify this factor as a major uncertainty regarding the possible toxicological risks related to binge ingestions of mine tailings by caribou at the Colomac site.

To address this uncertainty in bioaccessibility, two scenarios were run for the both the chronic exposure scenarios for all wildlife and for the acute binge ingestion scenario for caribou:

1. **Bioaccessibility = 100%:** This was an absolute worst-case scenario that assumed metals absorption from soil, sediment, granite and kimberlite was the same as the metals salts used in toxicity studies. This scenario was highly conservative and likely to overestimate risks from binge soil, granite and kimberlite ingestion.
2. **Bioaccessibility = 10%:** This was a more realistic, yet still conservative scenario, which assumed that metals absorption from soil, sediment, granite and kimberlite was 10% that of the metals salts used in toxicity studies. This scenario was considered important for aluminum and iron, which typically comprise a significant proportion of the mineral matrix of soil, sediment and rock. For these metals, this scenario was still conservative because the actual availability of metals in soil, sediment and rock is expected to be much lower. For example, the shake-flask testing described in Section 8, Appendix 8.III of the 2012 EIS Supplement (De Beers 2012) indicated that only a very small proportion (≤0.14%) of aluminum and iron in granite and kimberlite is present in a highly soluble form.

3.4.3 Bio-transfer and Bio-uptake Factors

Bio-transfer factors or bio-uptake factors are used to estimate the concentration of a COC in tissues resulting from exposure to the COC in the environment.

Bio-transfer factors are used to convert the estimated dietary intake of a COC by a species into a concentration of the COC in tissue. The estimated dietary intake is combined with chemical-specific bio-transfer factors to estimate COC concentrations (Equation 10):

$$TC_{DW} = \sum EDI \times Bw \times BTF$$

Where:

TC	=	concentration in tissues (mg/kg)
∑EDI	=	the sum of exposure from consumed media (food, water, soil, sediment; mg COC/kg body weight/day)
BW	=	body weight (kg)
BTF	=	bio-transfer factor that is chemical specific (day/kg)

Data for mammalian bio-transfer factors were available from studies that evaluated metal accumulation from diet (feed) to beef tissue (Appendix IV). These bio-transfer factors were used in Equation 10 to estimate COC accumulation in caribou and muskoxen, which are prey species for grizzly bears or wolves.

Sample et al*.* (1998) describe a method for estimating soil-to-small mammal bio-uptake factors for metals and other chemicals. The method applies regression-based relationships or average uptake values (both determined from field data) to provide concentration-dependent estimates of small mammal tissue metal concentrations. Although the bio-uptake factors are applied to soil concentrations only, these predictions are based on field data and assess the influence of multiple exposure routes including direct soil contact, soil ingestion, and consumption of plants growing in the same environment. Thus, the method using bio-uptake factors was considered to provide an established and defensible method for estimating COC concentrations in small mammals at the Project site.

Bio-uptake factors calculated using the methods of Sample et al*.* (1998) were applied to estimate COC accumulation from soil in small mammal herbivores, which are prey species for multiple bird and mammal carnivores in the food web model (Appendix IV). For COCs where bio-uptake factors were not available, the bio-transfer factor approach described above was applied.

4 TOXICITY ASSESSMENT

This section describes the approach and results of the Toxicity Assessment for the wildlife ERA. Section 4.1 describes the approach to deriving TRVs for chronic exposure and Section 4.2 describes the approach to deriving TRVs for acute exposure.

4.1 CHRONIC TOXICITY REFERENCE VALUES

A stepwise procedure was used to identify appropriate TRVs for the wildlife risk assessment from the available literature. First, the U.S. EPA Ecological Soil Screening Levels (Eco-SSLs; U.S. EPA 2010, internet site) were identified for each COC, if available. Where they were available, TRVs identified in the Eco-SSL documents were typically adopted as the TRVs for the risk assessment (any deviations from this approach are summarized in Appendix V). The Eco-SSL documents are considered to be the most up to date and definitive summaries of TRVs for the chemicals covered.

Where an Ecological Soil Screening Levels document was unavailable for a COC, a literature review was conducted to identify candidate TRVs, beginning with the Oak Ridge National Laboratory's Toxicological Benchmarks for Wildlife (Sample et al*.* 1996) and supported by additional detailed literature review as needed. In the literature review, selection of no observable adverse effects concentrations (NOAECs) and lowest observable adverse effects concentrations (LOAECs) was based on biologically relevant effects, as well as statistically significant toxicity endpoints. Statistically significant differences for endpoints that are not of direct ecological relevance were not used for TRV derivation.

Two types of TRVs were developed and applied for risk characterization; these included:

- **Lower-TRVs –** Highly conservative benchmarks for the estimated daily intake of COCs below which it can confidently be concluded that risks to wildlife are negligible. Exceeding these TRVs may or may not actually result in adverse effects, although COC exposures below the lower-TRVs may be screened out of the baseline ERA with confidence. The higher protection offered by the lower TRVs means they are also appropriate for assessing risks to listed or sensitive species, or species that are valued by people and communities as part of their culture and livelihood (as is the case for barren-ground caribou).
- **Upper-TRVs -** Effect-based thresholds above which there is evidence that an effect could occur. These provide a more realistic assessment

(i.e., somewhat *higher* threshold) of the potential for adverse effects to wildlife receptors, as these TRVs are associated with dietary intakes that have been observed to result in adverse effects in sensitive test organisms. However, as the upper-TRVs based on lowest observed adverse effects level (LOAELs) represent the most sensitive documented relevant endpoints, they should not be interpreted as thresholds for the actual study populations or receptors, particularly where the surrogate species is dissimilar to the site-specific receptor of concern

Appendix V provides a summary and the derivation of the chronic TRVs that were used for mammals and birds.

4.2 ACUTE TOXICITY REFERENCE VALUES

The predicted acute exposure from binge soil, granite and kimberlite ingestion was compared to a TRV derived from acute toxicity data for mammalian test species. Only a single TRV was developed for each COC.

A stepwise procedure was used to identify acute TRVs for possible soil “binge” ingestion by caribou at the Project site. The approach involved searching for relevant and applicable benchmark values from the following sources:

- **The Risk Assessment Information System (RAIS)** This database was used preferentially in the development of acute toxicity thresholds. The toxicity profiles in this database were developed using information taken from the U.S. EPA Integrated Risk Information System (IRIS), Health Effects Assessment Summary Tables (HEAST), and other regulatory sources.

Where RAIS information was lacking, the following sources were evaluated, and if necessary, a limited literature review was conducted:

- **Environmental Health Criteria Monographs** Environmental health data from the International Programme on Chemical Safety (IPCS) were applied. The IPCS is a joint venture of the United Nations Environment Programme, the International Labour Organization, and the World Health Organization. The overall objectives of the IPCS are to establish the scientific basis for assessment of the risk to human health and the environment from exposure to chemicals, through international peer review processes.
- **Concise International Chemical Assessment Documents (CICADs)** CICADs are concise documents that provide summaries of the relevant

scientific information concerning the potential effects of chemicals upon human health and/or the environment. They are based on selected national or regional evaluation documents or on existing Environmental Health Criteria Monographs. Before acceptance for publication as CICADs by IPCS, these documents have undergone extensive peer review by internationally selected experts to ensure their completeness, accuracy in the way in which the original data are represented, and the validity of the conclusions drawn.

- **Joint Expert Committee on Food Additives (JECFA)** The JECFA is an international scientific expert committee that is administered jointly by the Food and Agriculture Organization of the United Nations and the World Health Organization. It has been meeting since 1956, initially to evaluate the safety of food additives. Its work now also includes the evaluation of contaminants, naturally occurring toxicants, and residues of veterinary drugs in food. To date, JECFA has evaluated more than 1500 food additives, approximately 40 contaminants and naturally occurring toxicants, and residues of approximately 90 veterinary drugs. The Committee has also developed principles for the safety assessment of chemicals in food that are consistent with a risk assessment approach and take account of recent developments in toxicology and other relevant sciences.

The acute TRVs are provided in Appendix VI.

5 RISK CHARACTERIZATION

This section summarizes the Risk Characterization approach and results. The primary decision criterion for Risk Characterization involved the calculation of HQs and the assessment of uncertainty in the values. Section 5.1 describes the HQ estimation procedure and provides an overview of the approach to interpreting the HQ results.

The following sections summarize the HQ results and interpretation for:

- chronic exposure to COCs for all receptors except the caribou (Section 5.2); and
- chronic and acute exposure to COCs for the caribou (Section 5.3).

5.1 CALCULATIONS AND INTERPRETATION OF HAZARD QUOTIENTS

Risk characterization for both chronic and acute exposures of wildlife to metals at the Project site entailed the calculation of HQs for each combination of receptor group and COC. HQs were calculated according to Equation 11:

$$HQ = \frac{EDI}{TRV}$$

Where:

EDI = the estimated daily intake via all oral exposure routes (mg chemical/kg body weight/day)
TRV = toxicity reference value for acute or chronic oral exposure (mg chemical/kg body weight/day)

For the case of acute exposure, it was assumed that the exposure occurred over a time frame of 1 day.

Multiple HQs were calculated for each combination of receptor group and COC to represent the following bounding assessments:

(1) baseline (i.e., natural background), and combined construction, operations, and closure phases;

(2) the two levels of chronic TRVs (upper- and lower-TRVs) developed for each COC; and

(3) For the acute exposures, two scenarios were run to examine differing assumptions regarding the bioaccessibility of metals in soils, kimberlite and granitic mine rock,

For metals where predicted hazard quotients exceeded one, a magnitude of effects assessment was conducted to determine if the Project has a negligible, low, or high effect on the potential for unacceptable exposures. The following analyses were conducted to determine the magnitude of effects:

- magnitude of HQ value (which alone cannot indicate the size of ecological response);
- comparison of change in HQ values between the baseline and impact case to determine the potential for Project-related effects;
- evaluation of conservatism in exposure modeling assumptions;
- evaluation of conservatism in the toxicity reference value for the COC; and
- evaluation of the potential for ecological effects at predicted risk levels.

Based on the magnitudes of calculated HQs, and through consideration of the remain project-specific assumptions/uncertainties, risks were categorized as follows:

- **Negligible risk:** HQ less than or equal to 1. This conclusion is consistent with standard practice in risk assessment. The conservative assumptions applied in this assessment provide a high degree of confidence that this category conveys negligible probability and magnitude of actual harm.
- **Low risk and likely to be negligible:** HQ greater than 1 but less than or equal to 10. This conclusion is generally true but should be reviewed on a chemical-specific basis, as the conservatism of the analysis is dependent on the uncertainty factor(s) used to derive the toxicity reference value and the steepness of the dose-response curve (i.e., the magnitude of increase in toxicity associated with an incremental increase in exposure).
- **Potentially elevated risk:** HQ greater than 10; harmful effects are possible due to the substance in question. Additional evaluation of the uncertainties and assumptions should be conducted for these instances prior to making a narrative conclusion regarding potential for harm.

5.2 CHRONIC EXPOSURE SCENARIO RESULTS

This section presents the risk characterization results for all receptors (except the caribou, treated separately) from chronic exposure to COCs. Chronic exposure hazard quotients for mammals and birds for both bioaccessibility scenarios are presented in Appendix IX, and a summary of HQs greater than 1.0 and for which a greater than 10% increase was observed between baseline and project phases are presented in Tables 5.2-3 to 5.2-4.Magnitude of effect tables for COCs which have a HQ greater than 1.0 and for which a greater than 10% increase was observed between baseline and project phases are presented in Tables 5.2-5 to 5.2-8.

The COCS for which HQs exceeded 1.0 and showed an increase of greater than 10% between baseline and project phases included cadmium, chromium, copper and iron. An HQ greater than 1.0 was also obtained for nickel (in the shrew), but the change between baseline and construction operations was less than 10%; therefore, magnitude of effect was not assessed further for nickel.

Table 5.2-1 Summary of Chronic Exposure Hazard Quotients Exceeding One for Mammalian Receptors – Baseline and Project Phases; 100% Bioaccessibility

Parameter	Shrew		Medium Herbivore		Musk Ox	
	Baseline	Project	Baseline	Project	Baseline	Project
Lower TRVs						
cadmium	0.51	**2.1**	0.022	0.081	0.006	0.035
iron	**28.8**	**30.3**	**1.8**	**2.8**	0.74	**1.1**
nickel	**1.2**	**1.3**	0.29	0.40	0.11	0.15
Upper TRVs						
cadmium	0.40	**1.6**	0.017	0.062	0.005	0.027
iron	**9.6**	**10.1**	0.60	0.90	0.25	0.36

Parameter	Small					
	Carnivore		Herbivore		Omnivore	
	Baseline	Project	Baseline	Project	Baseline	Project
Lower TRVs						
cadmium	0.014	0.051	0.034	0.13	0.25	0.99
iron	**1.8**	**1.8**	**3.0**	**4.4**	**10.1**	**11.4**
nickel	0.38	0.42	0.47	0.65	0.42	0.55
Upper TRVs						
cadmium	0.01	0.04	0.03	0.1	0.19	0.76
iron	0.59	0.63	**1.0**	**1.5**	**3.4**	**3.8**

Notes: Bold and highlighted values indicate a hazard quotient (HQ) equal to or greater than 1.0. Only COPCs and mammals with an HQ greater than 1.0 are shown. Refer to Appendix IX for further information.

COPC = chemical of potential concern; TRV = toxicity reference value.

Table 5.2-2 Summary of Chronic Exposure Hazard Quotients Exceeding One for Mammalian Receptors – Baseline and Project Phases; 10% Bioaccessibility

Parameter	Shrew		Medium Herbivore		Musk Ox	
	Baseline	Project	Baseline	Project	Baseline	Project
Lower TRVs						
cadmium	0.51	**2.1**	0.02	0.08	0.006	0.03
iron	**18.5**	**19.6**	**1.2**	**2.1**	0.53	0.9
nickel	0.3	0.3	0.23	0.35	0.09	0.13
Upper TRVs						
cadmium	0.39	**1.6**	0.02	0.06	0.005	0.03
iron	**6.2**	**6.5**	0.40	0.69	0.18	0.29

Parameter	Small					
	Carnivore		Herbivore		Omnivore	
	Baseline	Project	Baseline	Project	Baseline	Project
Lower TRVs						
cadmium	0.01	0.05	0.03	0.12	0.24	0.99
iron	0.3	0.4	**1.9**	**3.3**	**8.9**	**10.2**
nickel	0.25	0.28	0.37	0.55	0.31	0.44
Upper TRVs						
cadmium	0.01	0.04	0.03	0.10	0.19	0.76
iron	0.10	0.12	0.6	**1.1**	**3.0**	**3.4**

Notes: Bold and highlighted values indicate a hazard quotient (HQ) equal to or greater than 1.0. Only COPCs and mammals with an HQ greater than 1.0 under the mammal 100% soil and sediment bioaccessibility scenario are shown. Refer to Appendix IX for further information.

COPC = chemical of potential concern; TRV = toxicity reference value.

Table 5.2-3 Summary of Chronic Exposure Hazard Quotients Exceeding One for Avian Receptors – Baseline and Project Phases; 100% Bioaccessibility

Parameter	Upland Breeding Birds							
	Medium		Small					
	Omnivore		Insectivore		Herbivore		Omnivore	
	Baseline	Project	Baseline	Project	Baseline	Project	Baseline	Project
Lower TRVs								
chromium	0.63	0.79	**1.0**	**1.4**	0.39	0.54	0.56	0.69
copper	0.73	0.82	**1.6**	**1.8**	0.48	0.52	0.51	0.54
Upper TRVs								
chromium	0.61	0.76	0.99	**1.3**	0.37	0.51	0.53	0.66
copper	0.63	0.71	**1.4**	**1.6**	0.42	0.45	0.44	0.47
iron	**4.4**	**5.0**	**7.3**	**8.7**	1.0	**1.6**	**2.3**	**2.8**

Parameter	Water Breeding Birds									
	Large		Medium						Small	
	Carnivores		Carnivores		Herbivores		Omnivores		Insectivore	
	Baseline	Project	Baseline	Project	Baseline	Project	Baseline	Project	Baseline	Project
Lower TRVs										
chromium	0.07	0.07	0.23	0.27	0.17	0.20	0.2	0.3	0.85	**1.1**
copper	0.10	0.11	0.39	0.43	0.17	0.17	0.31	0.34	**1.8**	**2.0**
Upper TRVs										
chromium	0.07	0.07	0.22	0.25	0.16	0.19	0.2	0.3	0.81	**1.1**
copper	0.09	0.09	0.34	0.37	0.14	0.15	0.27	0.30	**1.6**	**1.7**
iron	**1.0**	**1.0**	**3.4**	**3.5**	**1.5**	**1.6**	**1.5**	**1.8**	**11.8**	**12.9**

Notes: Bold and highlighted values indicate a hazard quotient (HQ) equal to or greater than 1.0. Only COPCs and mammals with an HQ greater than 1.0 are shown. A lower TRV for iron was not available; therefore an HQ was not calculated. Refer to Appendix IX for further information.

COPC = chemical of potential concern; TRV = toxicity reference value.

Table 5.2-4 Summary of Chronic Exposure Hazard Quotients Exceeding One for Avian Receptors – Baseline and Project Phases; 10% Bioaccessibility

Parameter	Upland Breeding Birds							
	Medium		Small					
	Omnivore		Insectivore		Herbivore		Omnivore	
	Baseline	Project	Baseline	Project	Baseline	Project	Baseline	Project
Lower TRVs								
chromium	0.27	0.40	0.6	0.9	0.34	0.48	0.50	0.625
copper	0.63	0.72	**1.5**	**1.7**	0.47	0.51	0.49	0.528
Upper TRVs								
chromium	0.26	0.38	0.54	0.8	0.32	0.46	0.48	0.60
copper	0.55	0.62	**1.3**	**1.5**	0.40	0.44	0.43	0.46
iron	**1.8**	**2.3**	**4.1**	**5.3**	0.6	**1.2**	**1.9**	**2.4**

Parameter	Water Breeding Birds									
	Large		Medium						Small	
	Carnivores		Carnivores		Herbivores		Omnivores		Insectivore	
	Baseline	Project	Baseline	Project	Baseline	Project	Baseline	Project	Baseline	Project
Lower TRVs										
chromium	0.01	0.01	0.04	0.08	0.09	0.12	0.16	0.23	0.265	0.536
copper	0.05	0.06	0.25	0.28	0.10	0.11	0.27	0.30	**1.3**	**1.5**
Upper TRVs										
chromium	0.01	0.01	0.04	0.07	0.09	0.12	0.16	0.22	0.253	0.513
copper	0.05	0.05	0.21	0.24	0.09	0.10	0.23	0.26	**1.2**	**1.3**
iron	0.1	0.1	0.6	0.7	0.3	0.4	0.7	0.9	**3**	**4**

Notes: Bold and highlighted values indicate a hazard quotient (HQ) equal to or greater than 1.0. Only COPCs and mammals with an HQ greater than 1.0 under the avian 100% soil and sediment bioaccessibility scenario are shown. A lower TRV for iron was not available; therefore an HQ was not calculated. Refer to Appendix IX for further information.

COPC = chemical of potential concern; TRV = toxicity reference value.

Table 5.2-5 Further Analysis of Cadmium and Determination of Magnitude of Effect (Mammalian Receptors)

Analysis Criteria	Discussion
Magnitude of hazard quotients	Assuming 100% bioaccessibility of metals in soil and sediment; the HQ findings were as follows: • The HQ for the shrew (upland small insectivorous mammal) was 2.1 for the project phase calculated using the lower TRV and 1.6 for the project phase calculated using the upper TRV. • The HQs for the other mammalian receptors assessed were below 1.0.
Comparison of baseline and impact cases	With 100% bioaccessibility, the HQs for the shrew increased from 0.5 to 2.1 (calculated using the lower TRV and increased from 0.4 to 1.6 (calculated using the upper TRV) (4.1-fold increase).
Uncertainty and conservatism in exposure estimates	The EDI of cadmium for the shrew was primarily from terrestrial invertebrates (98%). Literature-based BAFs obtained from relevant U.S. EPA guidance (U.S. EPA, 1999, 2007a; refer to Appendix IV) were used to approximate the transfer of metals to tissues for terrestrial invertebrates. These literature-based BAFs were non-site-specific creating uncertainty; for cadmium, the BAF was based on an invertebrate versus soil regression and was likely neutral with respect to degree of protection.
Uncertainty and conservatism in the toxicity reference value	The mammalian TRVs were developed by the U.S. EPA (2010) to provide protective benchmarks for evaluating ecological effects. These TRVs are based on feeding studies with soluble cadmium (and therefore highly bioavailable), and therefore are likely conservative for the assessment of cadmium in environmental matrices. The lower-TRV for mammals was based on reproduction, growth, and survival effects from the data compiled by the U.S. EPA (2010). The upper-TRV for mammals was based growth effects (reduction in body weight). The upper-TRV was considered adequately protective for shrew because it is not classified as threatened, sensitive or of special concern.
Magnitude of effect	For the shrew, HQs increased from the baseline to the project phase (4.1-fold increase) but the HQ for the applicable upper-TRV (1.6) was at the bottom of the range classified as “low risk” in Section 5.1. The HQs for the other mammalian receptors assessed were less than 1. Project-related risks from cadmium are considered to be low and likely to be negligible for mammals.

Notes: EDI = estimated daily intake; HQ = hazard quotient; TRV = toxicity reference value; NOAEL = no observable adverse effect level; NOAEC = no observable adverse effect concentration; LOAEC = lowest observable adverse effect concentration; U.S. EPA = United States Environmental Protection Agency.

Table 5.2-6 Further Analysis of Chromium and Determination of Magnitude of Effect (Avian Receptors)

Analysis Criteria	Discussion
Magnitude of hazard quotients	Assuming 100% bioaccessibility of metals in soil and sediment; the HQ findings were as follows: • The HQs for avian receptors were below 1.0 for the baseline and project phases with the exception of the small insectivorous upland bird and the small insectivorous waterbird. • The HQ for small insectivorous upland birds increased from 1.0 to 1.4 for the lower-TRV and from 0.99 to 1.3 for the upper-TRV. • The HQ for small insectivorous waterbirds increased from 0.85 to 1.1 for the lower-TRV and increased from 0.81 to 1.1 for the upper-TRV.
Comparison of baseline and project phases	The HQs for the small insectivorous upland bird and the small insectivorous waterbird (lower and upper TRV) increased 1.3-fold.
Uncertainty and conservatism in exposure estimates	The EDI of chromium for the small insectivorous upland bird was primarily from a combination of aquatic invertebrates (36%), soil (40%), and terrestrial invertebrates (24%). The EDI of chromium for the small insectivorous waterbird was primarily from a combination of aquatic invertebrates (42%) and sediment (58%). The 100% bioaccessibility scenario is likely to result in an overestimate of the dose of chromium from consumed soil and sediment because some of the chromium in these matrices would be part of the non-soluble mineral matrix and geochemical and physical properties in these matrices have been demonstrated to reduce the bioaccessibility of chromium (e.g., Stewart et al., 2003; UK Environment Agency, 2005). Literature-based BAFs obtained from relevant U.S. EPA guidance (U.S. EPA, 1999, 2007a; refer to Appendix IV) were used to approximate the transfer of metals to tissues for aquatic and terrestrial invertebrates; these literature-based BAFs were non-site-specific creating uncertainty. For terrestrial invertebrates, the BAF was a median value meaning that is was likely neutral with respect to protectiveness. For aquatic invertebrates, the BAF was the highest of three possible values, meaning that the uncertainty was likely in the direction of over-protectiveness. In addition, total concentrations of chromium in water were used for the invertebrate tissue estimates but approximately 25% of chromium is expected to be in particulate phase (refer to Section 9 of the 2012 EIS Supplement [De Beers 2012a]), and this fraction is unlikely to be available for uptake by invertebrates.
Uncertainty and conservatism in the toxicity reference value	The avian TRVs were developed by the U.S. EPA (2010) to provide protective benchmarks for evaluating ecological effects. These TRVs are based on feeding studies with soluble (and therefore highly bioavailable) chromium, and therefore are likely conservative for the assessment of chromium in environmental matrices. The lower-TRVs for birds are the geometric means of NOAEL values compiled by the U.S. EPA (2010) for growth and reproduction effects. The upper-TRV for birds is based on reproductive effects and a decrease in survival in black ducks exposed to trivalent chromium in their food. The small water and upland insectivorous birds are considered vulnerable (refer to Table 2.3-1), the lower-TRV would normally be considered to offer an appropriate level of protection. However, given the multiple conservative assumptions regarding soil ingestion and bioaccessibility, both TRVs were considered adequately protective.
Magnitude of effect	The HQs for avian receptors were below 1.0 for most receptors and only slightly exceeded 1.0 in the project phase for small birds feeding on aquatic and terrestrial invertebrates. However, the HQs were only slightly higher in the project phase than in the baseline phase indicating limited Project impacts. As a result, the risks of Project-related adverse effects to avian receptors from chromium is low and likely to be negligible.

Notes: EDI = estimated daily intake; HQ = hazard quotient; NOAEL = no observable adverse effect level; LOAEL = lowest observable adverse effect level; TRV = toxicity reference value; U.S. EPA = United States Environmental Protection Agency

Table 5.2-7 Further Analysis of Copper and Determination of Magnitude of Effect (Avian Receptors)

Analysis Criteria	Discussion
Magnitude of hazard quotients	Assuming 100% bioaccessibility of metals in soil and sediment; the HQ findings were as follows: • The HQs for avian receptors were below 1.0 for the baseline and project phases with the exception of the small insectivorous upland bird and the small insectivorous waterbird. • The HQ for the small carnivorous upland bird increased from 1.6 to 1.8 from the baseline to project phase when calculated using the lower TRV and increased from 1.4 to 1.6 under the same scenario when calculated using the upper TRV. • The small insectivorous waterbird HQ increased from 1.8 to 2.0 from the baseline to project phase when calculated using the lower TRV and increased from 1.6 to 1.7 under the same scenario when calculated using the upper TRV.
Comparison of baseline and project phases	For avian receptors with an HQ greater than 1.0 for copper, the project phase was approximately 1.1-fold higher than the baseline phase.
Uncertainty and conservatism in exposure estimates	The EDI of copper for the small insectivorous upland bird was primarily from a combination of aquatic invertebrates (85%), soil (8%), and terrestrial invertebrates (8%). The EDI of copper for the waterbird small insectivore was primarily from a combination of aquatic invertebrates (75%) and sediment (25%). The 100% bioaccessibility scenario is likely to result in an overestimate of the dose of copper from consumed soil and sediment because some of the copper in these matrices would be part of the non-soluble mineral matrix and geochemical and physical properties in these matrices. For example, in a review of human bioaccessibility of heavy metals in soil, Gron and Andersen (2003) concluded a possible range of 10-90% copper bioaccessibility in soils. Literature-based BAFs obtained from relevant U.S. EPA guidance (U.S. EPA, 1999, 2007a; refer to Appendix IV), were used to approximate the transfer of metals to tissues for aquatic and terrestrial invertebrates; these literature-based BAFs were non-site-specific . For terrestrial invertebrates, the BAF was a median value while for aquatic invertebrates the BAF was a geometric mean value; both were likely neutral with respect to protectiveness.
Uncertainty and conservatism in the toxicity reference value	The avian TRVs were developed by the U.S. EPA (2010) to provide protective benchmarks for evaluating ecological effects. These TRVs are based on feeding studies with soluble copper chloride (and therefore highly bioavailable), and therefore are likely conservative for the assessment of copper in environmental matrices. The lower-TRV for birds is the geometric mean of NOAEL values compiled by the U.S. EPA (2010) for growth and reproduction effects. The upper-TRVs for birds are based growth effects (reduction in body weight). The small water- and upland insectivorous birds are considered vulnerable (refer to Table 2.3-1), and as a result, the lower-TRV would normally be considered to offer an appropriate level of protection.
Magnitude of effect	Most avian receptors HQs were below 1.0 and where they exceeded 1.0, they were only slightly higher in the project phase than the baseline phase. As a result, the risk to Project-related adverse effects from copper to avian receptors is low and likely to be negligible.

Notes: EDI = estimated daily intake; HQ = hazard quotient; TRV = toxicity reference value.

Table 5.2-8 Further Analysis of Iron and Determination of Magnitude of Effect (Mammalian Receptors)

Analysis Criteria	Discussion
Magnitude of hazard quotients	For the project phase HQs calculated using the lower TRVs exceeded 1.0 (range 1.1 to 30.3) for all mammalian receptors except the grizzly bear, medium carnivore, and the wolf. However, in most cases, baseline HQs were also elevated above 1.0 suggesting that the predicted risks could be due to naturally elevated concentrations in exposure media such as mineralized soil and rock within the project area, and an overestimate of the bioaccessibility of iron in soil and rock. It is expected that local organisms would be adapted to the bioaccessible fraction of iron from these media that they are exposed to either directly or indirectly. More importantly, none of the receptors for which lower-TRV HQs exceeded 1.0 are considered threatened, sensitive or of special concern, and therefore, the upper-TRVs provide an adequate level of protection for these receptors. For the project phase, the HQs calculated using the upper TRVs exceeded 1.0 (range 1.5 to 10.1) for the shrew, small herbivore and small omnivore.
Comparison of baseline and project phases	Assuming 100% bioaccessibility: • The HQs calculated using the upper TRV for the shrew increased from baseline (9.6) to project (10.1) phase (1.1-fold increase). • The HQs calculated using the upper TRV for the small herbivore increased from 1 to 1.5 from baseline to project phase (1.5-fold increase). • The HQs calculated using the upper TRV for the small omnivore increased from 3.4 to 3.8 for the upper TRV from baseline to project phase (1.1-fold increase).
Uncertainty and conservatism in exposure estimates	The EDI of iron for shrew, small omnivore and small herbivore under the baseline and project phases comes primarily from consumption of either soil, or soil-linked food items (terrestrial invertebrates, plants), as follows: • Shrew = 59% invertebrates, 39-40% soil and 1-2% grasses • Small omnivore – 69-75% invertebrates, 13-14% soil, 12-19% plants • Small herbivore = 29-40% from soil; 60-71% from plants. The assumption of 100% bioaccessibility of iron in soil, for exposure directly to these receptor or indirectly via uptake into food items, likely results in an overestimate of exposure. Assuming 10% bioaccessibility of iron in soil, reduced project HQs from 10.1 to 6.5 for shrew, from 1.5 to 1.1 for small herbivore and from 3.8 to 3.4 for small omnivore. Literature-based BAFs obtained from relevant U.S. EPA guidance (U.S. EPA, 1999, 2007a; refer to Appendix IV), were used to approximate the transfer of metals to tissues for terrestrial invertebrates. In the case of iron, a metal-specific BAF was not available and the value was based on the mean BAF observed for other metals (refer to Appendix IV). Use of a non-specific BAF for iron creates uncertainty, but the uncertainty was likely in the direction of over-protectiveness given that some of the metals included in the mean BAF calculation (e.g., cadmium, lead, mercury) are known to accumulate in animals, whereas iron is an essential mineral that is regulated in animals and therefore unlikely to accumulate to a large degree.
Uncertainty and conservatism in the toxicity reference value	Derivation of a reliable chronic TRV for iron is difficult given the limited number of toxicity studies for this substance. There also appears to be a wide variation in sensitivity to ingested iron. A lower-TRV of 20 mg/kg-day was selected to represent the threshold for non-negligible risk (*i.e.*, no effects observed in all long-term feeding studies, and no clinical signs reported in dogs). An upper-TRV of 60 mg/kg-day was selected to represent a low level of risk (*i.e.*, no effects observed in several long-term feeding studies, but some clinical signs reported in dogs). None of the receptors for which lower-TRV HQs exceeded 1.0 are considered threatened, sensitive or of special concern, and therefore, the upper-TRVs provide an adequate level of protection for these receptors.
Magnitude of effect	The baseline HQs are greater than 1.0 for iron due to naturally elevated concentrations in the mineralized soil and rock within the project area, to which local organisms may have adapted. There are only slight changes in the project phase HQs for mammalian receptors (1.1-fold to 1.5-fold increase from the baseline phase). Given the conservative exposure assumptions utilized, the risk of Project-related adverse effects to mammalian receptors from iron is considered to be low and likely to be negligible.

Notes: EDI = estimated daily intake; HQ = hazard quotient; TRV = toxicity reference value; NOAEL = no observable adverse effect level; U.S. EPA = United States Environmental Protection Agency.

Table 5.2-9 Further Analysis of Iron and Determination of Magnitude of Effect (Avian Receptors)

Analysis Criteria	Discussion
Magnitude of hazard quotients	For iron in birds, only a single TRV was derived (i.e., no lower-TRV). Assuming 100% bioaccessibility, project phase HQs calculated using this TRV exceeded 1.0 (range 1.6 to 13) for multiple avian receptors. However, in most cases, baseline HQs were also elevated above 1.0 suggesting that the predicted risks could be due to naturally elevated concentrations of iron in exposure media such as mineralized soil, sediment and rock within the project area, and an overestimate of the bioaccessibility of iron in soil, sediment and rock. It is expected that local organisms would be adapted to the bioaccessible fraction of iron from these media that they are exposed to either directly or indirectly.
Comparison of baseline and project phases	Assuming 100% bioaccessibility, HQs that exceeded 1.0 are provided below with an indication of the change in HQ between baseline and project phases: • HQs for the medium upland omnivorous bird increased from 4.4 to 5.0 (1.1-fold increase). • HQs for the small upland insectivorous bird increased 7.3 to 8.7 (1.2-fold increase). • HQs for the small upland herbivorous bird increased from 1.0 to 1.6 (1.6-fold increase). • HQs for the small upland omnivorous bird increased from 2.3 to 2.8 (1.2-fold increase). • HQs for the medium carnivorous waterbird increased from 3.4 to 3.5 (1.04-fold increase). • HQs for the medium herbivorous waterbird increased from 1.5 to 1.6 (1.1-fold increase). • HQs for the medium omnivorous waterbird increased from 1.5 to 1.8 (1.2-fold increase). • HQs for the small insectivorous waterbird increased from 12 to 13 (1.1-fold increase). Assuming 10% bioaccessibility, HQs that exceeded 1.0 are provided below with an indication of the change in HQ between baseline and project phases: • HQs for the medium upland omnivorous bird increased from 1.8 to 2.3 (1.3-fold increase). • HQs for the small upland insectivorous bird increased 4.1 to 5.3 (1.3-fold increase). • HQs for the small upland herbivorous bird increased from 0.6 to 1.2 (2-fold increase). • HQs for the small upland omnivorous bird increased from 1.9 to 2.4 (1.3-fold increase). • HQs for the small insectivorous waterbird increased from 3 to 4 (1.3-fold increase).

Table 5.2-9 Further Analysis of Iron and Determination of Magnitude of Effect (Avian Receptors) (continued)

Analysis Criteria	Discussion
Uncertainty and conservatism in exposure estimates	For the waterbirds, the EDI for iron with 100% bioaccessibility was was driven primarily by sediment consumption (52-93%); with the HQs increasing with the EDI from sediment exposure, but very little change between the baseline and project phases (4 to 16% increase). The assumption of 100% bioaccessibility of iron in sediments was highly conservative and likely results in an overestimate of exposure. If iron was 100% bioaccessible in sediments, then local organisms would be adapted to this iron exposure. Furthermore, when 10% bioaccessibility of iron in sediments was assumed, HQs were lower and the only waterbird for which HQs exceeded 1.0 was the small insectivorous waterbird. Assuming 100% bioaccessibility of iron, the EDI for upland birds, for which HQs exceeded 1.0 and also show a greater than 10% increase between the baseline and project phases, is largely driven by intake of soil, or soil-linked food items (terrestrial invertebrates, plants). For the insectivore and omnivore, aquatic invertebrates are also important, as follows: • Small carnivorous upland bird – 43-49% from soil, 30-38% from aquatic invertebrates, and 19-21% from terrestrial invertebrates. • Small herbivorous upland bird – 60-73% from grasses and berries and 27-40% from soil • Small omnivorous upland bird - 30-32% from berries and leaves, 41-49% from terrestrial invertebrates and 17-20% from soil The assumption of 100% bioaccessibility of iron in soil was highly conservative and likely results in an overestimate of exposure. If iron was 100% bioaccessible in soils, then local organisms would be adapted to this iron exposure. Furthermore when 10% bioaccessibility of iron in soil was assumed, HQs were lower (maximum HQ of 5.3 in small upland insectivorous bird) and exceeded 1.0 for fewer receptors. Literature-based BAFs obtained from relevant U.S. EPA guidance (U.S. EPA, 1999, 2007a; refer to Appendix IV), were used to approximate the transfer of metals to tissues for aquatic and terrestrial invertebrates. In the case of iron, metal-specific BAFs were not available and the values were was based on the mean of BAFs observed for other metals (refer to Appendix IV). Use of non-specific BAFs for iron creates uncertainty, but the uncertainty was likely in the direction of over-protectiveness given that some of the metals included in the mean BAF calculations (e.g., cadmium, lead, mercury and selenium) are known to accumulate in animals, whereas iron is an essential mineral that is regulated in animals and therefore unlikely to accumulate to a large degree.
Uncertainty and conservatism in the toxicity reference value	There are limited data on the toxicity of iron to avian wildlife. A literature review was conducted, but did not identify sufficient data to derive a dose-response relationship. Therefore the TRVs were based on point estimates. Although this creates uncertainty, the resulting TRVs were supported by information from other studies. A daily intake of 125 to 136 mg/kg-day caused a small reduction (0 to 14%) in egg production when administered to hens via control meal or cottonseed meal. The lower range was selected as the chronic TRV and was considered intermediate between a lower-TRV and upper-TRV given the low level of effect observed (i.e., 0% to 14%). This TRV was considered to provide a conservative representation of the threshold for adverse effects given the highly bioavailable form of iron used for dosing and the marginal level of effect observed.
Magnitude of effect	The baseline HQs are greater than 1.0 for iron due to naturally elevated concentrations in the soil and sediment within the project area, to which local organisms may have adapted. There are only slight changes in the project phase HQs for avian receptors (up to a 2-fold increase from the baseline phase for HQs < 1.5 and up to a 1.3-fold increase from the baseline phase for HQs >1.5). Given the multiple conservative exposure assumptions utilized, the low magnitude of HQs or small increase in iron exposure from baseline to project phases do not indicate a Project-related increase the incremental risk from iron. Therefore, the risk of Project-related adverse effects to avian receptors from iron is considered to be low and likely to be negligible.

Notes: EDI = estimated daily intake; HQ = hazard quotient; TRV = toxicity reference value; NOAEL = no observable adverse effect level; U.S. EPA = United States Environmental Protection Agency.

5.3 ACUTE AND CHRONIC EXPOSURE RESULTS FOR THE CARIBOU

This section presents the risk characterization results for the caribou. Hazard quotients results for binge ingestion of soil, kimberlite and granitic mine rock (acute exposure) and chronic exposure (100% bioaccessibility scenario only) for the caribou are presented in Table 5.3-1. Appendix IX presents the hazard quotient results for chronic exposure and the 10% bioaccessibility scenario.

Magnitude of effect tables for COCs with a HQ greater than 1.0 and greater than 10% increase between baseline and project phases (aluminum and iron) are presented in Tables 5.3-2 to 5.3-4.

Table 5.3-1 Hazard Quotients for Acute and Chronic Exposure for the Caribou – Baseline and Project Phase

COC	Acute Exposure HQ - *Worst-Case*[(a)]			Acute Exposure HQ – *Realistic*[(b)]			Chronic Exposure HQ[(c)]			
							Baseline		Project	
	Baseline Soil	Granite	Kimberlite	Baseline Soil	Granite	Kimberlite	Lower TRV	Upper TRV	Lower TRV	Upper TRV
Aluminum	0.6	0.7	**1.7**	0.1	0.1	0.2	-	-	-	-
Antimony	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	-	-	-
Barium	0.009	0.008	0.100	0.001	0.001	0.010	-	-	-	-
Bismuth	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-
Boron	0.44	<0.001	0.013	0.044	<0.001	0.001	-	-	-	-
Cadmium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.006	0.004	0.04	0.03
Chromium	0.008	0.022	0.094	0.001	0.002	0.009	0.07	0.06	0.09	0.080
Cobalt	0.005	0.008	0.070	0.001	0.001	0.007	-	-	-	-
Copper	0.001	0.001	0.005	<0.001	<0.001	<0.001	0.027	0.026	0.030	0.029
Iron	**2.2**	**3.9**	**9.6**	0.2	0.4	1.0	**1.06**	0.35	**1.45**	0.48
Lead	<0.001	0.001	0.001	<0.001	<0.001	<0.001	-	-	-	-
Molybdenum	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	-	-	-	-
Nickel	0.015	0.006	0.232	0.001	0.001	0.023	0.13	0.082	0.18	0.11
Selenium	0.006	0.004	0.004	0.001	<0.001	<0.001	0.11	0.11	0.12	0.12
Strontium	<0.001	<0.001	0.003	<0.001	<0.001	<0.001	-	-	-	-
Thallium	<0.001	0.025	0.010	<0.001	0.003	0.001	-	-	-	-
Titanium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	-	-	-
Vanadium	0.006	0.012	0.023	0.001	0.001	0.002	-	-	-	-
Zinc	0.010	0.025	0.018	0.001	0.002	0.002	0.025	0.025	0.026	0.026

Notes: Bold and highlighted values indicate a HQ equal to or greater than 1.0.
For parameters with HQs greater than 1, see the magnitude of effects tables (Tables 5.3-2 to 5.3-4) for further information.

(a) assumes 50% soil, kimberlite or granite ingestion rate and 100% bioaccessibility

(b) assumes 50% soil, kimberlite or granite ingestion rate and 10% bioaccessibility

(c) chronic estimates include exposure to soil, water, and dietary items; results are presented here for the 100% bioaccessibility scenario only.

n/a = an acute threshold was not found for bismuth; - = indicates that the parameter was not a COPC for chronic exposure; HQ = hazard quotient.

Table 5.3-2 Further Analysis of Aluminum and Determination of Magnitude of Effect for the Caribou (Acute Exposure)

Analysis Criteria	Discussion
Magnitude of hazard quotients	Hazard quotients (HQs) for caribou acute exposures to aluminum ranged from 0.6 (for binge ingestion of baseline soil or granite mine rock) to 1.7 (for binge ingestion of kimberlite mine rock) under the *worst-case* scenario, but were all below 1.0 for the *realistic* scenario.
Comparison of baseline and project phases	Worst-case HQs for caribou binge ingestion were similar for baseline soil and granite mine rock, but were almost three-fold higher for caribou binging on kimberlite mine rock.
Uncertainty and conservatism in exposure estimates	The acute worst-case scenario risk estimates were derived using a binge ingestion rate equal to 50% of the normal food intake rate and 100% bioaccessibility of ingested aluminum. The binge ingestion rate was based on the maximum of the potential range of soil ingestion rates proposed in a study of tailings ingestion rates for caribou at the Colomac Mine site (MacDonald and Gunn 2004). The assumed binge ingestion rate is likely an overestimate, making the resulting HQ estimates conservative. The assumed bioaccessibility of aluminum is likely an overestimate, even under the realistic scenario, given that aluminum in mine rock is predominantly aluminum oxide, which has very limited solubility (Shock et al. 2007). Based on these considerations, both the worst-case and the realistic scenario risk estimates are considered highly conservative.
Uncertainty and conservatism in the toxicity reference value	A review of acute aluminum toxicity studies for mammals (Appendix VI) identified five studies of the toxicity of soluble aluminum salts, with lethal dose in 50% of the animals tested (LD50) values ranging from 261 to 770 mg Al per kg body weight. The lowest reported LD50 (261 mg Al per kg body weight, based on aluminum nitrate) was selected as the TRV (refer to Appendix VI). This TRV is conservative, considering bioaccessibility (see above) and given that it was the lowest of LD50 of five studies (other LD50s ranged up to three-fold higher).
Magnitude of effect	None of the acute exposure scenarios for granite resulted in an HQ exceeding 1.0. The difference in HQs for the granite ingestion scenario and baseline soil ingestion is very slight (0.6 versus 0.7), indicating negligible risk to caribou from binge ingestion of granite mine rock. The kimberlite ingestion scenario resulted in a HQ (1.7) that exceeded 1.0 and is higher than the HQ (0.6) for baseline soil. However, access by caribou to processed kimberlite is expected to be very limited during construction operations and negligible after closure (see Section 1.1.1.1). This consideration, combined with the multiple sources of conservatism in the exposure estimate and the TRV, suggests that the kimberlite HQs represent a low but likely negligible risk of adverse effects to caribou from binge ingestion of kimberlite.

Notes: HQ = hazard quotient; TRV = toxicity reference value.

Table 5.3-3 Further Analysis of Iron and Determination of Magnitude of Effect for the Caribou (Acute Exposure)

Analysis Criteria	Discussion
Magnitude of hazard quotients	Hazard quotients (HQs) for caribou acute exposures to iron ranged from 2.2 (for binge ingestion of baseline soil) to 9.6 (for binge ingestion of kimberlite mine rock) under the worst-case scenario but were equal to or below 1.0 for the realistic scenario.
Comparison of baseline and project phases	The HQ (3.9) for binge ingestion of granite mine rock increased almost two-fold compared to baseline soil (HQ=2.2). The HQ (9.6) for binge ingestion of the kimberlite mine rock was over four-fold higher than for baseline soil.
Uncertainty and conservatism in exposure estimates	Risk estimates for both exposure scenarios were calculated using an assumed binge ingestion comprising 50% of the diet. The binge ingestion rate was based on the maximum of the potential range of soil ingestion rates proposed in a study of tailings ingestion rates for caribou at the Colomac Mine site (MacDonald and Gunn 2004). The assumed binge ingestion rate is likely an overestimate, making the resulting HQ estimates conservative. The assumed bioaccessibility of iron is likely an overestimate, even under the realistic scenario, given that iron in mine rock is predominantly iron oxide, which has very limited solubility (Shock et al. 2007). This also results in an overestimate of the HQs for both scenarios. Based on these considerations, both the worst-case and the realistic scenario risk estimates are highly conservative.
Uncertainty and conservatism in the toxicity reference value	A review of acute iron toxicity for mammals was conducted (Appendix VI); five acute toxicity estimates were found (range from 28 to 305 mg/kg). The lowest value was considered anomalously low given that is was 5- to 10-fold lower than the acute toxicity estimates from other studies (refer to Appendix VI) and well below the range for acute toxicity reported by Albretsen (2006). Therefore an acute dose of 60 mg/kg which was associated with mild clinical symptoms in dogs was retained as the TRV. This TRV is likely highly conservative, considering bioaccessibility (see above) and given that it was the lower than doses where no adverse effects were observed in both acute and long-term feeding studies.
Magnitude of effect	Binge ingestion by caribou resulted in an HQ up to 9.6, with ingestion of mine rock resulting in up to a four-fold increase in HQs relative to baseline soils, but HQs exceeded 1.0 only for the worst-case scenario. However, the bioaccessibility of iron in mine rock is expected to be much lower than the iron salts used in toxicity testing, and it is unlikely that these elevated HQs for the worst-case scenario represent an actual risk of adverse effects. When an adjustment was applied in the realistic scenario to account for the lower bioaccessibility of iron in mine rock, HQs did not exceed 1.0. Hazard quotients (HQs) were highest for kimberlite ingestion. However, access by caribou to processed kimberlite is expected to be very limited during construction operations and negligible after closure (see Section 1.1.1.1). This consideration, combined with expected low bioaccessibility and the conservative TRV, suggests that that the risk of Project related adverse effects to caribou from iron as a result of binge ingestion are low and likely to be negligible.

Notes: HQ = hazard quotient; TRV = toxicity reference value.

Table 5.3-4 Further Analysis of Iron and Determination of Magnitude of Effect for the Caribou (Chronic Exposure)

Analysis Criteria	Discussion
Magnitude of hazard quotients	Hazard quotients (HQs) calculated using the lower TRV were 1.06 in the baseline phase and 1.45 in the project phase. Hazard quotients (HQs) calculated using the upper TRV were less than 1.0.
Comparison of baseline and project phases	Project phase HQs were 1.4-fold higher than baseline HQs.
Uncertainty and conservatism in exposure estimates	Soil ingestion accounted for a 32 to 43% of the total dietary dose of iron to caribou and HQs for iron are therefore influenced by the conservative assumptions regarding soil ingestion. Average daily soil ingestion by caribou was based on the mean value estimated by MacDonald and Gunn (2004), which included data for caribou which had binged on soil, and therefore the selected value of 3.4% soil ingestion is likely conservative. The exposure predictions assume 100% bioaccessibility of iron in soil consumed by caribou. As discussed for the acute binge ingestion scenarios, this assumption results in a large overestimate of the solubility and result absorption of iron by caribou and is highly conservative. If 10% bioaccessibility were assumed, the daily intake of iron would be reduced such that all HQs did not exceed 1.0 both the baseline and project phases. Based on this consideration, the risk estimate for chronic exposure to iron is considered highly protective.
Uncertainty and conservatism in the toxicity reference value	Derivation of a reliable chronic TRV for iron is difficult given the limited number of toxicity studies for this substance. There also appears to be a wide variation in sensitivity to ingested iron. For this ecological risk assessment, a lower-TRV of 20 mg/kg-day was selected to represent the threshold for non-negligible risk (i.e., no effects observed in all long-term feeding studies, and no clinical signs reported in dogs). An upper-TRV of 60 mg/kg-day was selected to represent a low level of risk (i.e., no effects observed in several long-term feeding studies, but some clinical signs reported in dogs). Because caribou are ecologically and culturally important, the lower-TRV would normally be considered to offer an appropriate level of protection. However, given the multiple conservative assumptions regarding soil ingestion and bioaccessibility, both TRVs were considered adequately protective.
Magnitude of effect	The baseline scenario resulted in HQs exceeding 1.0 for the lower-TRV, likely because the lower-TRV provides a very conservative basis for assessing ingestion of insoluble iron minerals, for which the bioaccessibility was likely overestimated. Despite the multiple conservative assumptions incorporated into the risk assessment (e.g., 100% foraging on the project site, conservatively high soil ingestion rates), the project phase resulted in only slightly higher HQs than the baseline phase. This is indicative that the Project activities will likely have negligible effect on iron concentrations in soil and caribou forage in the vicinity of the Project. These observations indicate that the risk of Project related adverse effects to caribou from iron are low and likely to be negligible.

Notes: HQ = hazard quotient; TRV = toxicity reference value.

5.4 UNCERTAINTY ASSESSMENT

There is inherent uncertainty associated with all risk assessment predictions. The magnitudes of the uncertainties are in large part a function of the quality, quantity, and variability of available data. The following list identifies the main areas of uncertainty associated with this analysis:

- representativeness of existing baseline data for depicting relevant conditions in abiotic media and resident biological communities terrestrial and aquatic habitats of the LSA;
- uncertainties incorporated in the aerial deposition and water quality models and associated assumptions;
- bioaccessibility of metals in soil, sediment, and mine rock (kimberlite and granite) in the LSA;
- uptake factors for COCs from water to fish; from soil to plants; and from water, soil, and plants to mammals and birds;
- consumption rates (i.e., grams per day) of food based on literature estimates and energetic-based models;
- essentiality of certain COCs;
- extrapolation of toxicity data from laboratory animals to wildlife receptors, often across different species, and using forms of metals different than those expected to occur either naturally (baseline) or under a project scenario; and
- amount of time wildlife receptors spend near the Project.

When information is uncertain, it is standard practice in a risk assessment to make assumptions that are biased towards safety (i.e., conservative assumptions). The purpose of using conservative assumptions is to ensure that risks are not underestimated for the “maximally exposed wildlife receptor”. Thus, there is high confidence in “negligible risk” conclusions when predicted exposure to COCs does not exceed threshold values (i.e., does not exceed a hazard quotient of 1.0). Table 5.4-1 provides a summary of the sources of uncertainty in the assessment, assumptions and rationale, and potential influence on risk predictions. Collectively, these assumptions weigh heavily towards HQ values that overestimate the true risk that is likely to be caused by the Project.

Table 5.4-1 Summary of Sources of Uncertainty, Assumptions and Rationale, and Potential Influence on Risk Predictions

Source of Uncertainty	Assumption/Approach	Rationale	Degree of Uncertainty	Influence on Risk Predictions
Estimation of receptor characteristics	Grouped species according to body size and feeding guilds and applied the lowest body size and the general feeding preferences for the group as a whole.	Simple transparent method to assess multiple species at once.	Low – feeding preferences were similar for all receptors in a group. The lowest body weight of all the receptors in the group was used, which is conservative.	Overestimates risk
Baseline soil, vegetation, and sediment concentrations	Applied 95% ULCM or 90th percentile (for adequate data sets) or maximum (for inadequate data sets) baseline values in the food web model.	Data sets were small, leading to uncertainty with respect to how well baseline conditions were represented. The 95% UCLM was applied when there were at least 10 discrete detected values or more; the 90th percentile was used when data were insufficient for calculation of a 95% UCLM.	Moderate – normal variability associated with soil, vegetation, and sediment data.	Likely overestimates risk
Baseline water concentrations in Lakes N11 and 410	Applied the long-term average baseline values for water quality modeling and in the food web exposure model.	The baseline data set is sufficiently large to adequately characterize baseline conditions. Concentrations represent the long-term average that wildlife and their aquatic prey would be exposed to.	Moderate - normal variability associated with water quality data.	Neutral
	Used total concentrations (as opposed to dissolved portion) for the initial predictions.	Total concentrations provide an estimate of overall effects to water quality.	Moderate - metals accumulation in aquatic prey for wildlife would likely be driven by the dissolved concentration. The BAFs for aquatic invertebrates in the exposure model are based on dissolved concentrations.	Overestimates risk
Predicted water concentrations for in Lakes N11 and 410during construction and operations	The maximum COC concentrations of all project phases, and maximum values between the two lakes were applied to represent project water quality.	The maximum water concentration takes into account all phases of Project.	Moderate – uncertainty is associated with conservative assumptions for the water quality model.	Overestimates risk

Table 5.4-1 Summary of Sources of Uncertainty, Assumptions and Rationale, and Potential Influence on Risk Predictions (continued)

Source of Uncertainty	Assumption/Approach	Rationale	Degree of Uncertainty	Influence on Risk Predictions
Wet and dry deposition rates of COCs	Applied maximum Project development area boundary deposition rate estimates to project phases.	Conservative, worst-case assumption; actual rates will vary seasonally and depend on Project activities but will be less than or equal to selected values.	Moderate - uncertainty is associated with conservative assumptions for the air quality model and with selection of the worst-case value to represent project conditions.	Overestimates risk
Home range size of receptors of concern	Assume that wildlife receptors feed entirely in LSA and/or Lakes N11 and 410.	Conservative, worst-case assumption.	Low to moderate – some receptors would be resident within the LSA for all or part of the year while others would range outside of the LSA and RSA and be exposed to much lower COC concentrations.	Neutral to overestimate of risk
BAFs for aquatic invertebrates	Applied values and relationships reported in the literature and government guidance documents.	Applied the best available information. Applying the same BAF regardless of concentration is conservative because BAFs may have an inverse relationship with concentration.	Moderate – the applicability of generic BAF values and equations to waterbodies in the LSA is uncertain.	Neutral to overestimate of risk
BAFs for fish	Determine site-specific BAFs for fish.	Site-specific BAFs.	Low to moderate – site-specific BAFs represent actual accumulation in waterbodies of the LSA but baseline BAFs may not be representative of those during the project phase when water concentrations would be higher (i.e., actual accumulation could be concentration dependent)	Neutral to overestimate of risk
BAFs for soil invertebrates	Applied values reported in the literature and government guidance documents.	Applied the best available information.	Moderate – the applicability of generic BAF values to the LSA is uncertain	Neutral
Water concentrations for predicting fish and invertebrate tissue concentrations	Applied total (rather than dissolved) baseline and predicted water concentrations for most COCs.	Total concentrations provide an estimate of overall effects to water quality.	Moderate – dissolved concentrations are more representative of the fraction available for uptake and for many of the COCs do not increase as much as total concentrations.	Neutral to overestimate of risk
Reliable COC uptake factors not available for birds	Assumed that higher predators consumed small mammals rather than birds.	The small mammals in the model occupy similar body size and feeding guilds as smaller bird receptors and would have similar exposure to COCs.	Moderate – accumulation of COCs could differ between birds and mammals.	Unknown

Table 5.4-1 Summary of Sources of Uncertainty, Assumptions and Rationale, and Potential Influence on Risk Predictions (continued)

Source of Uncertainty	Assumption/Approach	Rationale	Degree of Uncertainty	Influence on Risk Predictions
Bioaccessibility of COCs in kimberlite, granite, soils and sediment	Assumed 100% bioaccessibility of COCs in kimberlite, granite, soils and sediment for the *worst-case* scenario.	Highly conservative, worst-case assumptions.	High – The bioaccessibility of the form of certain COCs (e.g., aluminum and iron oxides) is expected to be very low because they comprise a portion of the mineral matrix.	Likely large overestimate of risk
	Assumed 10% bioaccessibility of COCs in kimberlite, granite, soils and sediment for the *realistic* scenario.	More realistic than the worst-case scenario, but still a highly conservative assumption.	High – The bioaccessibility of the form of certain COCs (e.g., aluminum and iron oxides) is expected to be very low because they comprise a portion of the mineral matrix.	Likely overestimate of risk
Essentiality of certain COCs	Assumed no compensatory homeostatic regulation of responses to chromium, copper or iron. Assumed linear uptake response for accumulation of these metals in tissues.	Conservative assumption that does not consider homeostatic regulation.	Moderate - Organisms have developed metabolic systems for internal regulation of essential minerals (U.S. EPA 2007b). Although deficiency or toxicity can still occur for regulated compounds if exposures are too high or too low, homeostasis results in a band of exposure levels for which the organism expends metabolic energy to keep internal concentrations within a safe range. Iron is regarded as a macronutrient (i.e., required in high concentrations), and on this basis is often screened automatically from ecological risk assessments. As a conservative approach we have retained iron, but recognize that several factors in the risk assessment result in overestimates of exposure and toxicity. The ratio of essential mineral uptake to external exposure (as reflected in a BAF) is not expected to follow a linear uptake response, but rather will be influenced by the organism's regulation of the element and decrease with increasing exposure.	Likely overestimate of risk

Table 5.4-1 Summary of Sources of Uncertainty, Assumptions and Rationale, and Potential Influence on Risk Predictions (continued)

Source of Uncertainty	Assumption/Approach	Rationale	Degree of Uncertainty	Influence on Risk Predictions
Extrapolation of toxicity data from laboratory animals to wildlife receptors for naturally occurring metals	Assumed similar sensitivity to COCs between wildlife receptors and laboratory animals	Conservative assumption that does not consider potential adaptation of wildlife to naturally occurring metals.	Moderate – Because animals have evolved in the presence of metals, and have adapted to regional requirements for and/or tolerance to certain metals, it is unlikely that that the exposures of non-indigenous laboratory animals to soluble metal salts will reflect the sensitivity of wild organisms inhabiting areas naturally high in metals (U.S. EPA 2007b)	Likely overestimate of risk
Forecasting ecological risks to wildlife during the closure and reclamation phase	When the data was available the maximum concentration of all phases was used. It is assumed that the construction/operation phase of the Project is the worst case scenario.	Environmental COC concentrations would decrease post-closure, and potential risks would be lower than or equal than those during construction and operations.	Low – there is no known mechanism by which environmental COC concentrations could increase post-closure.	Neutral

COC = chemical of concern; BAF = bioaccumulation factor; LSA = Local Study Area; RSA = Regional Study Area; HQ = hazard quotient; 95% UCLM = 95% upper confidence limit of the mean.

6 SUMMARY OF RISKS TO WILDLIFE RECEPTORS

Magnitude of Effects – Mammalian and Avian Receptors (Other Than Caribou)

For most COCs, predicted chronic exposure by wildlife receptors other than caribou did not exceed the threshold for non-negligible risk (i.e., HQ values were less than 1.0), indicating negligible risk of adverse effects.

A number of COCs exhibited HQs that exceeded 1.0 and increased greater than 10% as a result of the Project, suggesting potential risks which required magnitude of effects assessments. For mammals, this included cadmium and iron while for birds this included chromium, copper and iron. The magnitude of effects conclusions for substances for which HQs were greater than 1.0 are summarized below:

- Project-related risks were considered to be low and likely to be negligible for mammals exposed to cadmium and iron.
- Project-related risks were considered to be low and likely to be negligible for birds exposed to chromium, copper and iron.

Magnitude of Effects – Caribou

For most COCs, predicted acute binge and chronic exposure by caribou did not exceed the threshold for non-negligible risk (i.e., HQ values were less than 1.0), indicating negligible risk of adverse effects.

Predicted exposure for two COCs (aluminum and iron) exceeded the threshold for non-negligible risk. The magnitude of effects conclusions for substances for which HQs were greater than 1.0 are summarized below:

- Project-related risks were considered to be low and likely to be negligible for acute exposure by caribou to aluminum and iron.
- Project-related risks were considered to be low and likely to be negligible for chronic exposure by caribou to iron.

7 REFERENCES

Albretsen, J.A. 2006. *The Toxicity of Iron, an Essential Element*. Vet. Med. 2006: 82-90

Barnthouse, L.W., W.R. Munns and M.T. Sorensen. 2007. *Population-level Ecological Risk Assessment*. SETAC/Taylor and Francis. Boca Raton, FL.

BC MoELP (BC Ministry of Environment, Lands and Parks [now BC Ministry of Environment]). 2000. *Tier I ecological Risk Assessment Policy Decision Summary*. Available online: http://www.env.gov.bc.ca/epd/remediation/standards_criteria/standards/tier1policy.htm

Beyer, W. N., E. Conner, and S. Gerould. 1994. *Estimates of Soil Ingestion by Wildlife*. J. Wildl. Manage. 58:375-382.

CCME (Canadian Council of Ministers of the Environment). 1996. *A Framework for Ecological Risk Assessment: General Guidance*. National Contaminated Sites Remediation Program, Canadian Council of Ministers of the Environment, Winnipeg, MB.

CCME. 1999a. *Canadian Soil Quality Guidelines for the Protection of Environmental Health (with updates to 2011)*. In: Canadian Environmental Quality Guidelines, 1999, Canadian Council of Ministers of the Environment, Winnipeg, MB. Available at: http://ceqg-rcqe.ccme.ca/

CCME. 1999b. *Canadian Water Quality Guidelines for the Protection of Aquatic Life (with updates to 2002)*. In: Canadian Environmental Quality Guidelines, 1999, Canadian Council of Ministers of the Environment, Winnipeg, MB. Available at: http://ceqg-rcqe.ccme.ca/

CCME. 1999c. Canadian *Water Quality Guidelines for the Protection of Agricultural Water Uses (with updates to 2006)*. In: Canadian Environmental Quality Guidelines, 1999, Canadian Council of Ministers of the Environment, Winnipeg, MB. Available at: http://ceqg-rcqe.ccme.ca/

CCME. 1999d. *Canadian Sediment Quality Guidelines for the Protection of Aquatic Life (with updates to 2002)*. Updated. In: Canadian Environmental Quality Guidelines, 1999, Canadian Council of Ministers of the Environment, Winnipeg, MB. Available at: http://ceqg-rcqe.ccme.ca/

Chang, L.W., L. Magos, and T. Suzuki (editors). 1996. *Toxicology of Metals*. CRC Press Inc. Boca Raton, FLA. 1198 p.

Chapman, P.M., and J. Anderson. 2005. *A Decision-making Framework for Sediment Contamination*. Integrated Environmental Assessment and Management 1: 163-173.

COSEWIC. 2007. *COSEWIC Assessment and Update Status Reports*. Committee on the Status of Endangered Wildlife in Canada. Ottawa. www.sararegistry.gc.ca/status/status_e.cfm).

Gahcho Kué Panel. 2007. *Terms of Reference for the Gahcho Kué Environmental Impact Statement*. Mackenzie Valley Environmental Impact Review Board. Yellowknife, NWT. October 5, 2007.

De Beers (De Beers Canada Inc.). 2010. *Environmental Impact Statement for the Gahcho Kué Project. Volumes 1, 2, 3a, 3b, 4, 5, 6a, 6b, 7 and Annexes A through N*. Submitted to Mackenzie Valley Environmental Impact Review Board. December 2010.

De Beers. 2011. *Environmental Impact Statement for the Gahcho Kué Project. Volumes 3a Revision 2, 3b Revision 2, 4 Revision 2, and 5 Revision 2*. Submitted to the Mackenzie Valley Environmental Impact Review Board in Response to the Environmental Impact Statement Conformity Review. July 2011.

De Beers. 2012a. *Environmental Impact Statement Supplemental Information Submission for the Gahcho Kué Project*. Submitted to the Mackenzie Valley Environmental Impact Review Board, Yellowknife, NWT, Canada. May 2012.

De Beers. 2012b. *Environmental Impact Statement for the Gahcho Kué Project - 2012 Updated Air Quality Assessment*. Submitted to the Mackenzie Valley Environmental Impact Review Board, Yellowknife, NWT, Canada. August 2012.

GNWT (Government of the Northwest Territories). 2006. *Northwest Territories Species 2006-2010 - General Status Ranks of Wild Species in the Northwest Territories*. Department of Environment and Natural Resources, Government of the Northwest Territories, Yellowknife, NT. III pp. http://www.nwtwildlife.com.

Golder (Golder Associates Ltd.). 2012a. *2011 Water Quality and Sediment Quality Supplemental Monitoring Report.* Report No. 11-1365-0001/DCN-050. Submitted to De Beers Canada Inc. March 2012.

Golder. 2012b. *2011 Wildlife Supplemental Monitoring Report*. Report No. 11-1365-0001/DCN-044. De Beers Canada Inc. March 2012.

Government of Canada. 2006. *Species at Risk Public Registry, Schedule 1 – Species List*. (http://www.sararegistry.gc.ca/species/default_e.cfm).

Gron, C and L Andersen. 2003. *Human Bioaccessibility of Heavy Metals and PAH from Soil*. Environmental Project No. 840 2003 Technology Programme for Soil and Groundwater Contamination. Danish Environmental Protection Agency.

Holling, C.S. 1992. *Cross-scale Morphology, Geometry, and Dynamics of Ecosystems*. Ecological Monographs 62(4):447-502.

LKDFN (Łutsel K'e Dene First Nation). 2001. Łutsel K'e Dene Elders, Stephen Ellis, Brenda Parlee, Bertha Catholique, Henry Catholique, Marlene Michel, and Shawn Catholique. July 2001. *Traditional Knowledge in the Nâ Yaghe Kué Region: An Assessment of the Snap Lake Project*. Final Assessment Report. Submitted to De Beers Canada Mining Inc.

MacDonald, C. and A. Gunn. 2004. *Analysis of the Ash Weight and Elemental Composition in Caribou (Rangifer tarandus) Faecal Pellets Collected at Colomac and Other Sites in the NWT*. Manuscript Report No. 159. Department of Resources, Wildlife and Economic Development. Government of Northwest Territories. Yellowknife, NWT.

MVEIRB (Mackenzie Valley Environmental Impact Review Board). 2006. *Reasons for Decision and Report of Environmental Assessment for the De Beers Gahcho Kué Diamond Mine, Kennady Lake, NT*. June 28, 2006.

Puls, R. 1994. *Mineral Levels in Animal Health*. 2nd Edition. Clearbrook: Sherpa International.

Sample, B.E., J.J. Beauchamp, R.A. Efroymson, and G.W. Suter, II. 1998. *Development and Validation of Bioaccumulation Models for Small Mammals*. Oak Ridge National Laboratory, Oak Ridge TN. ES/ER/TM-219.

Sample, B.E., M.S. Aplin, R.A. Efroymson, G.W. Suter, II. and C.J.E. Welsh. 1997. *Methods and Tools for Estimation of the Exposure of Terrestrial Wildlife to Contaminants*. Oak Ridge National Laboratory, Oak Ridge TN. ORNL/TM-13391.

Sample, B.E., Opresko, D.M., and G.W. Suter II. 1996. *Toxicological Benchmarks for Wildlife: 1996 Revision*. Prepared for U.S. Department of Energy, Office of Environmental Management. Oak Ridge National Laboratory. ES/ER/TM-86/R3. 43 pp. + appendices.

Shock, S.S., B.A. Bessinger, Y.W. Lowney, and J.L. Clark. 2007. *Assessment of the Solubility and Bioaccessibility of Barium and Aluminum in Soils Affected by Mine Dust Deposition*. Environ Sci. Technol. 41(13):4813-4820.

Stewart MA, Jardine PM, Barnett MO, Mehlhorn TL, Hyder LK, McKay LD. 2003. *Influence of Soil Geochemical and Physical Properties on the Sorption and Bioaccessibility of Chromium(III)*. J Environ Qual. 2003 Jan-Feb;32(1):129-37.

Suter, G.W. 1990. *Endpoints for Regional Ecological Risk Assessment*. Environ. Manage. 14: 19-23.

Suter, G.W. 1993. *Ecological Risk Assessment*. Lewis Publishers; Chelsea, MI.

U.S. EPA (United Stated Environmental Protection Agency). 1992. *Framework for Ecological Risk Assessmen*t. EPA/630/R-92/001, Washington, DC, USA.

U.S. EPA. 1998. *Guidelines for Ecological Risk Assessment*. EPA/630/R-95/002F. Washington, DC, USA. April 1998

U.S. EPA. 1999. *Screening Level Ecological Risk Assessment Protocol: Appendix C – Media-to-receptor Bioconcentration Factors (BCFs)*. Region 6 Multimedia Planning and Permitting Division, Center for Combustion Science and Engineering.

U.S. EPA. 2006a. *U.S. EPA Region III Ecological Risk Assessment Freshwater Screening Benchmarks*. July 2006. http://www.epa.gov/reg3hwmd/risk/eco/index.htm.

U.S. EPA. 2006b. *US EPA Region III Ecological Risk Assessment Freshwater Sediment Screening Benchmarks*. August 2006. http://www.epa.gov/reg3hwmd/risk/eco/index.htm.

U.S. EPA. 2007a. *Guidance for Developing Ecological Soil Screening Levels (Eco-SSLs)*. Attachment 4-1: Exposure Factors and Bioaccumulation Models for Derivation of Wildlife Eco-SSLs. OSWER Directive 9285.7-55.

U.S. EPA. 2007b. *Framework for Metals Risk Assessment*. Office of the Science Advisor, Risk Assessment Forum, U.S. Environmental Protection Agency, Washington, DC. EPA 120/R-07/001. March 2007.

U.S. EPA. 2010. *Ecological Soil Screening Levels*. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, Washington, DC. Available at: http://www.epa.gov/ecotox/ecossl/

UK Environment Agency. 2005. *Environment Agency's Science Update on the Use of Bioaccessibility*. Testing in Risk Assessment of Land Contamination. February 2005.

Warren-Hicks, W., Parkhurst, G.R., and S.S. Baker Jr. (Eds.). 1989. *Ecological Assessment of Hazardous Waste Sites: A Field and Laboratory Reference Document*, EPA/600/3-89/013, Washington, DC, USA.

8 ACRONYMS AND GLOSSARY

8.1 ACRONYMS AND ABBREVIATIONS

BAF	bioaccumulation factor
BTF	bio-transfer factor
BW	body weight
CCME	Canadian Council of Ministers of the Environment
C_f	concentration of chemical in food source
CICAD	Concise International Chemical Assessment Documents
C_m	concentration of chemical in media
COC	chemical of concern
COPC	chemical of potential concern
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
C_t	concentration of chemical in tissue
Eco-SSL	ecological soil screening levels
EDI	estimated daily intake
EIS	environmental impact statement
EnRA	environmental risk assessment
ERA	ecological risk assessment
GNWT	Government of the Northwest Territories
HEAST	Health Effects Assessment Summary Tables
HQ	hazard quotient
IPCS	International Programme on Chemical Safety
IR	ingestion rate
IRIS	Integrated Risk Information System
JECFA	Joint FAO/WHO Expert Committee on Food Additives – The JECFA
LD_{50}	exposure dose that is lethal to 50 percent of test population
LOAEC	lowest observed adverse effects concentration
LOAEL	lowest observed adverse effects level
LSA	local study area
Max	maximum
MVEIRB	Mackenzie Valley Environmental Impact Review Board
n	sample size
NOAEC	no observable adverse effects concentration
NWT	Northwest Territories
ORNL	Oak Ridge National Laboratory
PAH	polycyclic aromatic hydrocarbons
PK	processed kimberlite
PKC	Processed Kimberlite Containment
Project	Gahcho Kué Project
RAIS	Risk Assessment Information System

ROPC	receptor of potential concern
RSA	regional study area
SARA	*Species at Risk Act*
ToR	Terms of Reference
TRV	toxicity reference value
UCLM	upper confidence limit of the mean
U.S. EPA	United States Environmental Protection Agency
VC	valued component

8.2 UNITS OF MEASURE

cm	centimetre
cm^2	square centimetre
g	gram
kg	kilogram
kg/day	kilogram per day
km	kilometre
km^2	square kilometre
L/day	litre per day
m	metre
m^2	square metre
m^3	cubic metre
mg/g	milligram per gram
mg/kg	milligram per kilogram
mg/kg/d	milligrams of substance per kilogram of body weight per day
mg/L	milligram per litre
Mt	million tonne
yr	year

8.3 GLOSSARY

Acute Occurring over a short period of time or as a result of a short period of exposure to a substance. Acute toxicity or effect describes the adverse effects resulting from either a single exposure or multiple exposures in a short space of time.

Assessment Endpoint An explicit expression of the actual environmental value that is protected, operationally defined by an ecological entity and its attributes.

Attribute A quality of an endpoint that reflects one aspect of its value for informing the risk assessment.

Baseline A surveyed or predicted condition that serves as a reference point to which later surveys are coordinated or correlated.

Baseline Case The assessment case representing risks to wildlife under baseline conditions. The project pase is compared to the baseline case to determine if there is any incremental increase in risks to wildlife as a result of the Project.

Bias A systematic tendency that distorts the interpretation of results. In ERA, a bias occurs in two main forms. In the study design or interpretation, bias is a perjorative term that reflects partiality of a practitioner that prevents objective consideration of an issue or situation. In statistical measurement, bias reflects a systematic under- or over-prediction of a true parameter value. Both forms of bias introduce systematic error into risk estimates.

Bioaccessibility The fraction of a substance that is released from soil during processes like digestion into solution (the so called bioaccessible fraction); making it available for absorption. It has an influence on oral bioavailability but also influenced by other factors such as chemical speciation.

Bioaccumulation When an organism stores within its body a higher concentration of a substance than is found in the environment from all sources combined (e.g., water, food, and air). This is not necessarily harmful. For example, freshwater fish must bioaccumulate salt to survive in intertidal waters.

Bioavailability It refers to the fraction of the chemical that can be absorbed by the body through the gastrointestinal system.

Bioconcentration When an organism (typically aquatic) stores within its body a higher concentration of a substance than is found in the environment from non-dietary sources (e.g., water, air, and dermal contact).

Bio-transfer The process of a substance transferring from dietary intake to tissues.

Bio-uptake The process of a substance being absorbed into organism tissues from the surrounding environment

Chemical of Potential Concern (COC)	A chemical that is emitted or released into the environment and poses a potential risk of exposure to humans.
Chronic	Occurring over a medium to long period of time or as a result of a medium to long period of exposure to a substance. Chronic toxicity or effect describes an adverse effect resulting from either from repeated or continued exposure over a medium to long period of time. Chronic should be considered a relative term depending on the life span of the organism.
Concentration	Quantifiable amount of a chemical in environmental media.
Conceptual Model	A narrative and graphical representation of the relationships between contaminant sources, fate, exposure pathways, and receptors.
Conservative	Adjective expressing the tendency to deliberately overstate the potential for environmental harm. The overestimate is intended to provide a margin of error to buffer against uncertainty in the analysis, and to provide increased confidence that estimates or predictions of risk are not understated. In ERA practice, it is common to apply conservatism in parameter estimation. However, when conservatism is too great, either through unrealistic assumptions or through compounding of multiple conservative assumptions, an analysis is deemed to be ultra-conservative, and therefore suspect.
Ecological Relevance	The degree to which a type of information used in an ERA (i.e., a measurement endpoint or line of evidence) can be meaningfully extrapolated to the biological scale of interest (i.e., the assessment endpoint).
Ecological Risk Assessment (ERA)	The process of evaluating the potential adverse effects on non-human organisms, populations or communities in response to human-induced stressors. ERA entails the application of a formal framework, analytical process, or model to estimate the effects of human actions on natural organisms, populations or communities and interprets the significance of those effects in light of the uncertainties identified in each study component.
Endpoint	A measurable change in an attribute that can be described in some qualitative and/or qualitative fashion.
Environmental Impact Statement (EIS)	An EIS is a tool for decision making. It describes the positive and negative environmental effects of a proposed action that may or may not significantly affect the quality of the human environment.

Exposure The contact reaction between a chemical and a biological system, or organism. Estimated dose of chemical that is received by a particular receptor through a specific exposure pathway (e.g., ingestion, inhalation); expressed as the amount of chemical received, per body weight, per unit time (i.e., mg/kg day).

Exposure Assessment For any line of evidence, the component of a risk assessment that quantifies the degree to which an organism encounters a stressor.

Exposure Pathway The route by which a receptor comes into contact with a chemical or physical agent. Examples of exposure pathways include: the ingestion of water, food and soil; the inhalation of air and dust; and dermal absorption.

Extrapolation Inference or estimation by extending or projecting known information to a domain (spatial, temporal, biological, or chemical) that has not yet been studied. In statistics, extrapolation entails estimation (of a value of a variable outside a known range) from values within a known range, and requires an assumption that the estimated value follows logically from the known values.

Gastrointestinal Absorption The process by which substrates enter the bloodstream via stomach and intestine of an organism.

Groundwater That part of the subsurface water that occurs beneath the water table, in soils and geologic formations that are fully saturated.

Guideline A regulatory value that is recommended for the screening of environmental data. A guideline usually differs from a standard in that a guideline does not convey a legal requirement or formal responsibility. Canadian Environmental Quality Guidelines are intended as nationally endorsed science based goals for environmental quality. The term is also used to describe a technical practice that is recommended to facilitate consistency among practitioners, but that is not strictly required.

Hazard Quotient — A numerical ratio that divides an estimated environmental concentration or other exposure measure by a response benchmark. Typically the response benchmark is a value assumed to be protective of the receptor of concern. HQ values below one (1.0) indicate negligible potential for harm, whereas HQ values above one indicate that an adverse response is possible and that more precise or accurate evaluation of risks may be warranted to address uncertainty.

Herbivore — An animal which consumes only autotrophs such as plants, algae and photosynthesizing bacteria

Home Range — The area within which an animal normally lives, and traverses as part of its annual travel patterns.

Insectivore — An insectivore is a type of carnivore with a diet that consists chiefly of insects and similar small organisms.

Lowest Observed Adverse Effect Level (LOAEL) — In toxicity testing, it is the lowest concentration at which adverse effects on the measurement end point are observed.

Measurement Endpoint — A measurable change in an attribute of an assessment endpoint or its surrogate in response to a stressor to which it is exposed.

Model — A simplified description of a system, theory, or phenomenon that accounts for its known or inferred properties and that may be used for further study of its characteristics. In all cases, a model is a simplification of a more complex system, and the details not represented by the model structure are considered to be errors/variations not central to the problem at hand. Models include statistical models (numerical processes used to simulate or approximate complex processes) and conceptual models (graphical or schematic representation of key processes and pathways).

No Observed Adverse Effect Level (NOAEL) — In toxicity testing, it is the highest concentration at which no adverse effects on the measurement end point are observed.

Omnivorous — A diet which consists of both plants and animals.

Percentile — A value of a variable below which a certain percent of observations fall.

Polycyclic Aromatic Hydrocarbon (PAH) A chemical by-product. Aromatics are considered to be highly toxic components of petroleum products. PAHs, many of which are potential carcinogens, are composed of at least two fused benzene rings. Toxicity increases along with molecular size and degree of alkylation of the aromatic nucleus.

Problem Formulation A process for generating and evaluating preliminary hypotheses about why ecological effects have occurred, or may occur, from human activities. It provides the foundation for the entire risk assessment.

Project Case The assessment case representing risks to wildlife under Project conditions. Project conditions are usually predicted from baseline conditions, considering emissions from the Project. The project case is compared to the baseline case to determine if there is any incremental increase in risks to wildlife as a result of the Project.

Qualitative Adjective describing an approach that is narrative, referring to the characteristics of something being described, rather than numerical measurement.

Quantitative Adjective describing an approach that is numerical (applies mathematical scores, probabilities, or parameters) in the derivation or analysis of risk estimates.

Receptor of Concern (ROC) In ERA, any non-human individual organism, species, population, community, habitat or ecosystem that is potentially exposed to contaminants of potential concern and that is considered in the ERA. Identification of an organism as an ROC does not mean that it is being harmed, only that a pathway exists such that there is potential for harm.

Regional Study Area (RSA) Defines the spatial extent related to the cumulative effects resulting from the project and other regional developments.

Regression A form of statistical modeling that attempts to evaluate the numerical relationship between one variable (termed the dependent variable) and one or more other variables (termed the independent variables).

Risk The likelihood or probability that the toxic effects associated with a chemical or physical agent will be produced in populations of individuals under their actual conditions of exposure. Risk is usually expressed as the probability of occurrence of an adverse effect, i.e., the expected ratio between the number of individuals that would experience an adverse effect at a given time and the total number of individuals exposed to the factor. Risk is expressed as a fraction without units and takes values from 0 (absolute certainty that there is no risk, which can never be shown) to 1.0, where there is absolute certainty that a risk will occur.

Risk Analysis Process that identify potential issues and risks ahead of time before these were to pose cost and/or schedule negative impacts.

Risk Assessment Process that evaluates the probability of adverse effects that may occur, or are occurring on target organism(s) as a result of exposure to one or more stressors.

Risk Characterization The process of evaluating the potential risk to a receptor based on comparison of the estimated exposure to the toxicity reference value.

Runoff The portion of water from rain and snow that flows over land to streams, ponds or other surface water bodies. It is the portion of water from precipitation that does not infiltrate into the ground, or evaporate.

Stressor Any substance or process that may cause an undesirable response to the health or biological status of an organism.

Threshold Dividing line (in units of exposure concentration or dose) between a zone of potential response and a zone of negligible response. Thresholds may be estimated using theory, data, or a combination of both. In nature, thresholds generally do not occur as precise or static entities, due to the variations among individuals and environmental factors that influence responses. Therefore, a threshold is usually expressed as a best estimate considered protective of most of the population, and often includes a margin of safety in the derivation.

Toxicant A toxicant is a chemical compound that poses a negative effect on organisms.

Toxicity The inherent potential or capacity of a material to cause adverse effects in a living organism.

Toxicity Assessment The process of determining the amount (concentration or dose) of a chemical to which a receptor may be exposed without the development of adverse effects.

Toxicity Reference Value (TRV) For a non-carcinogenic chemical, the maximum acceptable dose (per unit body weight and unit of time) of a chemical to which a specified receptor can be exposed, without the development of adverse effects. For a carcinogenic chemical, the maximum acceptable dose of a chemical to which a receptor can be exposed, assuming a specified risk (e.g., 1 in 100,000). May be expressed as a Reference Dose (RfD) for non-carcinogenic (threshold-response) chemicals or as a Risk Specific Dose (RsD) for carcinogenic (non-threshold response) chemicals. Also referred to as exposure limit.

Toxicology The field of science that explores the relationship between substances of environmental concern and the responses elicited to organisms.

Trophic Level Each of several hierarchical levels in an ecosystem, comprising organisms that share the same function in the food chain or food web and the same nutritional relationship to the primary sources of energy. A food chain or food web represents a succession or organization of organisms that eat another organism and are, in turn, eaten themselves.

Upper Confidence Limit of The Mean A value, when calculate a random set of data, equals or exceeds the true means a percentage that equals the value of the time.

Valued Components (VC) For purposes of ERA, this term should be considered synonymous with receptor of concern (ROC). The term VC originates in Environmental Impact Assessment literature.

Wildlife Under the *Species at Risk Act*, wildlife is defined as a species, subspecies, variety or geographically or genetically distinct population of animal, plant or other organism, other than a bacterium or virus that is wild by nature and is native to Canada or has extended its range into Canada without human intervention and has been present in Canada for at least 50 years.

APPENDIX I

WORKED EXAMPLE FOR LARGE HERBIVORE (MUSKOXEN) EXPOSED TO CHROMIUM IN THE BASELINE PHASE

Ingestion Rates

Ingestion Rate of Food:

$IR_{food} = 0.0687\ (Bw)^{0.822}$

IR_{food} = Food ingestion (kg_{food}/day dry weight);
Bw= Body weight (kg)

$IR_{food} = 0.0687\ (180)^{0.822}$

IR_{food} = 4.91 kg/day

Ingestion Rate of Water:

$IR_{water} = 0.099\ (Bw)^{0.9}$

IR_{water}= Water Ingestion (L/day);
Bw= Body weight (kg)

$IR_{water} = 0.099\ (180)^{0.9}$

IR_{water} = 10.60 L/day

Ingestion Rate of Soil:

$IR_{soil} = 0.02 \times IR_{food}$

IR_{soil}= Soil Ingestion (kg_{soil}/day dry weight),
IR_{food} = Food ingestion (kg_{food}/day dry weight);

$IR_{soil} = 0.02 \times 4.91$

IR_{soil} = 0.098 kg/day

Media Concentrations for Baseline Case

C_{soil} = 26.8 mg/kg dry weight; C_{water}= 0.00016 mg/L; C_{lichen} = 6.15 mg/kg dry weight; C_{leaves} = 3.94 mg/kg dry weight; $C_{grasses}$ = 3.49 mg/kg dry weight

Estimated Daily Intake

$$EDI = \frac{IR_m \times FD \times C_m \times AF}{Bw}$$

EDI = Estimated daily dose ($mg_{CoC}/kg_{bw}\cdot day$);
IR_m= Ingestion rate of media m (kg/day dry weight or L/day);
FD = fraction of diet (for food items only)
C_m = Concentration of CoC in media m that is consumed (mg_{CoC}/kg dry weight for food and soil; mg_{CoC}/L for water). Baseline CoC concentrations are summarized in Appendix III
AF = Absorption factor (normally 1.0);
Bw= Body weight (kg wet weight).

Lichen:

$$EDI = \frac{4.91\ kg/day \times 0.33 \times 6.15\ mg/kg \times 1.0}{180\ kg}$$

EDI = 0.055 mg/kg·day

Leaves:

$$EDI = \frac{4.91\ kg/day \times 0.33 \times 3.94\ mg/kg \times 1.0}{180\ kg}$$

EDI = 0.035 mg/kg·day

Grasses:

$$EDI = \frac{4.91\ kg/day \times 0.34 \times 3.49\ mg/kg \times 1.0}{180\ kg}$$

EDI = 0.032 mg/kg·day

Water:

$$EDI = \frac{10.60\ L/day \times 0.00016\ mg/L \times 1.0}{180\ kg}$$

EDI = 0.0000094 mg/kg·day

Soil:

$$EDI = \frac{0.098\ kg/day \times 26.8\ mg/kg \times 1.0}{180\ kg}$$

EDI = 0.0146 mg/kg·day

Sum of Estimated Daily Intakes:

$\sum EDI = EDI_{lichen} + EDI_{leaves} + EDI_{grasses} + EDI_{water} + EDI_{soil}$

$\sum EDI = 0.055 + 0.035 + 0.032 + 0.0000094 + 0.0146$

$\sum EDI = 0.136$ mg/kg·day

Hazard Quotient

$$HQ = \frac{\sum EDI}{TRV}$$

Lower TRV = 2.4 mg/kg·day

$$HQ = \frac{0.136 \text{ mg/kg·day}}{2.4 \text{ mg/kg·day}}$$

HQ = 0.057

Tissue Concentration

$TC_{DW} = \sum EDI \times Bw \times BTF$

TC_{DW}= Dry weight concentration in tissues (mg_{CoC}/kg_{tissue});
$\sum EDI$ = The sum of exposure from food, water and soil (mg_{CoC}/kg_{bw}·day);
Bw= Body weight (kg);
BTF = Biotransfer factor that is chemical specific (day/kg_{tissue} dry weight);
Chromium BTF = 0.0055 day/kg_{tissue} dry weight

TC_{DW} = 0.136 mg/kg·day x 180 kg x 0.0055 day/kg

TC_{DW} = 0.135 mg/kg

APPENDIX II

SCREENING TABLES

The screening tables for the baseline case are presented in Tables II-1 to II-6. The screening tables for the construction/operation/closure phases are presented in Tables II-7 to II-9.

Table II-1 Baseline Soil Metal Screening Results for the Gahcho Kué Project

Parameter[(a)]	CCME Guidelines[(b)]		U.S. EPA Eco-SSL[(d)]		Maximum Measured Baseline Concentration	Above Guideline or Screening Level?
	Agricultural[(c)]	Notes	Avian Wildlife	Mammalian Wildlife		
Total Metals						
Aluminum	NG	-	NG	NG	12,900	NG
Antimony	20	G	NG	0.27	<0.1	No
Arsenic	17	SC	43	46	2.1	No
Barium	750	G	NG	2,000	402	No
Beryllium	4 (I)	G	NG	21	0.6	No
Bismuth	NG	-	NG	NG	<0.5	No
Boron	2 (I)	G	NG	NG	38	**Yes**
Cadmium	3.8	SFI	0.77	0.36	0.64	**Yes**
Chromium	64	SC	Cr(III) 26	Cr(III) 34; Cr(VI) 130	129	**Yes**
Cobalt	40 (I)	G	120	230	29.7	No
Copper	63	SC	28	49	28.4	**Yes**
Iron	NG	-	NG	NG	23,400	NG
Lead	70	SFI	11	56	4.2	No
Manganese	NG	-	4300	4000	348	No
Mercury	12	SC	NG	NG	0.172	No
Molybdenum	5 (I)	G	NG	NG	1.55	No
Nickel	50	SC	210	130	429	**Yes**
Selenium	1	SC	1.2	0.63	0.37	No
Silver	20 (I)	G	4.2	14	0.13	No
Strontium	NG	-	NG	NG	180	NG
Thallium	1	SFI	NG	NG	0.25	No
Tin	5 (I)	G	NG	NG	<2	No
Titanium	NG	-	NG	NG	678	NG
Uranium	33	SFI	NG	NG	1.66	No
Vanadium	130	SC	7.8	280	30.4	**Yes**
Zinc	200	SC	46	79	38.5	No

Notes:

(a) Units for all metals are milligrams per kilogram (mg/kg) as dry weight.

(b) Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health (CCME 1999a, with updates to 2011).

(c) Agricultural land use. Soil texture not specified.

(d) United States Environmental Protection Agency Ecological Soil Screening Levels (U.S. EPA 2010).

Abbreviations:

NG = no guideline; CCME = Canadian Council of Ministers of the Environment; U.S. EPA = United States Environmental Protection Agency; Eco-SSL = ecological soil screening levels; G = Generic guideline; I = CCME Interim remediation criteria; SC = Soil contact; SFI = Soil and food ingestion.

Table II-2 Baseline Soil PAH Screening Results for the Gahcho Kué Project

Parameter[a]	CCME Guidelines[b]		U.S. EPA Eco-SSL[d]		Maximum Measured Baseline Concentration	Above Guideline or Screening Level?
	Agricultural[c]	Notes	Avian Wildlife	Mammalian Wildlife		
Polycyclic Aromatic Hydrocarbons						
Acenaphthene	21.5	SFI	NG	NG	<0.09	No
Acenaphthylene	NG	-	NG	NG	<0.02	No
Anthracene	2.5	SC	NG	NG	<0.02	No
Benz(a)anthracene	6.2	SFI	NG	NG	<0.03	No
Benzo(a)pyrene	0.6	SFI	NG	NG	<0.8	No
Benzo(b)fluoranthene	6.2	SFI	NG	NG	<0.09	No
Benzo(b+j+k)fluoranthene	6.2	[e]	NG	NG	<0.09	No
Benzo(g,h,i)perylene	NG	-	NG	NG	<0.07	No
Benzo(k)fluoranthene	6.2	SFI	NG	NG	<0.02	No
Chrysene	6.2	SFI	NG	NG	<0.03	No
Dibenz(a,h)anthracene	0.1	I	NG	NG	<0.03	No
Fluoranthene	15.4	SFI	NG	NG	0.01	No
Fluorene	15.4	SFI	NG	NG	0.16	No
Indeno(1,2,3-c,d)pyrene	0.1	I	NG	NG	<0.04	No
2-Methylnaphthalene	8.8	[f]	NG	NG	<0.02	No
Naphthalene	8.8	SFI	NG	NG	<0.02	No
Phenanthrene	43.0	SFI	NG	NG	<0.02	No
Pyrene	7.7	SFI	NG	NG	<0.09	No
∑LMW PAHs [g]	NG	-	NG	100	0.36	No
∑HMW PAHs [h]	NG	-	NG	1.1	0.58[i]	No

Notes:

[a] Units for all PAHs are milligrams per kilogram (mg/kg) as dry weight.

[b] Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health (CCME 1999a, with updates to 2011).

[c] Agricultural land use. Soil texture not specified.

[d] United States Environmental Protection Agency Ecological Soil Screening Levels (U.S. EPA 2010).

[e] A guideline for benzo(b+j+k)floranthene is not available; the guideline for benzo(b)fluoranthene was applied.

[f] A guideline for 2-methylnaphthalene is not available; the guideline for naphthalene was applied.

[g] LMW-PAHs include: acenaphthene, acenaphthylene, anthracene, fluoranthene, fluorene, 2-methylnapthalene, naphthalene, and phenanthrene.

[h] HMW-PAHs include: benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(b+j+k)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, indeno(1,2,3-cd)pyrene, and pyrene.

[i] All HMW-PAHs were summed based on half the detection limit.

Abbreviations:

NG = no guideline; CCME = Canadian Council of Ministers of the Environment; U.S. EPA = United States Environmental Protection Agency; Eco-SSL = ecological soil screening levels; G = Generic guideline; I = CCME Interim remediation criteria. PAH = Polycyclic Aromatic Hydrocarbons; SC = Soil contact pathway; SFI = Soil and food ingestion pathway.

Table II-3 Predicted Baseline Water Screening Results for the Gahcho Kué Project

Parameter [k]	Health Canada – Drinking Water Guidelines [a]	CCME Water Guideline - Livestock [b]	CCME Water Guideline – Aquatic Life [c]	Predicted Maximum Baseline Water Quality in Lake N11/Lake 410	Above Lowest Guideline or Benchmark?[j]
Conventionals					
pH [f] (pH units)	6.5 – 8.5	-	6.5 – 9	6.5-9.0	No
Total Dissolved Solids	≤500 [d]	3000	-	16	No
Major Ions					
Sulphate	≤500 [d]	1000	-	0.88	No
Nutrients					
Nitrate (NO_3) (mg/L as N)	10 [e]	-	3	0.084	No
Nitrogen - Ammonia (NH_4) (mg/L as N)	-	-	4.5 [l]	0.023	No
Total Metals					
Aluminum	0.1 [d]	5	0.1 [m]	0.0185	No
Antimony	0.006	-	-	0.0000617	No
Arsenic	0.010	0.025	0.005	0.000122	No
Barium	1	-	-	0.00274	No
Beryllium	-	0.1 [g]	-	0.000064	No
Boron	5	5	1.5	0.001743	No
Cadmium	0.005	0.08	0.000018	0.000019	No
Chromium	0.05	0.05 [h]	0.001 [n]	0.00016	No
Cobalt	-	1	-	0.00019	No
Copper	≤1.0 [d]	0.5 to 5 [i]	0.00131	0.00128	No
Iron	≤0.3 [d]	-	0.3	0.059	No
Lead	0.010	0.1	0.0013	0.000061	No
Manganese	≤0.05 [d]	-	-	0.0057	No
Mercury	0.001	0.003	0.000026	0.0000051	No
Molybdenum	-	0.5	0.073	0.00003	No
Nickel	-	1	0.0564	0.000465	No
Selenium	0.01	0.05	0.001	0.000032	No
Silver	-	-	0.0001	0.0000081	No
Strontium	-	-	1.5 [o]	0.0069	No
Thallium	-	-	0.0008	0.0000142	No
Uranium	0.02	0.2	0.015	0.0000158	No
Vanadium	-	0.1	0.02	0.000094	No
Zinc	≤5.0 [d]	50	0.03	0.0024	No

Notes:

[a] Health Canada Drinking Water Guidelines (Health Canada 2012).

[b] Canadian Water Quality Guidelines of the Protection of Agricultural Water Uses - Livestock Water (CCME 1999c, with updates to 2006).

[c] Canadian Water Quality Guidelines for the Protection of Aquatic Life – Freshwater (CCME 1999b, with updates to 2012)

[d] Guidelines refer to an operational guidance value or aesthetic objectives.

[e] Equivalent to 10 mg/L as nitrate-N. Where nitrate and nitrite are determined separately, levels of nitrite should not exceed 3.2 mg/L.

[f] Assumed pH value based on observed results in the baseline geochemistry test results.

[g] Interim guideline.

[h] Interim guideline for both hexavalent and trivalent chromium.

[i] Guideline is 0.5 mg/L for sheep, 1 mg/L for cattle, and 5 mg/L for swine and poultry.

[j] Chemical of concern only if the maximum concentration from all project scenarios is greater than the baseline concentration + 10% and the lowest guideline.

[k] All units in mg/L unless otherwise noted.

[l] Guideline for ammonia is pH and water temperature dependent. Guideline shown is based on pH 7.0 and water temperature 15°C and converted to ammonia-N by multiplying 6.98 mg/L by 0.8224.

[m] Guideline is for pH ≥ 6.5.

[n] Guideline is speciation dependent: 0.001 mg/L is for hexavalent chromium and 0.0089 mg/L is for trivalent chromium. Guideline shown is for hexavalent chromium.

[o] US Environmental Protection Agency (USEPA) Region 3 Freshwater Ecological Screening Benchmark (USEPA 2006b) for dissolved metals.

Table II-4 Baseline Sediment Screening Results for the Gahcho Kué Project

Parameter[a]	CCME Guidelines[b]	U.S. EPA Region III[c]	Maximum Measured Baseline Concentration	Above Guideline or Benchmark?
	Interim Freshwater Sediment Quality Guidelines	Freshwater Sediment Screening Benchmarks		
Metals				
Aluminum	NG	NG	22,100	NG
Antimony	NG	2	0.2 [4]	No
Arsenic	5.9	9.8	12	**Yes**
Barium	NG	NG	120	NG
Beryllium	NG	NG	0.8	NG
Boron	NG	NG	9	NG
Cadmium	0.6	0.99	1.0	**Yes**
Chromium	37.3	43.4	170	**Yes**
Cobalt	NG	50	29	No
Copper	35.7	31.6	110	**Yes**
Iron	NG	20,000	69,500	**Yes**
Lead	35	35.8	18.3	No
Manganese	NG	460	2400	**Yes**
Mercury	0.17	0.18	0.13 [4]	No
Molybdenum	NG	NG	6.4	NG
Nickel	NG	22.7	93	**Yes**
Selenium	NG	2	20	**Yes**
Silver	NG	1	0.2[d]	No
Strontium	NG	NG	39	NG
Thallium	NG	NG	0.4	NG
Uranium	NG	NG	4	NG
Vanadium	NG	NG	65	NG
Zinc	123	121	170	**Yes**

Notes:
(a) Units for all parameters are milligrams per kilogram (mg/kg) as dry weight.
(b) Canadian Sediment Quality Guidelines for the Protection of Aquatic Life (CCME 1999d, with updates to 2012).
(c) U.S. EPA Region III Ecological Risk Assessment Freshwater Sediment Screening Benchmarks (US EPA 2006a).
(d) Maximum detected value.

Abbreviations:
NG = no guideline; CCME = Canadian Council of Ministers of the Environment; U.S. EPA = United States Environmental Protection Agency.

Table II-5 Baseline Granite Screening Results for the Gahcho Kué Project (for caribou only)

Parameter[a]	CCME Guidelines[b]	U.S. EPA Eco-SSL[d]	Maximum Measured Baseline Concentration	Above Guideline or Screening Level?
	Agricultural[c]	Mammalian Wildlife		
Metals				
Aluminum	NG	NG	46,100	**Yes** [e]
Antimony	20 (I)	0.27	123.7	**Yes**
Arsenic	17	46	8.7	No
Barium	750	2,000	1,000	**Yes**
Beryllium	4 (I)	21	NV	No
Bismuth	NG	NG	0.3	**Yes** [e]
Boron	2 (I)	NG	187	**Yes**
Cadmium	3.8	0.36	5.7	**Yes**
Chromium	64	Cr(III) 34; Cr(VI) 130	594	**Yes**
Cobalt	40 (I)	230	89.1	**Yes**
Copper	63	49	258.2	**Yes**
Iron	NG	NG	117,500	**Yes** [e]
Lead	70	56	1,008	**Yes**
Manganese	NG	4,000	1,100	No
Mercury	12	NG	0.02	No
Molybdenum	5 (I)	NG	403.3	**Yes**
Nickel	50	130	1,372.2	**Yes**
Selenium	1	0.63	0.9	**Yes**
Silver	20 (I)	14	2.1	No
Strontium	NG	NG	475	**Yes**[e]
Thallium	1	NG	1.8	**Yes**
Tin	5 (I)	NG	NV	No
Titanium	NG	NG	3,890	**Yes**[e]
Uranium	33	NG	9.2	No
Vanadium	130	280	361	**Yes**
Zinc	200	79	2,916	**Yes**

Notes:

(a) Units for all metals are milligrams per kilogram (mg/kg) as dry weight.

(b) Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health (CCME 1999a, with updates to 2011).

(c) Agricultural land use. Soil texture not specified.

(d) United States Environmental Protection Agency Ecological Soil Screening Levels (U.S. EPA 2010).

(e) No screening criteria were available; therefore the compound was carried forward.

Abbreviations:

NG = no guideline; NV = no value; CCME = Canadian Council of Ministers of the Environment; U.S. EPA = United States Environmental Protection Agency; Eco-SSL = ecological soil screening levels; I = CCME Interim remediation criteria.

Table II-6 Baseline Kimberlite Screening Results for the Gahcho Kué Project (for caribou only)

Parameter[a]	CCME Guidelines[b]	U.S. EPA Eco-SSL[d]	Maximum Measured Baseline Concentration	Above Guideline or Screening Level?
	Agricultural[c]	Mammalian Wildlife		
Metals				
Aluminum	NG	NG	40,000	**Yes** [e]
Antimony	20 (I)	0.27	3.3	**Yes**
Arsenic	17	46	10.2	No
Barium	750	2,000	1,434	**Yes**
Beryllium	4 (I)	21	NV	No
Bismuth	NG	NG	0.2	**Yes**[e]
Boron	2 (I)	NG	1,747	**Yes**
Cadmium	3.8	0.36	0.5	**Yes**
Chromium	64	Cr(III) 34; Cr(VI) 130	820.9	**Yes**
Cobalt	40 (I)	230	107.1	**Yes**
Copper	63	49	148.2	**Yes**
Iron	NG	NG	56,900	**Yes**[e]
Lead	70	56	99.4	**Yes**
Manganese	NG	4,000	1,556	No
Mercury	12	NG	0.02	No
Molybdenum	5 (I)	NG	87.8	**Yes**
Nickel	50	130	1,521.3	**Yes**
Selenium	1	0.63	0.50	No
Silver	20 (I)	14	0.7	No
Strontium	NG	NG	10,000	**Yes**[e]
Thallium	1	NG	4	**Yes**
Tin	5 (I)	NG	NV	No
Titanium	NG	NG	2,300	**Yes**[e]
Uranium	33	NG	4.8	No
Vanadium	130	280	123	No
Zinc	200	79	236	**Yes**

Notes:

(a) Units for all metals are milligrams per kilogram (mg/kg) as dry weight.

(b) Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health (CCME 1999a, with updates to 2011).

(c) Agricultural land use. Soil texture not specified.

(d) United States Environmental Protection Agency, Ecological Soil Screening Levels (U.S. EPA 2010).

(e) No screening criteria were available; therefore the compound was carried forward.

Abbreviations:

NG = no guideline; NV = no value; CCME = Canadian Council of Ministers of the Environment; U.S. EPA = United States Environmental Protection Agency; Eco-SSL = ecological soil screening levels; I = CCME Interim remediation criteria.

Table II-7 Soil Metal Screening Results for the Gahcho Kué Project - Construction and Operation Phases

Parameter[a]	CCME Guidelines[b]	U.S. EPA Eco-SSL[d]		Maximum Measured Baseline Conc.	Maximum Measured Baseline Conc. +10 %	Maximum Predicted Conc. for Construction and Operations Phases	Above Maximum Measured Baseline Conc. + 10%?	Above Lowest Guideline or Screening Level?	Chemical of Concern?
	Agricultural[c]	Avian Wildlife	Mammalian Wildlife						
Metals									
Aluminum	NG	NG	NG	12,900	14,200	12,921	No	NG	No
Antimony	20 (I)	NG	0.27	<0.1	0.11	0.1008	No	No	No
Arsenic	17	43	46	2.1	2.31	2.10	No	No	No
Barium	750	NG	2,000	402	442	402	No	No	No
Beryllium	4 (I)	NG	21	0.6	0.66	0.60	No	No	No
Bismuth	NG	NG	NG	<0.5	0.55	0.50	No	NG	No
Boron	2 (I)	NG	NG	38	41.8	38.0	No	**Yes**	No
Cadmium	3.8	0.77	0.36	0.64	0.76	0.699	No	**Yes**	No
Chromium	64	Cr(III) 26	Cr(III) 34; Cr(VI) 130	129	142	129	No	**Yes**	No
Cobalt	40 (I)	120	230	29.7	32.7	29.7	No	No	No
Copper	63	28	49	28.4	31.2	28.4	No	**Yes**	No
Iron	NG	NG	NG	23,400	25,740	23,442	No	NG	No
Lead	70	11	56	4.2	4.62	4.22	No	No	No
Manganese	NG	4,300	4,000	14.6	383	349	No	No	No
Mercury	12	NG	NG	0.172	0.189	0.176	No	No	No
Molybdenum	5 (I)	NG	NG	1.55	1.71	1.56	No	No	No
Nickel	50	210	130	429	472	429	No	**Yes**	No
Selenium	1	1.2	0.63	0.37	0.41	0.371	No	No	No
Silver	20 (I)	4.2	14	0.13	0.143	0.14	No	No	No
Strontium	NG	NG	NG	180	198	180	No	NG	No
Thallium	1	NG	NG	0.25	0.275	0.279	**Yes**	No	No
Tin	5 I	NG	NG	<2	2.2	2	No	No	No
Titanium	NG	NG	NG	678	746	680	No	NG	No
Uranium	33	NG	NG	1.66	1.82	1.66	No	No	No
Vanadium	130	7.8	280	30.4	33.4	30.5	No	**Yes**	No
Zinc	200	46	79	38.5	42.4	38.6	No	No	No

Notes:

(a) Units for all metals are milligrams per kilogram (mg/kg) as dry weight.

(b) Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health (CCME 1999a, with updates to 2011).

(c) Agricultural land use. Soil texture not specified.

(d) United States Environmental Protection Agency, Ecological Soil Screening Levels (U.S. EPA 2010).

NG = no guideline; CCME = Canadian Council of Ministers of the Environment; U.S. EPA = United States Environmental Protection Agency; Eco-SSL = ecological soil screening levels; I = CCME Interim remediation criteria; Conc. = Concentrations.

Table II-8 Soil PAH Screening Results for the Gahcho Kué Project - Construction and Operation Phases

Parameter[a]	CCME Guidelines[b]	U.S. EPA Eco-SSL[d]		Maximum Measured Baseline Conc.	Maximum Measured Baseline or Detection Limit +10 %	Maximum Predicted Conc. for Construction and Operations Phases	Above Maximum Measured Baseline or Detection Limit + 10%?	Above Lowest Guideline or Screening Level?	Chemical of Concern?
	Agricultural[c]	Avian Wildlife	Mammalian Wildlife						
Low Molecular Weight PAHs									
1-Methylnaphthalene	8.8 [e]	NG	NG	<0.02[g]	0.022	0.055	**Yes**	No	No
1-Methylphenanthrene	43.0 [e]	NG	NG	<0.01[g]	0.011	0.012	**Yes**	No	No
2-Methylanthracene	2.5 [e]	NG	NG	<0.01[g]	0.011	0.011	**Yes**	No	No
2-Methylfluorene	15.4 [e]	NG	NG	<0.01[g]	0.011	0.010	No	No	No
2-Methylnaphthalene	8.8 [e]	NG	NG	<0.02	0.022	0.093	**Yes**	No	No
2-Methylphenanthrene	43.0 [e]	NG	NG	<0.01[g]	0.011	0.015	**Yes**	No	No
3-Methyldibenzothiophene	NG	NG	NG	<0.01[g]	0.011	0.010	No	NG	No
3-Methylphenanthrene	43.0 [e]	NG	NG	<0.01[g]	0.011	0.014	**Yes**	No	No
4-+9-Methylphenanthrene	43.0 [e]	NG	NG	<0.01[g]	0.011	0.013	**Yes**	No	No
4-Methyldibenzothiophene	NG	NG	NG	<0.01[g]	0.011	0.010	No	NG	No
Acenaphthene	21.5	NG	NG	<0.09	0.099	0.092	No	No	No
Acenaphthylene	NG	NG	NG	<0.02	0.022	0.028	**Yes**	NG	No[f]
Anthracene	2.5	NG	NG	<0.02	0.022	0.021	No	No	No
Dibenzothiophene	NG	NG	NG	<0.01[g]	0.011	0.01	No	NG	No
Fluorene	15.4	NG	NG	0.16	0.0176	0.172	No	No	No
Naphthalene	8.8	NG	NG	<0.02	0.022	0.199	**Yes**	No	No
Phenanthrene	43.0	NG	NG	<0.02	0.022	0.031	**Yes**	No	No
∑LMW PAHs	NG	NG	100	0.36	0.396	0.707	**Yes**	No	No
High Molecular Weight PAHs									
2-Methylpyrene	7.7 [e]	NG	NG	<0.01[g]	0.011	0.010	No	No	No
Acephenanthrylene	NG	NG	NG	<0.02	0.022	0.011	No	NG	No
Benz(a)anthracene	6.2	NG	NG	<0.03	0.033	0.030	No	No	No
Benzo(a)fluorene	NG	NG	NG	<0.01[g]	0.011	0.0105	No	NG	No
Benzo(a)pyrene	0.6	NG	NG	<0.08	0.088	0.800	No	**Yes**	No
Benzo(b)fluoranthene	6.2	NG	NG	0.09	0.099	0.092	No	No	No
Benzo(e)pyrene	NG	NG	NG	<0.01[g]	0.011	0.010	No	NG	No
Benzo(g,h,i)fluoranthene	NG	NG	NG	<0.01[g]	0.011	0.0107	No	NG	No
Benzo(g,h,i)perylene	NG	NG	NG	<0.07	0.077	0.0705	No	NG	No
Benzo(k)fluoranthene	6.2	NG	NG	<0.02	0.022	0.0201	No	No	No
Chrysene	6.2	NG	NG	<0.03	0.033	0.0304	No	No	No
Coronene	NG	NG	NG	<0.01[g]	0.011	0.01	No	NG	No
Cyclopenta(c,d)pyrene	NG	NG	NG	<0.01[g]	0.011	0.0103	No	NG	No

Table II-8 Soil PAH Screening Results for the Gahcho Kué Project - Construction and Operation Phases (continued)

Parameter[a]	CCME Guidelines[b]	U.S. EPA Eco-SSL[d]		Maximum Measured Baseline Conc.	Maximum Measured Baseline or Detection Limit +10 %	Maximum Predicted Conc. for Construction and Operations Phases	Above Maximum Measured Baseline or Detection Limit + 10%?	Above Lowest Guideline or Screening Level?	Chemical of Concern?
	Agricultural[c]	Avian Wildlife	Mammalian Wildlife						
Dibenzo(a,h)anthracene	0.1	NG	NG	<0.03	0.033	0.0305	No	NG	No
Fluoranthene	15.4	NG	NG	0.01	0.011	0.016	**Yes**	No	No
Indeno(1,2,3-cd)fluoranthene	NG	NG	NG	<0.01[g]	0.011	0.01	No	NG	No
Indeno(1,2,3-cd)pyrene	NG	NG	NG	<0.04	0.044	0.04	No	NG	No
Indeno(1,2,3-W)pyrene	NG	NG	NG	<0.01[g]	0.011	0.0103	No	NG	No
Nitro-pyrene	NG	NG	NG	<0.01[g]	0.011	0.0103	No	NG	No
Perylene	NG	NG	NG	<0.01[g]	0.011	0.01	No	NG	No
Picene	NG	NG	NG	<0.01[g]	0.011	0.01	No	NG	No
Pyrene	7.7	NG	NG	<0.09	0.099	0.0986	No	No	No
∑HMW PAHs	NG	NG	1.1	0.58	0.638	0.0603	No	No	No

Notes:

(a) Units for all PAHs are milligrams per kilogram (mg/kg) as dry weight.

(b) Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health (CCME 1999a, with updates to 2011).

(c) Agricultural land use. Soil texture not specified.

(d) United States Environmental Protection Agency, Ecological Soil Screening Levels (U.S. EPA 2010).

(e) A guideline is not available for this parameter. A guideline for the parent compound was used for screening purposes.

(f) Not considered a COC, because the maximum predicted concentration is well below the available PAH guidelines for other parameters. Also, the sum of PAHs is below the guideline.

(g) If the PAH was not analyzed, then the detection limit was assumed to be the baseline concentration.

Abbreviations:

NG = no guideline; CCME = Canadian Council of Ministers of the Environment; U.S. EPA = United States Environmental Protection Agency; Eco-SSL = ecological soil screening levels; I = CCME Interim remediation criteria; PAH = Polycyclic aromatic hydrocarbons; BL = Baseline; DL = Detection Limit.

Table II-9 Water Screening Results for the Gahcho Kué Project - Construction and Operation Phases

Parameter [(k)]	Health Canada Drinking Water Guidelines [(a)]	CCME Water Guideline - Livestock [(b)]	CCME Water Guideline – Aquatic Life [(c)]	Predicated Long-term Baseline Water Concentrations in Lake N11/Lake 410	Predicted Long-term Baseline Case Water Concentrations +10%	Predicted Maximum Water Concentration (Construction & Operations) in Lake N11/Lake 410	Above Predicted Long-term Baseline +10%?	Above Lowest Guideline or Benchmark?	Chemical of Concern?[(j)]
Conventionals									
pH [(f)] (pH units)	6.5 to 8.5	-	6.5 to 9	6.5 to 9	6.5 to 9	6.5 to 9	No	No	No
Total Dissolved Solids	≤500 [(d)]	3000	-	16	17.6	57	**Yes**	No[d]	No[d]
Major Ions									
Sulphate	≤500 [(d)]	1000	-	0.88	0.97	5.69	**Yes**	No	No
Nutrients									
Nitrate (NO_3) (mg/L as N)	10 [(e)]	-	3	0.084	0.092	1.461	**Yes**	No	No
Nitrogen - Ammonia (NH_4) (mg/L as N)	-	-	4.5 [(l)]	0.023	0.025	1.391	**Yes**	No	No
Total Metals									
Aluminum	0.1 [(d)]	5	0.1 [(m)]	0.0185	0.02035	0.029413	**Yes**	No	No
Antimony	0.006	-	-	0.0000617	0.00006787	0.00034562	**Yes**	No	No
Arsenic	0.010	0.025	0.005	0.000122	0.0001342	0.00074229	**Yes**	No	No
Barium	1	-	-	0.00274	0.003014	0.010349	**Yes**	No	No
Beryllium	-	0.1 [(g)]	-	0.000064	0.0000704	0.000073019	**Yes**	No	No
Boron	5	5	1.5	0.001743	0.0019173	0.025646	**Yes**	No	No
Cadmium	0.005	0.08	0.000018	0.000019	0.0000209	0.000023557	**Yes**	**Yes**	**Yes**
Chromium	0.05	0.05 [(h)]	0.001 [(n)]	0.00016	0.000176	0.00037784	**Yes**	No	No
Cobalt	-	1	-	0.00019	0.000209	0.00036136	**Yes**	No	No
Copper	≤1.0 [(d)]	0.5 to 5 [(i)]	0.00131	0.00128	0.001408	0.0014728	**Yes**	**Yes**	**Yes**
Iron	≤0.3 [(d)]	-	0.3	0.059	0.0649	0.088467	**Yes**	No	No
Lead	0.010	0.1	0.0013	0.000061	0.0000671	0.00011104	**Yes**	No	No
Manganese	≤0.05 [(d)]	-	-	0.0057	0.00627	0.013632	**Yes**	No	No
Mercury	0.001	0.003	0.000026	0.0000051	0.00000561	0.0000064593	**Yes**	No	No
Molybdenum	-	0.5	0.073	0.00003	0.000033	0.0015659	**Yes**	No	No
Nickel	-	1	0.0564	0.000465	0.0005115	0.0012217	**Yes**	No	No
Selenium	0.01	0.05	0.001	0.000032	0.0000352	0.000056341	**Yes**	No	No

Parameter [k]	Health Canada Drinking Water Guidelines [a]	CCME Water Guideline - Livestock [b]	CCME Water Guideline – Aquatic Life [c]	Predicated Long-term Baseline Water Concentrations in Lake N11/Lake 410	Predicted Long-term Baseline Case Water Concentrations +10%	Predicted Maximum Water Concentration (Construction & Operations) in Lake N11/Lake 410	Above Predicted Long-term Baseline +10%?	Above Lowest Guideline or Benchmark?	Chemical of Concern?[j]
Silver	-	-	0.0001	0.0000081	0.00000891	0.000019677	**Yes**	No	No
Strontium	-	-	1.5 [o]	0.0069	0.00759	0.017244	**Yes**	N	No
Thallium	-	-	0.0008	0.0000142	0.00001562	0.000049169	**Yes**	No	No
Uranium	0.02	0.2	0.015	0.0000158	0.00001738	0.00037221	**Yes**	No	No
Vanadium	-	0.1	0.02 [o]	0.000094	0.0001034	0.00051294	**Yes**	No	No
Zinc	≤5.0 [d]	50	0.03	0.0024	0.00264	0.0034645	**Yes**	No	No

Notes:

(a) Health Canada Drinking Water Guidelines (Health Canada 2012).
(b) Canadian Water Quality Guidelines of the Protection of Agricultural Water Uses - Livestock Water (CCME 1999c, with updates to 2006).
(c) Canadian Water Quality Guidelines for the Protection of Aquatic Life - Freshwater (CCME 1999b, with updates to 2012).
(d) Guidelines refer to an operational guidance value or aesthetic objectives.
(e) Equivalent to 10 mg/L as nitrate-N. Where nitrate and nitrite are determined separately, levels of nitrite should not exceed 3.2 mg/L.
(f) Assumed pH value based on observed results in the baseline geochemistry test results.
(g) Interim guideline.
(h) Interim guideline for both hexavalent and trivalent chromium.
(i) Guideline is 0.5 mg/L for sheep, 1 mg/L for cattle, and 5 mg/L for swine and poultry.
(j) Chemical of concern only if the maximum concentration from all project scenarios is greater than the baseline concentration + 10% and the lowest guideline.
(k) Units in mg/L unless otherwise noted.
(l) Guideline for ammonia is pH and water temperature dependent. Guideline shown is based on pH 7.0 and water temperature 15°C and converted to ammonia-N by multiplying 6.98 mg/L by 0.8224.
(m) Guideline is for pH ≥ 6.5.
(n) Guideline is speciation dependent: 0.001 mg/L is for hexavalent chromium and 0.0089 mg/L is for trivalent chromium. Guideline shown is for hexavalent chromium.
(o) US Environmental Protection Agency (USEPA) Region 3 Freshwater Ecological Screening Benchmark (USEPA 2006b) for dissolved metals.

References

CCME. 1999a (with updates to 2011). *Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health*. In: Canadian environmental quality guidelines, 1999, Canadian Council of Ministers of the Environment, Winnipeg. Available at: http://ceqg-rcqe.ccme.ca/

CCME. 1999b. *Canadian Water Quality Guidelines for the Protection of Aquatic Life (with updates to 2012)*. In: Canadian Environmental Quality Guidelines, 1999, Canadian Council of Ministers of the Environment, Winnipeg, MB. Available at: http://ceqg-rcqe.ccme.ca/

CCME. 1999c. Canadian *Water Quality Guidelines for the Protection of Agricultural Water Uses (with updates to 2006)*. In: Canadian Environmental Quality Guidelines, 1999, Canadian Council of Ministers of the Environment, Winnipeg, MB. Available at: http://ceqg-rcqe.ccme.ca/

CCME. 1999d. *Canadian Sediment Quality Guidelines for the Protection of Aquatic Life (with updates to 2002)*. Updated. In: Canadian Environmental Quality Guidelines, 1999, Canadian Council of Ministers of the Environment, Winnipeg, MB. Available at: http://ceqg-rcqe.ccme.ca/

Health Canada (2012). *Guidelines for Canadian Drinking Water Quality* - Summary Table. Water, Air and Climate Change Bureau, Healthy Environments and Consumer Safety Branch, Health Canada, Ottawa, Ontario.

U.S. EPA. 2006a. *US EPA Region III Ecological Risk Assessment Freshwater Sediment Screening Benchmarks*. August 2006. http://www.epa.gov/reg3hwmd/risk/eco/index.htm.

U.S. EPA. 2006b. *U.S. EPA Region III Ecological Risk Assessment Freshwater Screening Benchmarks*. July 2006. http://www.epa.gov/reg3hwmd/risk/eco/index.htm.

U.S. EPA. 2010. *Ecological Soil Screening Levels*. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, Washington, DC. Available at: http://www.epa.gov/ecotox/ecossl/

APPENDIX III

RECEPTOR DATA

III.1 MAMMALIAN RECEPTORS

Table III.1-1 provides a summary of species, body weights, and feeding preferences for the individual and composite mammalian receptor groups for the wildlife ecological risk assessment. Table III.1-2 provides a summary of species and soil/sediment ingestion rates. Additional detail is provided in the following sections.

Table III.1-1 Summary of Body Weights and Diet for Mammalian Receptors used in the Food Chain Model

Receptor	Species Components	BW [(a)] [kg]	Diet
Small herbivore	meadow vole collared lemming	0.055	33% leaves 33% berries 34% grasses
Medium herbivore	arctic ground squirrel snowshoe hare arctic hare	0.7	33% leaves 34% berries 33% grasses
Large herbivore	musk oxen	180	34% grasses 33% lichen 33% leaves
	caribou	100	50% lichen 25% grasses 25% leaves
Small carnivore	ermine mink marten	0.025	25% small herbivore 25% medium herbivore 50% fish
Medium carnivore	wolverine red fox arctic fox	2.5	16% fish 27% small herbivore 27% caribou 27% shrew 3% berries
Large carnivore	wolf	25	50% musk oxen 50% caribou
Small insectivore	masked shrew	0.0025	88% invertebrates 12% grasses
Small omnivore	deer mouse	0.01	50% invertebrates 20% grasses 15% leaves 15% berries
Large omnivore	grizzly bear	125	3% invertebrates 47% berries 6% medium herbivore 44% caribou

Notes: NA – Not applicable.

(a) Within each receptor group, the mammal with the lowest body weight was used for modelling. Also, for each individual mammal species the lowest value in the range of body weights was used.

Table III.1-2 Soil ingestion rates used in the food web model

Group	Receptor	Surrogate	Soil/Sediment Ingestion Rate	Source	Media Ingested
Mammals	Caribou	None	0.034 IR_{food}	3	soil
	insectivore	shrew	0.13 IR_{food}	1	soil
	small omnivore	white-footed mouse	0.02 IR_{food}	2	soil
	small herbivore	meadow vole	0.024 IR_{food}	2	soil
	small carnivore	red fox	0.028 IR_{food}	2	soil
	medium herbivore	woodchuck	0.02 IR_{food}	2	soil
	medium carnivore	red fox	0.028 IR_{food}	2	soil
	large herbivore	moose	0.02 IR_{food}	2	soil
	large omnivore	assumed the lower range for mammals	0.02 IR_{food}	2	soil
	large carnivore	assumed the lower range for mammals	0.02 IR_{food}	2	soil
Birds	upland small insectivore	stilt sandpiper	0.17 IR_{food}	2	soil
	upland small herbivore	assumed the lower range for birds	0.02 IR_{food}	2	soil
	upland small omnivore	assumed the lower range for birds	0.02 IR_{food}	2	soil
	upland medium carnivore	assumed the lower range for birds	0.02 IR_{food}	2	soil
	upland medium herbivore	assumed the lower range for birds	0.02 IR_{food}	2	soil
	upland medium omnivore	semipalmated sandpiper	0.3 IR_{food}	2	soil
	upland large carnivore	assumed the lower range for birds	0.02 IR_{food}	2	soil
	waterbird small insectivore	western sandpiper	0.18 IR_{food}	2	sediment
	waterbird medium carnivore	wood duck	0.11 IR_{food}	2	sediment
	waterbird medium omnivore	mallard	0.033 IR_{food}	2	sediment
	waterbird medium herbivore	canada goose	0.082 IR_{food}	2	sediment
	waterbird large carnivore	assumed to be the same as the canada goose	0.082 IR_{food}	2	sediment
	waterbird large herbivore	assumed the lower range for birds	0.02 IR_{food}	2	sediment
	hawk and owl	assumed the lower range for birds	0.02 IR_{food}	2	soil
	eagle	assumed the lower range for birds	0.02 IR_{food}	2	soil

Notes:

1 –Sample and Suter 1994.

2- Beyer et al. 1994.

3 – MacDonald and Gunn 2004.

III.1.1 SMALL HERBIVORE

A generic receptor was created using the two herbivore mammals found in the region (i.e., meadow vole and the collard lemming). The body mass was assessed using the lowest for the two receptors (0.055 kg: collared lemming).

III.1.1.1 Meadow Vole

The meadow vole (*Microtus pennsylvanicus*) weighs approximately 45 g (33 to 65 g) and is the most widespread vole in North America (Neuburger 1999). It is active year-round, inhabiting moist to wet habitats including meadows, lowland fields, grassy marshes, and along rivers and lakes (Neuburger 1999). Home ranges vary considerably, from 20 to 800 m^2 (U.S. EPA 1993). Meadow voles feed primarily on vegetation such as grasses, leaves, sedges, seeds, roots, bark, fruits, and fungi, but will occasionally feed on insects and animal matter (U.S. EPA 1993, Neuburger 1999). Meadow voles are short-lived, rarely living for longer than one year in the wild (Neuburger 1999).

III.1.1.2 Collared Lemming

The collared lemming *(Dicrostonyx torquatus*) is a small rodent that lives on the tundra throughout the high Arctic; it weighs from 0.055 kg to 0.115 kg (CWS and CWF 1994). Lemming populations fluctuate markedly over periods of roughly four years (CWS and CWF 1994). Average home range sizes are approximately 0.35 ha for females and 2.4 ha for males (Predavec and Krebs 2000). The lemming is herbivorous, feeding on whatever vegetation exists within its habitat (e.g., willow, cranberries) (CWS and CWF 1994). In the winter, lemmings do not hibernate; rather, they forage in the space that forms between the snow and soil (CWS and CWF 1994). The lifespan of the collared lemming is 3.3 years (Carey and Judge 2002).

III.1.2 MEDIUM HERBIVORE

A generic receptor was created using the three herbivore mammals found in the region (i.e., Arctic ground squirrel, Snowshoe hare, and Arctic hare). The body weight was parameterized using the lowest for the three receptors (0.7 kg: Arctic ground squirrel).

III.1.2.1 Arctic Ground Squirrel

The Arctic ground squirrel (*Spermophilus parryii*) is an herbivore found throughout the Northwest Territories, weighing approximately 0.07 to 0.08 kg (Brensike 2000). The diet of the Arctic ground squirrel consists of grasses, sedges, mushrooms, bog rushes, bilberries, willows, roots, stalks, leaves, flowers, and seeds (Brensike 2000). The average home range is approximately 0.15 ha (Lacey and Wiedczorek 2001). The average lifespan of the Arctic ground squirrel is six years for males and 11 years for females (Hopkins 2006).

III.1.2.2 Snowshoe Hare

The Snowshoe hare (*Lepus americanus*) is found throughout Canada (CWS and CWF 2005a). The body weight for an adult snowshoe hare ranges from 1.2 to 1.6 kg (CWS and CWF 2005a). Active year-round, it feeds on herbaceous plants and leaves from shrubs in summer. Small twigs, buds, and bark make up their winter diet and on occasion the hare will consume small quantities of meat (CWS and CWF 2005a). The snowshoe hare tends to inhabit forests, swamps, and riverside thickets (CWS and CWF 2005a). Hare home range varies from 6 to 10 ha (CWS and CWF 2005a). Individuals may live up to 5 years in the wild (Carey and Judge 2002).

III.1.2.3 Arctic Hare

The Arctic hare (*Lepus arcticus*) inhabits the tundra regions of Canada occupying mountainous and lowland areas; it requires broken country with sheltered areas (Gorog 2003). Adult body mass ranges from 3 to 5 kg (Gorog 2003). The home range of the Arctic hare varies from 6 to 10 ha (CWS and CWF 2005a). Arctic hare diet is similar to that of the snowshoe hare, consisting mainly of willow twigs and roots, bark, shoots, leaves, grasses, herbs, and berries, but they have been observed to eat meat from hunters' traps (Gorog 2003). The lifespan of an Arctic hare is assumed to be similar to that of a snowshoe hare, with individuals living up to 5 years in the wild (Carey and Judge 2002).

III.1.3 LARGE HERBIVORE

III.1.3.1 Barren-ground Caribou

The key line of inquiry included the well-being of the Bathurst caribou herd, a subpopulation of the barren-ground caribou (*Rangifer tarandus groenlandicus*) that are known to migrate through or inhabit the Kennady Lake region at certain times of the year (De Beers 2010, Section 7).

The Canadian form of the barren-ground caribou is the most common caribou in Canada (CWS and CWF 2005b, NWT ENR 2010a). The body weight of an adult male barren-ground caribou ranges from 100 to 140 kg depending on the season (NWT ENR 2010a). For the food chain model, the lower end of the body weight range was conservatively used (100 kg).

The migratory barren-ground caribou spend most of the year on the tundra, but make migrations southward in the fall from the tundra to the taiga (hundreds of kilometres) and northward in the springtime to their small calving grounds and summer range on the tundra. There are some near-stationary sub-populations of barren-ground caribou (CWS and CWF 2005b). The Bathurst caribou herd currently occupies a range of approximately 250,000 km^2 (Case et al. 1996). The caribou diet consists of lichens, flowers, grasses and leaves of shrubs depending on seasonal availability, but lichens are the caribou's primary food source for much of the year (CWS and CWF 2005b). Caribou also utilize lick sites as a source of salt and have been observed to "binge" on tailings at other mine sites in the NWT (MacDonald and Gunn 2004). The average life expectancy is 4.5 years (Shefferly and Joly 2000). Females generally have longer life spans than males, with some females living over 15 years. Bulls typically live less than 10 years in the wild.

III.1.3.2 Muskoxen

Large herbivores such as muskoxen were included in the subjects of note for the Gahcho Kué Project (Project; De Beers 2010, Section 11.11).

The body weight of muskoxen (*Ovibos moschatus*) found in Canada's arctic range from 180 to 315 kg (males 270 to 315 kg, females 180 to 225 kg) (CWS and CWF 1990a). For the food chain model, the lower end of the body weight range was conservatively used (180 kg).

In the summer, their diet includes grasses, leafy plants, sedges, mosses, shrubs, herbs, and any other vegetation available. In the winter, the diet of muskoxen changes to willow, dwarf birch stems, roots, mosses, and lichen (Elder and Olson 2005). Home ranges for muskoxen in Alaska are reported to be very large in the summer, averaging 22,300 ha, but are much smaller in the winter and calving seasons, ranging from 2,700 to 7,000 ha (Elder and Olson 2005). Females typically live 15 to 18 years and males typically only live 10 to 12 years (Elder and Olson 2005).

III.1.4 SMALL CARNIVORE

A generic receptor was created using the three small carnivore mammals found in the region (i.e., ermine, mink and marten). The body mass was assessed using an lowest for the three receptors (0.025 kg: ermine).

III.1.4.1 Ermine

Ermine (*Mustela erminea*), or short-tailed weasel, weigh from 0.025 to 1.16 kg (males 0.067 to 1.16 kg and females from 0.025 to 0.080 kg) (Loso 1999). Ermine prefer riparian woodlands, marshes, shrubby fencerows, and open areas adjacent to forests or shrub borders (Loso 1999). Ermine home ranges vary from approximately 10 to 20 ha; home ranges of males are usually twice the size of those of females (Loso 1999). Ermine are ferocious hunters that specialize in small mammals (Loso 1999), preferably those of rabbit size and smaller. When mammalian prey are scarce, ermine may eat birds, eggs, frogs, fish, and insects (Loso 1999). The average lifespan is one to two years with a maximum lifespan of seven years (Loso 1999).

III.1.4.2 Mink

The mink (*Mustela vison*) weighs ranges from 0.7 to 1.6 kg (Schlimme 2003). It is a small member of the weasel family and is the most abundant and widely distributed carnivorous mammal in North America (U.S. EPA 1993). Mink are active year-round and tend to frequent forested areas that are in close proximity to water (Schlimme 2003). Home ranges vary considerably but are in the range of 8 to 380 ha (U.S. EPA 1993). Diet varies based on season but generally consists of small mammals, fish, amphibians, and crustaceans, as well as birds, reptiles, and insects (U.S. EPA 1993). The lifespan of the mink is approximately ten years (Schlimme 2003).

III.1.4.3 Marten

The marten (*Martes americana*), weighs approximately 0.8 kg (males 1.0 kg; females 0.65 kg) (CWS and CWF 1986). It is a small member of the weasel family. Martens prefer old growth coniferous or mixed woods forest, although they may seek food in some open areas. However, the amount of undisturbed forest is continually diminishing, and new-growth forests do not support as many marten (CWS and CWF 1986). Home range areas vary from 250 to 1,500 ha for males and 150 to 500 ha for females (NWT ENR 2010b). Red-backed voles and deer mice are staple food sources all year round. Marten eat snowshoe hares, particularly in winter when they are easier to catch. They eat bird eggs and insects in summer, berries in late summer, and will also eat squirrels, birds, shrews, and carrion (CWS and CWF 1986, NWT ENR 2010b). Marten have been found to live up to 14 years in the NWT, but in reality few live more than five years in the wild (NWT ENR 2010b).

III.1.5 MEDIUM CARNIVORE

Medium carnivores were identified as a subject of note for the Project (De Beers 2010, Section 11.10). Because they are of similar size and occupy a similar feeding niche, a generic receptor was created using the three medium carnivore mammals found in the region (i.e., wolverine, red fox and arctic fox). The body mass was assessed using the lowest for the three receptors (2.5 kg: Arctic fox).

III.1.5.1 Wolverine

The wolverine (*Gulo gulo*) is the largest member of the weasel family (Mustelidae) with an average weight of 12.5 kg (males 12 to 18 kg; females 8 to 12 kg) (CWS and CWF 2001). Wolverines in Canada are found in northern boreal forest and tundra (NWT ENR 2010c). The home range of an adult wolverine extends from less than 100 km^2 for females to over 1,000 km^2 for males (CWS and CWF 2001). These home ranges are the largest reported for a carnivore of this size. Home range varies depending on the availability of food and how it is distributed across the landscape; the more food there is, the smaller the home range needs to be (CWS and CWF 2001).

The greatest threats to the wolverine are hunting and human encroachment on their habitat, which has led to their "Special Concern" designation by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) (NWT ENR 2010c; COSEWIC 2003). Wolverines have been observed to live up to 17 years in captivity, but they generally succumb after 8 to 10 years in the wild (Weinstein et al. 1999). Wolverines are scavengers rather than hunters, and are usually dependent on other carnivores, such as wolves, to kill the animals for them to eat. Because of its great dependence on carrion from large mammal kills, the wolverine needs to be able to survive long periods without food. It will revisit old kills to consume frozen bones and pelts when it cannot find other food (CWS and CWF 2001). Wolverines also feed on small mammals, ptarmigan, fish, roots and berries (NWT ENR 2010c).

III.1.5.2 Red Fox

The red fox (*Vulpes vulpes*), weighs between 3.6 and 6.8 kg and is found throughout Canada (CWS and CWF 1993). Red foxes use a wide range of habitats including forest, tundra, prairie, and farmland (Fox 2003). Foxes are active year-round and prey heavily on small mammals such as voles, mice, and rabbits, and will also consume birds, insects, fruits, berries, and nuts; they are also noted scavengers (U.S. EPA 1993). Individual adults have home ranges that vary in size depending on the quality of the habitat. In high quality habitats, ranges may be between 500 and 1,200 ha; in poorer habitats ranges are larger, between 2,000 and 5,000 ha (Fox 2003). The lifespan of the red fox is 7 to 12 years in the wild (Carey and Judge 2002).

III.1.5.3 Arctic Fox

The Arctic fox (*Alopex lagopus*) is a relatively small mammal, weighing between 2.5 and 9.0 kg (CWS and CWF 1990c). It is distributed widely throughout the Arctic (Angerbjörn et al. 2004). The Arctic fox is active year-round and is an opportunistic predator and scavenger, feeding primarily on rodents throughout the year (Angerbjörn et al. 2004), as well as consuming birds, eggs, ground squirrels, and berries during the summer (CWS and CWF 1990b). They cache food in the summer and will also eat meat cached by Inuit hunters, and scavenge from wolf kills (CWS and CWF 1990c). Individuals that inhabit coastal regions also have access to inland prey and sea birds, seal carcasses, fish and invertebrates connected to the marine environment (Angerbjörn et al. 2004). Home ranges are approximately 457 ha (females) to 1,022 ha (males) in size (Anthony 1997). The average lifespan for animals that reach adulthood is 3 years with the oldest recorded individuals living 11 years (Angerbjörn et al. 2004)

III.1.6 LARGE CARNIVORE

III.1.6.1 Wolf

The wolf was identified as a subject of note for the Project (De Beers 2010, Section 11.10).

The gray wolf or timber wolf (*Canis lupus*) is a large carnivore. The body weight of males in the NWT ranges from 35 to 40 kg and for females 30 to 35 kg (NWT ENR 2010d). For the food chain model, the low end of the range for females was conservatively used (30 kg). This species occupies wilderness and remote area in Canada, Alaska and the northern USA (Mech and Boitani 2004). In Alaska the individual home range varies from 500 to 1,200 ha (NWT ENR 2010d). NWT ENR (2010d) distinguish three subpopulations or subspecies of wolf, based on behaviour and distribution, as inhabiting NWT: timber wolves[1], tundra wolves[2] and arctic wolves[3]. In the NWT, tundra wolves are a subpopulation of the gray wolf that migrate above and below the treeline, do not maintain regular territories and depend largely on barren-ground caribou. This is the subpopulation most likely to inhabit the Gahcho Kué region. In the central Northwest Territories, wolf winter range may be defined by the distribution of caribou (NWT ENR 2010d). In the NWT, wolves hunt both caribou and muskoxen. Depending on the area and time of year, a wolf's diet may also include hares, foxes, small rodents, beaver, muskrat, birds, fish, eggs or even small quantities of grass and other vegetable matter (NWT ENR 2010d). Gray wolves have been observed to live up to thirteen years in the wild, although the average lifespan is 5 to 6 years (Dewey and Smith 2002).

III.1.7 SMALL INSECTIVORE

III.1.7.1 Masked Shrew

The masked shrew (*Sorex cinereus*) weighs 2.5 to 4 g and is the most widely distributed shrew in North America; it is found throughout most of Canada (Lee 2001). It is common in moist environments and is found in open and closed forests, meadows, riverbanks, lakeshores, and willow thickets (Lee 2001). The average home range is 0.6 ha (Lee 2001). The masked shrew does not hibernate and feeds year-round on insects (NWF 2003; Lee 2001). In general, the diet includes insect larvae, ants, beetles, crickets, grasshoppers, spiders, harvestmen, centipedes, slugs, and snails, but they will also consume seeds and fungi (Lee 2001). The expected lifespan in the wild is two years (Lee 2001).

III.1.8 SMALL OMNIVORE

III.1.8.1 Deer Mouse

The deer mouse (*Peromyscus maniculatus*) derives its name from its bicoloured coat, rufous above and white below, which resembles the coat of a deer (Banfield 1974). Deer mice are found in a wide variety of habitats including grasslands, mixed vegetation, and woods (NWT ENR 2005). The body weight of a deer mouse ranges from 10 to 30 g (NWT ENR 2005); the lower end of the range was

[1] In NWT, timber wolves are a subpopulation of gray wolf that lives below the treeline.

[2] "Tundra wolves" in NWT do not appear to be the same subspecies as the tundra wolf (*Canus lupus albus*) which inhabits high latitude regions of Europe and Russia.

[3] Arctic wolves inhabit the Arctic islands. NWT ENR (2010) does not indicate whether these are a subpopulation of the gray wolf, or the subspecies *Canis lupus arctos*.

used for the food chain model. The diet of deer mice consists of grasses, leaves, fruit, insects, and nestling birds and eggs (Eder and Pattie 2001). The deer mouse plays an important role in the food web, providing a staple food supply to many carnivores (Banfied 1974).

III.1.9 LARGE OMNIVORE

III.1.9.1 Grizzly Bear

Large and medium carnivores including the grizzly bear were identified as a subject of note for the Project (De Beers 2010, Section 11.10).

The grizzly bear (*Ursus arctos*) is the second largest land carnivore in North America (next to the polar bear), with males weighing approximately 250 to 350 kg and females about half that weight (CWS and CWF 1990b). A body mass for a female grizzly bear (125 kg) was conservatively used for the food web model. Grizzlies occupy a variety of habitats, but the main requirement is an area with densely-covered daytime shelter (Dewey and Ballenger 2002). Although not a true hibernator, the grizzly bear enters its den around mid-November and emerges in March to early May (CWS and CWF 1990b). Home ranges vary by gender and family status. The average range of single males (7,250 km^2) is larger than that of both single females (2,000 km^2) and females with accompanying young (2,239 km^2) (McLoughlin et al. 2003). In the arctic, the grizzly bear diet changes based on the time of year. In spring and autumn the majority of their diet consists of caribou and arctic ground squirrel, whereas in the early and mid summer horsetails and sedges are prevalent, and in the late summer berries become prevalent (Gau et al. 2002). Although hunted, the greatest threat to grizzly bears is human encroachment on their habitat, which has led to their "Special Concern" designation by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) (CWS and CWF 1990c; COSEWIC 2002). Grizzlies have been known to live up to 25 to 30 years in the wild (Carey and Judge 2002).

III.2 AVIAN RECEPTORS

Birds and species at risk were identified as a subject of note for the project (De Beers 2010, Section 11.12). Given the large number of resident and migratory bird species in the regional study area, it was not considered practical to assess each bird species individually. Generic receptors were developed following the "clumping" principle of Holling (1992) to allow the food web simulation to represent the study area ecology. Table III.2-1 provides a summary of the body weight and feeding preferences of the composite receptors.

Table III.2-1 Summary of Body Weights and Diet for Avian Receptors used in the Food Chain Model

Class	Generic Receptor	Species Components	BW[(a)] [g]	Diet
Upland	Small upland insectivore	American Tree Sparrow, Least Sandpiper, Savannah Sparrow, Yellow Warbler, Yellow-rumped Warbler, Pectoral Sandpiper, Semipalmated Plover, Lesser yellowlegs	9	34% terrestrial invertebrates 66% aquatic invertebrates
	Medium upland carnivore	Long-tailed Jaeger	280	100% small mammal herbivores
	Large upland carnivore	Herring Gull	1,050	80% fish 20% aquatic invertebrates
	Small upland herbivore	Hoary Redpoll	11	80% grasses 20% berries
	Medium upland herbivore	Willow Ptarmigan	430	100% leaves
	Small upland omnivore	Blackpoll Warbler, Gray-cheeked Thrush, Harris's Sparrow, Horned Lark, Lapland Longspur, Rusty Blackbird, White-Crowned Sparrow, American Pipit, American Robin, Lincoln's Sparrow, Smith's Longspur, Stilt Sandpiper Semipalmated Sandpiper, Yellow Rail	7	39% berries 39% leaves 22% terrestrial invertebrates
	Medium upland omnivore	American Golden Plover, Common Snipe	90	60% aquatic invertebrates 30% terrestrial invertebrates 10% grasses
Waterbirds	Small insectivore waterbirds	Red-necked-Phalarope, Black Tern	32	100% aquatic invertebrates

Table III.2-1 Summary of Body Weights and Diet for Avian Receptors used in the Food Chain Model (continued)

Class	Generic Receptor	Species Components	BW[(a)] [g]	Diet
	Medium-sized carnivorous waterbirds	Horned Grebe, White-winged Scoter, Long-tailed Duck, Common Merganser, Red-breasted Merganser, Pacific loon, Red-Throated Loon; Caspian Tern, Hudsonian godwit, American bittern, Pied-Billed Grebe	196	80% fish 20% aquatic invertebrates
	Large carnivorous waterbirds	Common Loon, Yellow-billed Loon	2,200	100% fish
	Medium herbivorous waterbirds	Snow Goose, Greater White-fronted Goose, Canada Goose	950	50% leaves 50% grasses
	Large herbivorous waterbirds	Tundra Swan	3,800	100% grasses
	Medium omnivorous waterbirds	Northern Pintail, Green-winged Teal, Greater Scaup, Lesser Scaup, Surf Scoter, Black Scoter, Mallard, Redheaded Duck	210	17% terrestrial invertebrates 20% aquatic invertebrates 63% grasses
Raptors	Hawks and Owls	Snowy Owl, Rough-legged Hawk, Short-eared Owl, Raven, Northern Hawk Owl, Northern Harrier	206	25% shrews 25% small herbivore 10% amphibians [(b)] 40% terrestrial invertebrates
	Eagles	bald eagle and golden eagle	2,495	25% small herbivore 25% medium herbivore 50% fish

(a) Within each receptor group, the bird with the lowest body weight was used for modelling and is presented in this table. For each bird species the lowest value in the range of body weights was used.

(b) In the model, amphibians were assumed to be the same as fish, due to limited data for amphibians.

Generic avian receptors were created using the wildlife baseline data found in Annex F Wildlife Baseline (De Beers 2010). Birds were separated into three classes: Upland breeding birds (De Beers 2010, Annex F, Table F10.1-2), waterbirds (De Beers 2010, Annex F, Table F12.2-2) and raptors (De Beers 2010, Annex F, Table F11.1-2). The three classes were further separated by diet (carnivorous, herbivorous, and omnivorous) and body mass. The body mass of the smallest bird within each class was used in the model.

III.2.1 UPLAND BREEDING BIRDS

Upland birds were classified into three trophic groups:, insectivore/carnivores, herbivores, and omnivores.

III.2.1.1 Carnivorous Upland birds

Body weights and diets of ten upland insectivore/carnivorous species (Table III.2-2) were used to develop generic characteristics for this group. The yellow warbler was used as a generic receptor for small upland insectivore. The long-tailed jaeger was used as the generic receptor for a medium sized upland carnivore and the herring gull was used for the generic receptor of a large sized carnivore.

Table III.2-2 Body Size and Diet of Insectivorous/Carnivorous Upland Bird Species

Common Name [(a)]	Mass [(a)] [g]	Dietary Description [(b)]
Yellow Warbler	9	Insects, arthropods
Yellow-rumped Warbler	12	Insects
American Tree Sparrow	18	Insects
Savannah Sparrow	18	Insects
Least Sandpiper	19	Small amphipods
Pectoral Sandpiper	52	Arthropods
Semipalmated Plover	47	Aquatic invertebrates
Lesser Yellowlegs	67	Aquatic invertebrates
Long-tailed Jaeger	280	Lemmings
Herring Gull	1050	Fish and aquatic invertebrates

Note: Row shading – Small, Medium, Large upland carnivorous bird species.

(a) These data were taken from Table F10.1-2.

(b) Mass and diet data were obtained from The Birds of North America Online (http://bna.birds.cornell.edu/bna, Cornell Lab of Ornithology 2010) and the NatureServe Explorer (http://www.natureserve.org/explorer/index.htm; NatureServe.org 2010).

III.2.1.2 Herbivorous Upland Birds

The herbivorous upland birds only had two observed species, the hoary redpoll and the willow ptarmigan. These were treated as the generic receptors for the small and medium sized receptors, respectively (Table III.2-3).

Table III.2-3 Body Size, Diet, and Occurrence of Herbivorous Upland Bird Species

Common Name[(a)]	Mass[(b)] [g]	Dietary Description[(b)]
Hoary Redpoll	11	Seeds
Willow Ptarmigan	430	Willow buds, seeds

Note: Row shading – Small, Medium herbivorous upland bird species.

(a) These data were taken from Table F10.1-2.

(b) All mass and diet data were obtained from The Birds of North America Online (http://bna.birds.cornell.edu/bna, Cornell Lab of Ornithology 2010).

III.2.1.3 Omnivorous Upland Birds

Mass and dietary composition were compiled for 17 species of omnivorous upland birds (Table III.2-4). The boreal chickadee was used as a surrogate for small omnivorous upland birds and the common snipe for medium omnivorous uplands birds.

Table III.2-4 Body Size, Diet, and Occurrence of Omnivorous Upland Bird Species

Common Name[(a)]	Mass[(b)] [g]	Diet[(b)]		
		Dietary Description	Proportion Carnivorous Diet [%]	Proportion Vegetative Diet [%]
Boreal Chickadee	7	Seeds, terrestrial invertebrates	n/a	n/a
Blackpoll Warbler	10	Insects, fruit	95	5
Lincoln's Sparrow	17	Insects, arthropods, seeds	95	5
Smith's Longspur	20	Insects, seeds	10	90
American Pipit	20	Arthropods, seeds	95	5
Semipalmated Sandpiper	20	Aquatic invertebrates, seeds	90	10
Lapland Longspur	23	Seeds, invertebrates	4	96
White-crowned Sparrow	25	Seeds, grain, fruit	8	92
Gray-cheeked Thrush	26	Insects, fruit	75	25
Horned Lark	28	Insects, seeds	90	10
Harris' Sparrow	30	Insects, plants	34	66
Yellow Rail	41	Seeds, plants, terrestrial invertebrates	n/a	n/a
Stilt Sandpiper	50	Aquatic insects, seeds	95	5
Rusty Blackbird	55	Insects, plants	53	47
American Robin	77	Terrestrial invertebrates, fruit	42	58
Common Snipe	90	Insects, seeds, plants	60	40
American Golden Plover	122	Invertebrates, seeds	90	10

Note: Row shading – Small, Medium omnivorous upland bird species.

(a) These data were taken from Table F10.1-2

(b) All mass and diet data were obtained from The Birds of North America Online (http://bna.birds.cornell.edu/bna, Cornell Lab of Ornithology 2010), and the NatureServe Explorer (http://www.natureserve.org/explorer/index.htm; NatureServe.org 2010).

III.2.2 WATERBIRDS

Waterbirds were separated into three groups – insectivores/carnivores, herbivores, and omnivores.

III.2.2.1 Insectivorous/Carnivorous Waterbirds

Characteristics of 15 insectivous/carnivorous waterbird species were used in this evaluation (Table III.2-5). The red-necked phalarope, Hudsonian godwit, and common loon were used to represent small, medium, and large waterbirds respectively.

Table III.2-5 Body Size and Diet of Carnivorous Waterbird Species

Common Name[a]	Mass[b] [g]	Dietary Description[b]
Red-necked Phalarope	32	Aquatic insects
Black Tern	50	Fish and aquatic invertebrates
Hudsonian Godwit	196	Aquatic and benthic invertebrates
Pied-Billed Grebe	253	Fish and aquatic invertebrates
Horned Grebe	300	Aquatic arthropods
American Bittern	370	Fish and aquatic invertebrates
Caspian Tern	530	Fish and aquatic invertebrates
Long-tailed Duck	700	Insects
Red-breasted Merganser	800	Fish and aquatic invertebrates
White-winged Scoter	950	Crustaceans insects
Pacific Loon	1000	Fish and aquatic invertebrates
Red-throated Loon	1000	Fish and aquatic invertebrates
Common Merganser	1230	Small fish and insects
Common Loon	2200	Fish
Yellow-billed Loon	4000	Fish

Note: Row shading – Small, Medium, Large carnivorous waterbirds.

(a) These data were taken from Annex F, Table F12.2-2 (De Beers 2010).

(b) All mass and diet data were obtained from The Birds of North America Online (http://bna.birds.cornell.edu/bna, Cornell Lab of Ornithology 2010).

III.2.2.2 Herbivorous Waterbirds

Herbivorous waterbirds were separated into two groups: medium and large herbivorous waterbirds.

Table III.2-6 Body Size and Diet of Herbivorous Waterbird Species

Common Name[a]	Mass[b] [g]	Dietary Description[b]
Canada Goose	950	Grasses, willow, rhizomes
Snow Goose	1600	Grasses, willow, rhizomes
Greater White-fronted Goose	1800	Grasses, willow, rhizomes
Tundra Swan	3800	Seeds , stems, roots

Note: Row shading – Medium, Large herbivorous waterbird.

(a) These data were taken from Annex F, Table F12.2-2 (De Beers 2010)

(b) All mass and diet data were obtained from The Birds of North America Online (http://bna.birds.cornell.edu/bna, Cornell Lab of Ornithology 2010.

III.2.2.3 Omnivorous Waterbirds

Eight species of omnivorous waterbirds (Table III.2-7) were arrayed in terms of body mass (Figure III.2-8). Due to broad similarity in size across numerous waterbird species, a single group of medium-sized omnivorous waterbirds were characterized for the exposure models. The green-winged teal was conservatively used to represent medium omnivorous waterbirds.

Table III.2-7 Body Size and Diet of Omnivorous Waterbird Species

Common Name[a]	Mass[b] [g]	Diet[b]		
		Dietary Description	Proportion Carnivorous Diet [%]	Proportion Vegetative Diet [%]
Green-winged Teal	210	Seeds, stems, roots, aquatic insects	10	90
Greater Scaup	595	Seeds, stems, roots, aquatic insects	50	50
Lesser Scaup	627	Aquatic invertebrates, seeds	75	25
Redhead	630	Seeds, stems, roots, aquatic insects	70	30
Northern Pintail	715	Seeds, stems, roots, aquatic insects	30	70
Surf Scoter	859	Aquatic invertebrates, seeds, roots	90	10
Black Scoter	800	Crustaceans, insects, roots	90	10
Mallard	1037	Seeds, stems, roots, aquatic insects	18	82

Notes: Row shading – Medium omnivorous waterbird.

(a) These data were taken from Annex F, Table F12.2-2 (De Beers 2010).

(b) All mass and diet data were obtained from The Birds of North America Online (http://bna.birds.cornell.edu/bna, Cornell Lab of Ornithology 2010).

III.2.3 RAPTORS

The generic receptors were handled in a different manner because they all occur at a high trophic level and have different dietary patterns. Generic receptors were created for three groups - falcons, hawks and owls, and eagles. This approach grouped organisms that feed at similar rates and on similar items (Table III.2-8). The merlin was used as a surrogate for falcons, the short-eared owl as a surrogate for owls and hawks, and the golden eagle as a surrogate for eagles.

Table III.2-8 Body Size and Diet of Raptor Species

Common Name[a]	Mass[b] [g]	Dietary Description[b]
Merlin	152	Small birds
Gyrfalcon	250	Birds ranging in size
Peregrine Falcon	528	Birds ranging in size
Short-eared Owl	206	Small mammals
Northern Hawk Owl	242	Small mammals
Northern Harrier	290	Small mammals, reptiles, amphibians, small water birds
Raven	689	Mammals (41), birds (38), insects
Rough-legged Hawk	822	Voles, lemmings
Snowy Owl	1606	Small mammals, waterbird
Golden Eagle	2495	Hares and rabbits (90), birds (10
Bald Eagle	3680	Fish (56), birds (28), mammals (16)

Note: Row shading – Falcons, Hawks and Owls, Eagles.

[a] These data were taken from Annex F, Table F11.1-2 (De Beers 2010).

[b] All mass and diet data were obtained from The Birds of North America Online (http://bna.birds.cornell.edu/bna, Cornell Lab of Ornithology 2010).

III.3 REFERENCES

Angerbjörn, A., P. Hersteinsson, and M. Tannerfeldt. 2004. Arctic fox (*Alopex lagopus*). Pp 117-123 in: DW Macdonald and C Sillero-Zubiri (eds.). *Canids: Foxes, Wolves, Jackals and Dogs – Status Survey and Conservation Action Plan.* IUCN, Gland.

Anthony, R.M. 1997. Home ranges and movements of arctic fox (*Alopex lagopus*) in western Alaska. Arctic 50:147–157.

Banfield, A.W.F. 1974. The Mammals of Canada. University of Toronto Press, Toronto, Ontario.

Brensike, J. 2000. "*Spermophilus parryii*" (On-line), Animal Diversity Web. Available at: http://animaldiversity.ummz.umich.edu/site/accounts/information/Spermophilus_parryii.html. Accessed August, 2007

Carey, J., D. Judge. 2002. *Longevity Records: Life Spans of Mammals, Birds, Amphibians, Reptiles, and Fish* (On-line). Max Planck Institute for Demographic Research. Available at: http://www.demogr.mpg.de/. Accessed August 2007.

Case, R., L. Buckland and M. Williams. 1996. *The Status and Management of the Bathurst Caribou Herd, Northwest Territories, Canada*. Department of Renewable Resources, GNWT, Yellowknife, NWT.

Cornell Lab of Ornithology. 2010. *The Birds of North America Online*. Available at: http://bna.birds.cornell.edu/bna, Cornell Lab of Ornithology and the American Ornithologists' Union.

COSEWIC (Committee on the Status of Endangered Wildlife in Canada). 2002. *COSEWIC assessment and update status report on the Grizzly Bear Ursus arctos in Canada*. Committee on the Status of Endangered Wildlife in Canada. Ottawa, ON.

COSEWIC. 2003. *COSEWIC assessment and update status report on the Wolverine Gulo gulo in Canada*. Committee on the Status of Endangered Wildlife in Canada. Ottawa, ON.

CWS and CWF (Canadian Wildlife Service and Canadian Wildlife Federation). 1986. *Hinterland Who's Who: Marten*. Available athttp://www.hww.ca/hww2.asp?id=92 AccessedNovember 2010.

CWS and CWF. 1990a. *Hinterland Who's Who: Muskox*. Available at: http://www.hww.ca/hww2.asp?id=95 Accessed November 2010.

CWS and CWF. 1990b. *Hinterland Who's Who: Arctic Fox*. Available at http://www.hww.ca/hww2.asp?id=81. AccessedNovember 2010.

CWS and CWF. 1990c. *Hinterland Who's Who: Grizzly Bear*. Available at: http://www.hww.ca/hww2.asp?id=90. AccessedNovember 2010.

CWS and CWF. 1993. *Hinterland Who's Who: Red Fox*. Available at: http://www.hww.ca/hww2.asp?id=102. AccessedNovember 2010.

CWS and CWF. 1994. *Hinterland Who's Who: Collared Lemming*. Available at http://www.hww.ca/hww2.asp?id=91. AccessedNovember 2010.

CWS and CWF. 2001. Hinterland *Who's Who: Wolverin*e. Available at: http://ffdp.ca/hww2.asp?id=108#top . AccessedNovember 2010.

CWS and CWF. 2005a. *Hinterland Who's Who: Snowshoe Hare*. Available at http://www.hww.ca/hww2.asp?id=103 Accessed November 2010 .

CWS and CWF. 2005b. *Hinterland Who's Who: Caribou*. Available at: http://www.hww.ca/hww2.asp?id=85 AccessedNovember 2010.

De Beers (De Beers Canada Inc.). 2010. *Environmental Impact Statement for the Gahcho Kué Project*. Volumes 1, 2, 3a, 3b, 4, 5, 6a, 6b, 7 and Annexes A through N. Submitted to Mackenzie Valley Environmental Impact Review Board. December 2010.

Dewey, T. and J. Smith. 2002. *Canis lupus* (On-line), Animal Diversity Web. Available at: http://animaldiversity.ummz.umich.edu/site/accounts/information/Canis_lupus.html. Accessed November 2010

Dewey, T. and L. Ballenger. 2002. *Ursus arctos* (On-line), Animal Diversity Web. Available at: http://animaldiversity.ummz.umich.edu/site/accounts/information/Ursus_arctos.html. AccessedNovmeber 2010.

Eder T. And D. Pattie. 2001. Mammals of British Columbia. Lone Pine Publishing, Vancouver, British Columbia.

Elder, S., Mammology and L. Olson. 2005. *Ovibos moschatus*. (On-line), Animal Diversity Web. Available at http://animaldiversity.ummz.umich.edu/site/accounts/information/Ovibos_moschatus.html. Accessed August 2007.

Fox, D. 2003. *Vulpes vulpes*. (On-line), Animal Diversity Web. Available at: http://animaldiversity.ummz.umich.edu/site/accounts/information/Vulpes_vulpes.html. Accessed August 2007.

Gau, R.J., R. Case, D.F. Penner, and P.D. McLoughlin. 2002. Feeding patterns of barren-ground grizzly bears in the central Canadian Arctic. *Arctic* 55:339-344.

Gorog, A. 2003. *Lepus arcticus* (On-line), Animal Diversity Web. Available at http://animaldiversity.ummz.umich.edu/site/accounts/information/Lepus_arcticus.html. AccessedNovember 2010.

Holling, C.S. 1992. Cross-scale morphology, geometry, and dynamics of ecosystems. *Ecological Monographs 6*2(4):447-502.

Hopkins, B. 2006. Arctic ground squirrel. Blue Planet Biomes. Available at: http://www.blueplanetbiomes.org/arctic_ground_squirrel.htm. Accessed August 2007.

Lacey, E. and J.R. Wieczorek. 2001. Territoriality and male reproductive success in arctic ground squirrels. *Behavioral Ecology* 12(5):626-632.

Lee, W. 2001. *Sorex cinereus* (On-line), Animal Diversity Web Available at http://animaldiversity.ummz.umich.edu/site/accounts/information/Sorex_cinereus.html. Accessed August 2007

Loso, H. 1999. "Mustela erminea" (On-line), Animal Diversity Web. Available at http://animaldiversity.ummz.umich.edu/site/accounts/information/Mustela_erminea.html. Accessed August, 2007.

MacDonald, C., and A. Gunn. 2004. *Analysis of the ash weight and elemental composition in caribou (Rangifer tarandus) faecal pellets collected at Colomac and other sites in the NWT*. Manuscript Report No. 159. Department of Resources, Wildlife and Economic Development. Government of Northwest Territories. Yellowknife, NWT.

McLoughlin P.D., M.K. Taylor, H.D. Cluff , R.J. Gau, R. Mulders, R.L. Case, S. Boutin, and F. Messier. 2003. Demography of barren-ground grizzly bears. *Can. J. Zool.* 81:294-301

Mech L.D. and L. Boitani. 2004. Grey Wolf (*Canis lupus*). Pp 124-129 in: DW Macdonald and C Sillero-Zub*iri (eds.).* Canids: Foxes, Wolves, Jackals and Dogs – Status Survey and Conservation Action Plan. IUCN, Gland.

NatureServe.org. 2008. *NatureServe Explorer*. Available at http://www.natureserve.org/explorer/index.htm. Accessed August 2008.

Neuburger, T. 1999. *Microtus pennsylvanicus* (On-line), Animal Diversity Web. Available at http://animaldiversity.ummz.umich.edu/site/accounts/information/Microtus_pennsylvanicus.html. Accessed November 2010.

NWF (National Wildlife Federation). 2003. eNature. Available at: http://www.enature.com/fieldguides/detail.asp?allSpecies=yandsearchText=masked%20shrewandcurGroupID=5andlgfromWhere=andcurPageNum=1. Accessed August 2007.

NWT ENR (Northwest Territories Ministry of Environment and Natural Resources), Wildlife Division 2005. NWT Small Mammal Identification. Department of Environment and Natural Resources, August 2001 (updated 2005).

NWT ENR, Wildlife Division 2010a. *Caribou*. Available at: http://www.enr.gov.nt.ca/_live/pages/wpPages/caribou_information.aspx. Accessed November 2010.

NWT ENR, Wildlife Division 2010b. “Marten”. Available at http://www.enr.gov.nt.ca/_live/pages/wpPages/Marten.aspx. AccessedNovember 2010.

NWT ENR, Wildlife Division 2010c. *Wolverine.* Available at: http://www.enr.gov.nt.ca/_live/pages/wpPages/Wolverine.aspxAccessedNovember 2010.

NWT ENR, Wildlife Division 2010d. *Wolf.* Available at:http://www.enr.gov.nt.ca/_live/pages/wpPages/Wolves.aspx AccessedNovember 2010.

Predavec, M. and C.J. Krebs. 2000. Microhabitat utilization, home ranges, and movement patterns of the collared lemming (*Dicrostonyx groenlandicus*) in the central Canadian Arctic. *Can. J. Zool.* 78:1885-1890.

Schlimme, K. 2003. *Neovison vison* (On-line), Animal Diversity Web. Available at http://animaldiversity.ummz.umich.edu/site/accounts/information/Neovison_vison.html. Accessed November 2010.

Shefferly, N. and K. Joly. 2000. *Rangifer tarandus* (On-line), Animal Diversity Web. Available at http://animaldiversity.ummz.umich.edu/site/accounts/information/Rangifer_tarandus.html. Accessed August 2007.

U.S. EPA (U.S. Environmental Protection Agency). 1993. *Wildlife Exposure Factors Handbook.* Office of Health and Environmental Assessment, Office of Research and Development. Washington, D.C. December 1993.

Weinstein, B., L. Ballenger and M. Sygo. 1999. *Gulo gulo* (On-line), Animal Diversity Web. Available at: http://animaldiversity.ummz.umich.edu/site/accounts/information/Gulo_gulo.html. Accessed August 2007.

APPENDIX IV

EXPOSURE CONCENTRATIONS AND BIOACCUMULATION FACTORS

This appendix provides the bioaccumulation/bioconcentration factors, exposure concentrations and deposition rates used in the wildlife ecological food web model. Bioaccumulation and bioconcentration factors for applicable biota and media are provided in Tables IV-1 to IV-6. Exposure concentrations used in the food web model are provided in Tables IV-7 to IV-15. Deposition rates are provided in Tables IV-16.

Table IV-1 Wet Weight BAFs for the Water to Fish Pathway

COC	BAF (wet weight)
Arsenic	417
Cadmium	237
Chromium	78
Copper	839
Iron	150
Manganese	29
Nickel	232
Selenium	3,000
Uranium	270
Zinc	379

Notes: Fish tissue BAFs were derived in the Section 8 and 9 of the 2012 EIS Supplement (De Beers 2012). Predicted fish tissue concentrations were converted to dry weight assuming moisture content of 76%.
COC = contaminant of concern; BAF = bioaccumulation factor.
All units in L water/kg fish.

Table IV-2 Wet Weight BAFs for the Water to Aquatic Invertebrate Pathway

COC	Source	BAF (wet weight)
Arsenic	U.S. EPA 1999 (Table C-3)	73
Cadmium	U.S. EPA 1999 (Table C-3)	3,461
Chromium	U.S. EPA 1999 (Table C-3)	3,000
Copper	U.S. EPA 1999 (Table C-3)	3,718
Iron	U.S. EPA 1999 (Table C-3)	4,066
Manganese	U.S. EPA 1999 (Table C-3)	4,066
Nickel	U.S. EPA 1999 (Table C-3)	28
Selenium	U.S. EPA 1999 (Table C-3)	1,262
Uranium	U.S. EPA 1999 (Table C-3)	270
Zinc	U.S. EPA 1999 (Table C-3)	4,578

Notes: Predicted invertebrate tissue concentrations for these COCs were converted to dry weight assuming moisture content of 82.5%.
U.S. EPA (1999) recommends using the value 4066 for all metal parameters based on the arithmetic mean of antimony, arsenic, barium, cadmium, chromium, copper, lead, nickel, selenium, mercury, thallium and zinc.
COC = contaminant of concern; BAF = bioaccumulation factor
All units in L water / kg invertebrate

Table IV-3 Dry Weight BAFs for the Soil to Soil Invertebrate Pathway

COC	Source	BAF (dry weight)
Arsenic	U.S. EPA ECOSSL 2007	0.19
Cadmium	U.S. EPA ECOSSL 2007	11.5
Chromium	U.S. EPA ECOSSL 2007	0.306
Copper	U.S. EPA ECOSSL 2007	0.515
Iron	U.S. EPA 1999 (Table C-1)	0.22
Manganese	U.S. EPA ECOSSL 2007	0.0135
Nickel	U.S. EPA 1999 (Table C-1)	0.02
Selenium	U.S. EPA ECOSSL 2007	1.34
Uranium	ORNL 1996	0.063
Zinc	U.S. EPA ECOSSL 2007	7.55

Notes: U.S. EPA (1999) recommends using the value 0.22 for all metals based on the arithmetic mean of arsenic, cadmium, chromium, copper, lead, inorganic mercury, nickel, and zinc. Where values were not found from ECOSSL (2007) or U.S. EPA (1999), the default 0.22 was used.
COC = contaminant of concern; BAF = bioaccumulation factor
All units in kg soil / kg invertebrate

Table IV-4 Biotransfer Factors Used for Ungulates in the Food Web Model (RAIS 2012)

COC	BTF [day/kg bw dry weight]
Arsenic	0.002
Cadmium	0.00055
Chromium	0.0055
Copper	0.01
Iron	0.02
Manganese	0.0004
Nickel	0.006
Selenium	0.015
Uranium	0.0002
Zinc	0.1

Notes: COC = Contaminant of concern; BTF = biotransfer factor
Units in day per kg of body weight in dry weight.

Table IV-5 Dry Weight Bioaccumulation Factors for Soil to Small Mammals (U.S. EPA 2007)

COC	BAF soil to Mammal[c] [mg/kg dry weight]	BTF [day/kg bw dry weight]
Arsenic	0.00735[a]	-
Cadmium	0.6815[a]	-
Chromium	0.0968[a]	-
Copper	1.016[a]	-
Iron	NA	0.02[b]
Manganese	0.021[a]	-
Nickel	0.0834[a]	-
Selenium	1.566[a]	-
Uranium	NA	0.0002[b]
Zinc	4.642[a]	-

(a) ECO SSL BAF used (U.S. EPA 2007).

(b) RAIS cattle BTF used.

(c) BAF used when available, otherwise a BTF was used.

Notes: BTF – biotransfer factor (day per kg of body weight in dry weight); BAF – bioaccumulation factor (mg/kg dry weight); COC – contaminant of concern; NA – not available; "-" not used in risk assessment.

Source: Oak Ridge National Laboratory (ORNL 1996).

Table IV-6 Soil to Plant BAFs Used in the Food Web Model

COC	Lichen	Leaf	Berry	Sedges/Grasses/Forbs
Arsenic	0.625	0.095	0.105	0.105
Cadmium	1.284	0.824	0.239	0.259
Chromium	0.342	0.026	0.03	0.192
Copper	0.503	0.659	0.930	1.121
Iron	0.045	0.008	0.007	0.017
Manganese	1.56	5.01	3.14	2.641
Nickel	0.292	0.464	0.316	0.408
Selenium	4.545	4.545	4.55	4.76
Uranium	0.313	0.038	0.052	0.0515
Zinc	2.199	7.091	1.636	2.36

Notes: All units in kg soil/kg plant.

Table IV-7 Dry Weight Baseline Soil[a] Concentrations Used in Food Web Model

Parameter	Concentration [mg/kg dry weight]	Statistical Endpoint
Aluminum	6104	95% UCLM
Antimony	0.1	Detection Limit
Arsenic	1.436	95% UCLM
Barium	72.71	95% UCLM
Boron	10	90^{th} Percentile
Cadmium	0.191	95% UCLM
Chromium	26.8	95% UCLM
Cobalt[a]	4.108	95% UCLM
Copper	10.67	95% UCLM
Iron	8,810	95% UCLM
Lead	2.087	95% UCLM
Manganese	66.15	95% UCLM
Molybdenum	0.566	95% UCLM
Nickel	66.01	95% UCLM
Selenium	0.37	Maximum
Strontium	49	95% UCLM
Thallium	0.103	Maximum
Titanium	301.4	95% UCLM
Uranium	0.873	95% UCLM
Vanadium	12.86	95% UCLM
Zinc	20.94	95% UCLM

(a) See Tables IV-14 and -15 for granite and kimberlite concentrations for the acute caribou binge exposure scenario.

Notes: UCLM – upper confidence limit of the mean.

Table IV-8 Dry Weight Baseline Leaf Concentrations Used in Food Web Model

Parameter	Concentration [mg/kg dry weight]	Statistical Endpoint
Arsenic	0.05[a]	Detection Limit
Cadmium	0.252	95% UCLM
Chromium	3.942	95% UCLM
Copper	6.368	95% UCLM
Iron	364	95% UCLM
Manganese	356.2	95% UCLM
Nickel	7.325	95% UCLM
Selenium	0.2	Maximum Detected Value
Uranium	0.09	Maximum
Zinc	124.7	95th Percentile UCLM

(a) All values for arsenic were less than the method detection limit (MDL), therefore the smallest MDL value was used.

Notes: UCLM – upper confidence limit of the mean; mg/kg = milligrams per kilogram; % = percent.

Table IV-9 Dry Weight Baseline Berry Concentrations Used in Food Web Model

Parameter	Concentration [mg/kg dry weight]	Statistical Endpoint
Arsenic	0.2	Maximum
Cadmium	0.253	95% UCLM
Chromium	1.648	95% UCLM
Copper	6.074	95% UCLM
Iron	313	95% UCLM
Manganese	367.2	95% UCLM
Nickel	4.304	95% UCLM
Selenium	0.2[(a)]	Detection Limit
Uranium	0.09	Maximum
Zinc	43.03	95% UCLM

(a) All values for selenium were less than the MDL, therefore the smallest MDL value was used;

Notes: UCLM – upper confidence limit of the mean; mg/kg = milligrams per kilogram; % = percent.

Table IV-10 Dry Weight Baseline Sedges/Grasses/Forbs Concentrations used in Food Web Model

Parameter	Concentration [mg/kg dry weight]	Statistical Endpoint
Arsenic	0.082[(a)]	Detection Limit
Cadmium	0.17	Maximum
Chromium	3.494	95% UCLM
Copper	6.881	95% UCLM
Iron	256.1	95% UCLM
Manganese	199.6	95% UCLM
Nickel	4.281	95% UCLM
Selenium	0.6	Maximum Detected Value
Uranium	0.145	Maximum Detected Value
Zinc	51.42	95% UCLM

(a) All values for arsenic were less than the method detection limit (MDL), therefore the smallest MDL value was used.

Notes: UCLM – upper confidence limit of the mean; mg/kg = milligrams per kilogram; % = percent.

Table IV-11 Dry Weight Baseline Lichen Concentrations Used in Food Web Model

Parameter	Concentration [mg/kg dry weight]	Statistical Endpoint
Arsenic	0.334	95% UCLM
Cadmium	0.0718	95% UCLM
Chromium	6.151	95% UCLM
Copper	2.697	95% UCLM
Iron	487.2	95% UCLM
Manganese	105.1	95% UCLM
Nickel	4.45	95% UCLM
Selenium	0.6	Maximum Detected Value
Uranium	0.103	95% UCLM
Zinc	33.55	95% UCLM

Notes: UCLM – upper confidence limit of the mean; mg/kg = milligrams per kilogram; % = percent.

Table IV-12 Dry Weight Baseline Sediment Concentrations Used in Food Web Model

Parameter	Concentration [mg/kg dry weight]	Statistical Endpoint
Arsenic	5.794	95% UCLM
Cadmium	0.527	95% UCLM
Chromium	49.79	95% UCLM
Copper	58.58	95% UCLM
Iron	34,993	95% UCLM
Manganese	377.9	95% UCLM
Nickel	47.69	95% UCLM
Selenium	2.155	95% UCLM
Uranium	3.061	95% UCLM
Zinc	100.7	95% UCLM

Notes: UCLM – upper confidence limit of the mean; mg/kg = milligrams per kilogram; % = percent.

Table IV-13 Water Concentrations Used in Food Web Model

Parameter (Total Metals)	Baseline – Maximum Concentration in Lake N11/Lake 410 [mg/L]	Project – Maximum Concentration in Lake N11/Lake 410 [mg/L]
Arsenic	0.00012	0.00074
Cadmium	0.000019	0.000024
Chromium	0.00016	0.00038
Copper	0.0013	0.00147
Iron	0.06	0.088
Manganese	0.0057	0.0136
Nickel	0.00047	0.00122
Selenium	0.000032	0.000056
Uranium	0.000016	0.000372
Zinc	0.0024	0.00346

Note: mg/L = milligram per litre.

Table IV-14 Granite Wasterock Concentrations Used for Caribou Food Web Model (Acute Exposure Scenario)

Parameter	Concentration [mg/kg]	Statistical Endpoint
Aluminum	7,474	95% UCLM
Antimony	0.621	95% UCLM
Barium	64.83	95% UCLM
Boron	5.737	95% UCLM
Cadmium	0.115	95% UCLM
Chromium	77.34	95% UCLM
Cobalt	6.37	95% UCLM
Copper	13.63	95% UCLM
Iron	15,487	95% UCLM
Lead	13.53	95% UCLM
Molybdenum	6.634	95% UCLM
Nickel	24.75	95% UCLM
Selenium	0.25	90th Percentile
Strontium	15.16	95% UCLM
Thallium	24.93	95% UCLM
Titanium	0.0786	95% UCLM
Vanadium	25.25	95% UCLM
Zinc	53.71	95% UCLM

Notes: UCLM – upper confidence limit of the mean; mg/kg = milligram per kilogram; % = percent.

Table IV-15 Kimberlite Wasterock Concentrations Used for Caribou Food Web Model (Acute Exposure Scenario)

Parameter	Concentration [mg/kg]	Statistical Endpoint
Aluminum	18,544	95% UCLM
Antimony	0.1	90th Percentile
Barium	783.2	95% UCLM
Boron	183.4	95% UCLM
Cadmium	0.1	90th Percentile
Chromium	335.4	95% UCLM
Cobalt	57.69	95% UCLM
Copper	45.45	95% UCLM
Iron	38,244	95% UCLM
Lead	10.47	95% UCLM
Molybdenum	3.1	95% UCLM
Nickel	1,028	95% UCLM
Selenium	0.25	90th Percentile
Strontium	403.1	95% UCLM
Thallium	10.15	95% UCLM
Titanium	0.0777	95% UCLM
Vanadium	47.07	95% UCLM
Zinc	40.03	95% UCLM

Notes: UCLM – upper confidence limit of the mean; mg/kg = milligrams per kilogram; % = percent.

Table IV-16 Deposition Values Used in Food Web Model

Parameter	Dry deposition	Wet deposition	Total deposition	Dry deposition	Wet deposition	Total deposition
	Baseline [µg/m²/s]			Project [µg/m²/s]		
Arsenic	2.34E-10	1.21E-11	2.45E-10	1.76E-06	7.36E-08	1.83E-06
Cadmium	3.69E-09	2.96E-10	3.96E-09	4.91E-05	1.37E-06	5.05E-05
Chromium	2.69E-09	1.70E-10	2.85E-09	1.52E-04	5.85E-06	1.58E-04
Copper	9.88E-10	7.05E-11	1.05E-09	2.93E-05	1.04E-06	3.03E-05
Iron	2.99E-07	1.89E-08	3.16E-07	3.25E-02	1.24E-03	3.37E-02
Manganese	5.15E-09	3.30E-10	5.44E-09	4.73E-04	1.80E-05	4.91E-04
Nickel	4.34E-09	2.43E-10	4.55E-09	2.22E-04	9.01E-06	2.31E-04
Selenium	5.32E-10	2.69E-11	5.56E-10	9.51E-07	4.27E-08	9.93E-07
Uranium	1.31E-11	8.50E-13	1.39E-11	1.63E-06	6.20E-08	1.70E-06
Zinc	4.21E-09	3.43E-10	4.53E-09	7.81E-05	2.39E-06	8.05E-05

Note: µg/m²/s = micrograms per square metre per second.

References

De Beers (De Beers Canada Inc.). 2012. *Environmental Impact Statement Supplemental Information Submission for the Gahcho Kué Project*. Submitted to the Mackenzie Valley Environmental Impact Review Board, Yellowknife, NWT, Canada. May 2012.

ORNL (Oak Ridge National Laboratory). 1996. *White Oak Creek Watershed: Melton Valley Area Remedial Investigation Report*. Oak Ridge, TN, Volumn 3. Appendix C. DOE/OR/01-1546/V3&D1 also ORNL/M—5520/V3&D1

RAIS (Risk Assessment Information System). 2012. Online Database and Web Resource (http://rais.ornl.gov/). U.S. Department of Energy (DOE), Office of Environmental Management, Oak Ridge Operations (ORO) Office.

Sample, B.E. and G.W. Suter. 1994. *Estimating Exposure of Terrestrial Wildlife to Contaminants*. Oak Ridge National Laboratory, Oak Ridge, Tennessee. Prepared for U.S. Department of Energy.

U.S. EPA. (United States Environmental Protection Agency) 1999. *Screening level ecological risk assessment protocol: Appendix C – Media-to-receptor bioconcentration factors (BCFs).* Region 6 Multimedia Planning and Permitting Division, Center for Combustion Science and Engineering.

U.S. EPA. 2007. *Guidance for Developing Ecological Soil Screening Levels (Eco-SSLs)*. Attachment 4-1: Exposure factors and bioaccumulation models for derivation of wildlife Eco-SSLs. OSWER Directive 9285.7-55.

APPENDIX V

DERIVATION OF CHRONIC TOXICITY REFERENCE VALUES

1 OVERVIEW

This appendix summarizes the methods and data sources used to derive toxicity reference values (TRVs) for the wildlife risk assessment. The TRVs are used as effects thresholds for evaluation of estimated intake rates of chemicals of potential concern (COPCs) by receptors. The derived TRVs are summarized in Tables V-1 and V-2.

2 GENERAL APPROACH

A stepwise procedure was used to identify wildlife TRVs. Where available, the United States Environmental Protection Agency (U.S. EPA) Ecological Soil Screening Levels (Eco-SSLs) were selected for each COPC (U.S. EPA 2008a). Eco-SSLs represent a conservatively-based, systematic, and rigorous assessment of wildlife toxicity information. Where Eco-SSLs were unavailable, a literature review was conducted to identify candidate TRVs, beginning with the Oak Ridge National Laboratory Toxicological Benchmarks for Wildlife (Sample et al. 1996) and supported by an additional detailed literature review as needed.

The TRVs used to evaluate risk to wildlife receptors were initially based on dietary concentrations or intake rates associated with no observed adverse effect levels (NOAELs)[1] to test organisms (i.e., referred to henceforth as lower-TRVs). Although use of NOAELs has been discouraged in recent provincial and federal risk assessment guidance, the Eco-SSLs (which apply to the geometric mean of NOAELs as the starting point for TRV derivations) were retained due to the high volume toxicological data evaluated and the degree of rigour in the data quality screening. Eco-SSLs are “derived to be protective of the conservative end of the exposure and effects species distribution, and are intended to be applied at the screening stage of an ecological risk assessment” (U.S. EPA 2012). Other lower-TRVs are similarly conservative; all such screening ecotoxicity values are derived to avoid underestimating risk, and are not intended to identify risk levels warranting management actions.

To provide context for any identified exceedances of lower-TRVs, additional TRVs (i.e., referred to henceforth as upper-TRVs) were derived based on consideration of measures of adverse responses, including:

- lowest relevant lowest observed adverse effect concentrations (LOAELs), with documentation of the effect size (magnitude) associated with the LOAEL; or
- derivation of a dose-response relationship, with selection of the 20% inhibition concentration (IC_{20}) as the dose determined to be the biologically relevant threshold.

The latter approach is preferred due to compatibility with emerging provincial and federal risk assessment technical guidance, and because thresholds were identified based on consideration of biologically significant effects to relevant

[1] When data are expressed as a concentration in food, the term no-observed-adverse effect level (NOAEL) may be replaced with no-observed-adverse-effect concentration (NOAEC). The term NOAEL (or LOAEL) applies to both concentration and dose-based values.

toxicity endpoints, rather than simple statistical significance tests. However, application of this approach is data- and research-intensive and therefore was deferred for most COPCs pending the results of the screening-level analysis. For aluminum and boron, sufficient data were available to conduct the dose-response analysis, and IC_{20} based determinations were made for both birds and mammals. For these two compounds the dose response curve was also used to derive the lower-TRV and was based on the IC_{10}.

The thresholds discussed above may be interpreted as follows:

- Lower-TRVs provide a conservative assessment of the potential for adverse effects to wildlife receptors. Exceedances of these TRVs may or may not actually result in adverse effects, although COPC exposures below the lower-TRVs may be screened out of the baseline ERA with confidence.
- Upper-TRVs provide a more realistic assessment of the potential for adverse effects to wildlife receptors, as these TRVs are associated with dietary intakes that have been observed to result in adverse effects in sensitive test organisms. However, as the upper-TRVs based on LOAELs represent the most sensitive documented relevant endpoints, they should not be interpreted as thresholds for the actual study populations or receptors, particularly where the surrogate species is dissimilar to the site-specific receptor of concern.

2.1 SUMMARY OF ECOLOGICAL SOIL SCREENING LEVELS (ECO-SSL) DERIVATION

Eco-SSLs are derived separately for birds and mammals, and are presumed to provide adequate protection of terrestrial wildlife (U.S. EPA 2008a). The Eco-SSL derivation process represents the collaborative effort of a multi-stakeholder workgroup, and identifies screening levels (including TRVs for avian and mammalian wildlife) that are conservative. The Eco-SSL TRV was used as the lower-TRV for use in the wildlife risk assessment. The default Eco-SSL TRV is the geometric mean of the no-observed-adverse-effect level (NOAEL) values for reproduction and growth. However, consistent with the Eco-SSL derivation rules, where this geometric mean was higher than the lowest bounded lowest-observed-adverse-effect-levels (LOAELs) for reproduction, growth, or survival, the Eco-SSL TRV was set equal to the highest bounded NOAEC lower than the lowest bounded LOAEC for reproduction, growth or survival. Where Eco-SSL TRVs were available, the upper-TRV was set as the lowest LOAEL for reproduction, growth or survival above the NOAEL.

2.2 OTHER LITERATURE-BASED TOXICITY REFERENCE VALUES (TRVS)

A literature review of wildlife toxicity studies was conducted for COPCs that did not have suitable Eco-SSL information. The default secondary study for use in TRV derivation was obtained from Sample et al. (1996), which reports a single recommended study for each COPC (separate study for mammalian and avian receptors).

2.2.1 Selection Criteria

The following were important considerations in the selection of literature-based TRVs, which for this project included iron.

2.2.1.1 Biological Effects Measured in Study

The preferred measurement endpoints in the study were reproduction, growth, and/or development. Histopathology, enzyme induction, immunosuppression, and behavioural responses were not considered appropriate measurement endpoints due to their questionable linkage to the assessment endpoints of the risk assessment. Mortality was not a preferred measurement endpoint, unless other sublethal effects were evaluated (but not observed) in the study. Effects measured in the study were considered "significant" only if they had clear biological significance (i.e., relevance to overall maintenance and health of the population). Effects that were statistically significant but that have little or no relevance to health, either due to small effect sizes or to compensatory effects[2]) were not considered relevant endpoints. Preference was given to studies that provide both a NOAEL and a LOAEL for the effect of interest (i.e., bounded effects thresholds).

2.2.1.2 Technical Quality of Study

Studies must have included sufficient numbers of test organisms, and have included an appropriate control. The contaminant under investigation must have been isolated to avoid interactive effects. The test should have been conducted with normal levels of nutrition in the diet, because many metals are made more bioavailable in a nutrient-deficient diet.

[2] An example is a temporary inhibition of growth during a narrow time period that is rapidly compensated as the organism develops; in this case, the effect is not considered to significantly affect the organisms' ability to survive and reproduce, thus causing negligible impact to the receptor population.

2.2.1.3 Method of Administration

The preferred method of administration was oral exposure in the diet, either by feed or drinking water, because the receptors are assumed to receive their exposure via this route. Oral exposure by capsule and force-feeding (i.e., gavage studies) were less desirable administration methods. Injection studies were not considered to be acceptable exposure pathways, since gastrointestinal uptake is a process strongly influencing bioavailability and toxicity.

2.2.1.4 Duration of Study

Preferred test endpoints were chronic or subchronic, as it is conservatively assumed that wildlife receptors in the vicinity of the Project will be resident for periods sufficient for chronic exposure. Ideal chronic studies assessed effects spanning entire life spans or multiple generations of animals. Because chronic or multi-generational studies were not always available, tests spanning a significant portion of a life span or covering a sensitive life stage (i.e., reproductive period or juvenile development period) were also considered.

2.2.2 Data Processing

2.2.2.1 Conversion of Dietary Concentrations to a Daily Intake Value

The hazard quotient approach used in this risk assessment requires that TRVs be expressed in terms of daily intake standardized to body mass (i.e., milligrams per kilogram-day [mg/kg-day]). However, in many experimental studies, exposure is reported in terms of the concentration of contaminant in food or water supplied *ad libitum* (i.e., unlimited supply) to the test organisms. In these cases, estimates of food or water ingestion rates and animal body weights were required to translate feed concentration to daily intake. Where the original literature source measured or estimated these parameters, they were applied directly in the computation of TRVs. A secondary approach used ingestion rate and body weight data from other studies which tested the same species and life stage of organism. If neither of these two methods was feasible, ingestion rates were calculated using estimated or measured body weights, and using allometric scaling to derive a daily food intake rate.

2.2.2.2 Extrapolation Factors

In some cases, extrapolation factors were required to address uncertainty caused by limited data. Common extrapolation factors in wildlife TRV derivation include:

- Subchronic to chronic extrapolation – an extrapolation factor of 0.1 is multiplied to a subchronic TRV to derive a chronic TRV (Sample et al. 1996).
- Interspecies extrapolations – Toxicity data are rarely available for the receptor species of interest, and it is therefore often necessary to extrapolate toxicity test results from domestic species (e.g., chicken, mallard duck) to wildlife receptors. Interspecies extrapolation factors were not applied, either in terms of application (uncertainty) factors or allometric scaling based on body weight. Based on guidance in Sample et al. (1996), OMOE (2009), and Allard et al. (2010) allometric scaling of toxicity data is not warranted.

2.2.2.3 Chemical Conversions

In some cases, conversion of the total administered concentration or dose to base metal/metalloid exposure is necessary. In most bioassays, metals are administered as soluble metal salts. The mass of substance considered in TRV development was the mass of metal ion (e.g., aluminum, rather than aluminum chloride); adjustment of total salt concentration to the metal ion concentration was conducted where necessary.

2.3 RESULTS

The derivations of lower-TRV and upper-TRV thresholds are provided in Table V-1 and V-2 (mammals and birds, respectively).

Table V-1 Toxicity Data Used to Calculate Toxicity Reference Values for Mammals

Parameter	Lower-TRV	Upper-TRV	Details of Toxicity Study
Metals			
Arsenic (As)	1.04	1.66	A geometric mean of the NOAEL values for growth and reproduction based on multiple studies using standard laboratory mammals was calculated at 2.47 mg/kg-day (U.S. EPA 2005a). However, because this value was higher than the lowest bounded LOAEL for reproduction, growth, or survival results, the TRV of 1.04 mg/kg-day was derived, which is the highest bounded NOAEL lower than the lowest bounded LOAEL for reproduction, growth or survival (Neiger and Osweiler 1989; as cited in U.S. EPA 2005a). The lower and upper-TRVs were both derived from an eight month feeding study of juvenile dogs (*Canis familiaris*) and the LOAEL was based on growth effects.
Cadmium (Cd)	0.77	1.0	An Eco-SSL was available from U.S. EPA (2005b). A geometric mean of the NOAEC values for reproduction and growth was calculated at 1.86 mg/kg-day Cd. However, this value was higher than the lowest bounded LOAEC for reproduction, growth, or mortality; therefore, the lower-TRV was set equal to the highest bounded NOAEC below the lowest bounded LOAEC for reproduction, growth, or survival (0.77 mg/kg-day Cd; U.S. EPA 2005b). The lowest LOAEL for growth, reproduction, and survival above the NOAEL provided by the U.S. EPA (2005b) is 1 mg/kg-day. This LOAEL is based on a study by Rastogi et al. (1977), where juvenile rats were exposed to cadmium daily (as cadmium chloride) via intubation for 30 days. Body weights were reduced by 19% in rats exposed to 100ug/100g/day of the cadmium chloride solution compared to the control group.
Chromium (Cr)	2.4	2.82	For trivalent chromium, a geometric mean of the NOAEL values for growth and reproduction based on multiple studies using standard laboratory mammals was calculated to be 2.40 mg/kg-day (U.S. EPA 2008b) and used as the lower TRV. The lowest LOAEL for growth, reproduction, and survival above the NOAEL provided by the U.S. EPA (2008b) is 2.82 mg/kg-day. This LOAEL is based on a study by Mercado and Bibby (1973), where juvenile rats were exposed to chromium III via drinking water for 50 days. The LOAEL is based on a reduction in survival.
Copper (Cu)	5.6	5.78	An Eco-SSL was available from U.S. EPA (2007a). A geometric mean of the NOAEC values for reproduction and growth was calculated to be 25 mg/kg-day Cu. However, because this value was higher than the lowest bounded LOAEC for reproduction, growth, or mortality results, the TRV was set equal to the highest bounded NOAEC below the lowest bounded LOAEC for reproduction, growth, or survival. The latter value was 5.6 mg/kg-day Cu, and was derived from a study of copper exposure to juvenile pigs (*Sus scrofa*) over 4 weeks; sensitive endpoints included growth and survival (Allcroft et al. 1961). The lowest LOAEL for growth, reproduction, and survival above the NOAEL provided by the U.S. EPA (U.S. EPA 2007a) is 5.78 mg/kg-day. The LOAEL is based on a reduction in body weight for juvenile female rats exposed to copper in their drinking water for 91 days (Freundt and Ibrahim, 1990; as cited in U.S. EPA 2007a).
Iron (Fe)	20	60	A TRV from Eco-SSL and Sample et al. (1996) are not available; however, a literature review was conducted to identify potential thresholds for chronic toxicity. A NOAEL of 20 mg/kg-day was selected; no effects were observed in all long-term feeding studies and no clinical signs reported in an acute dog study (Albretsen 2006). A LOAEL of 60 mg/kg-day was based on an acute dog study where clinical signs of iron toxicosis were reported (Albretsen 2006). This is considered a conservative LOAEL as many chronic studies showed no effect at this concentration.

Table V-1 Toxicity Data Used to Calculate Toxicity Reference Values for Mammals (continued)

Parameter	Lower-TRV	Upper-TRV	Details of Toxicity Study
Manganese (Mn)	51.5	65.0	A geometric mean of the NOAEL values for growth and reproduction based on multiple studies using standard laboratory mammals was calculated to be 51.5 mg/kg-day (U.S. EPA 2007b). This value was lower than the lowest bounded LOAEL for reproduction, growth, or mortality results, therefore was used as the NOAEL. The lowest LOAEL for growth, reproduction, and survival above the NOAEL provided by the U.S. EPA (2007b) is 65.0 mg/kg-day. This LOAEL is based on growth effects noted in a study where cattle were exposed to manganese in their food for 84 days (Cunningham et al. 1966; as cited in U.S. EPA 2007b).
Nickel (Ni)	1.7	2.71	A geometric mean of the NOAEL values for growth and reproduction based on several studies using standard laboratory mammals was calculated to be 7.70 mg/kg-day (U.S. EPA 2007c). However, this value was higher than the lowest bounded LOAEL for reproduction, growth, or mortality results; therefore, the TRV was based on the highest bounded NOAEL below the lowest bounded LOAEL for reproduction, growth, or survival. The lower TRV is equal to 1.7 mg/kg-day and was based on the NOAEL for sperm cell production from the reproductive study that exposed mice to nickel for 35 days during a sensitive life stage. The lowest LOAEL for growth, reproduction, and survival above the NOAEL provided by the U.S. EPA (2007c) is 2.71 mg/kg-day. The LOAEL is based on a study by Pandey and Srivastava (2000) where juvenile male rats were exposed to nickel sulphate and nickel chloride orally for 35 days. Both sperm mobility and sperm count were significantly reduced. Sperm mobility was reduced by 15% and 24% in the groups given 10 mg/kg bwt/d nickel sulphate and nickel chloride respectively. Sperm count was reduced by 25% in the group exposed to 10 mg/kg-day of nickel chloride.
Selenium (Se)	0.143	0.145	A geometric mean of the NOAEL values for reproduction and growth based on multiple studies using standard laboratory mammals was calculated to be 0.437 mg selenium/kg bw/day (U.S. EPA 2007d). However, this value is higher than the lowest bounded LOAEL for reproduction, growth, or mortality results. Therefore, the TRV is equal to the highest bounded NOAEL below the lowest bounded LOAEL for reproduction, growth, or survival, and is equal to 0.143 mg selenium/kg bw/day (Mahan and Moxon, 1984; as cited in U.S. EPA 2007d). The lowest LOAEL for growth, reproduction, and survival above the NOAEL provided by the U.S. EPA (2007d) is 0.145 mg/kg-day. The LOAEL is based on reproductive effects noted in a study by Nobunaga et al. (1979) where mice were exposed to selenium in their drinking water for 56 days.
Zinc (Zn)	75.4	75.7	A geometric mean of the NOAEL values for growth and reproduction based on numerous studies using standard laboratory mammals was calculated to be 75.4 mg/kg-day (U.S. EPA 2007e). Because this value was lower than the lowest bounded LOAEL for reproduction, growth, or mortality results, it was retained as the TRV. The lowest LOAEL for growth, reproduction, and survival above the NOAEL provided by the U.S. EPA (2007e) is 75.7 mg/kg-day. The LOAEL is based on a reduction in body weight (43%) in lambs feed milk supplemented with zinc ($ZnSO_4$) for 33 days (Davies et al. 1977).

Notes: Eco-SSL = ecological soil screening level; ERA = Ecological Risk Assessment; LOAEL = lowest observed adverse effect level; mg/kg-day = milligrams per kilogram-day; mg/kg bw/d = milligrams per kilogram body weight per day; NOAEL = no observable adverse effect level; TRV = toxicity reference values; U.S. EPA = United States Environmental Protection Agency; ww = wet weight.

Table V-2 Toxicity Test Data Used to Calculate Toxicity Reference Values for Birds

Parameters	Lower-TRV	Upper-TRV	Details of Toxicity Study
Metals			
Arsenic (As)	2.24	3.55	The TRV was based on the lowest NOAEL of 2.24 mg/kg-day determined in a study where chickens were exposed to arsenic in food and growth and reproduction were test endpoints (Holcman and Stibilj, 1997; as cited in U.S. EPA 2005a). The lowest LOAEL for growth, reproduction, and survival above the NOAEL provided by the U.S. EPA (U.S. EPA 2005a) is 3.55 mg/kg-day. The LOAEL was based on a study by Howell and Hill (1978) where day old chicks were fed arsenic as arsenic trichloride for 21 days. Body weight of the chicks was reduced by 19% in chicks exposed to 50 ppm arsenic trichloride (Howell and Hill, 1978).
Cadmium (Cd)	1.47	2.37	The TRV for cadmium was calculated at 1.47 mg/kg-day based on the geometric mean of NOAEL values, which is lower than the lowest bound LOAEL (U.S. EPA 2005b). The lowest LOAEL for growth, reproduction, and survival above the NOAEL provided by the U.S. EPA (U.S. EPA 2005b) is 2.37 mg/kg-day. The LOAEL is based on a study where cadmium was administered via diet to chickens for 12 weeks. Egg production was reduced by 25% at 2.37 mg/kg-day (Leach et al. 1979).
Chromium (Cr)	2.66	2.78	A geometric mean of the NOAEL values for reproduction and growth for trivalent chromium was calculated at 2.66 mg/kg-day based on multiple studies where chickens, turkeys, or ducks were exposed to chromium (U.S. EPA 2008b). The lowest LOAEL for growth, reproduction, and survival above the NOAEL provided by the U.S. EPA (U.S. EPA 2008a) is 2.78 mg/kg-day (Haseltine et al. 1985, unpublished; as cited in U.S. EPA 2008b). Survival and reproductive effects were noted in black ducks exposed to chromium 180-190 days and 10 months respectively in their food (Haseltine et al. 1985, unpublished; as cited in U.S. EPA 2008b).
Copper (Cu)	4.05	4.68	A geometric mean of the avian NOAEL values for reproduction and growth was calculated at 18.5 mg copper/kg bw/day (U.S. EPA 2007a). However, this value is higher than the lowest bounded LOAEL for reproduction, growth, and survival. Therefore, the NOAEL is equal to the highest bounded NOAEL lower than the lowest bounded LOAEL for reproduction, growth, and survival of 4.05 mg/kg-day. The lowest LOAEL for growth, reproduction, and survival above the NOAEL provided by the U.S. EPA (2007a) is 4.68 mg/kg-day. The LOAEL is based on a study by Kashani et al. (1986; as cited in U.S. EPA 2007), that administered copper to juvenile turkeys (*Melagris gallopavo*) via food for 8 weeks. The LOAEL was for a reduction in body weight (Kashani et al. 1986).

Table V-2 Toxicity Test Data Used to Calculate Toxicity Reference Values for Birds (continued)

Parameters	Lower-TRV	Upper-TRV	Details of Toxicity Study
Iron (Fe)	125 (single TRV)		A TRV from Eco-SSL and Sample et al. (1996) are not available; however, a literature review was conducted to identify potential thresholds for chronic toxicity. Because of the limited toxicity data for iron in birds, only a single representative TRV was derived. Panigrahi (1992) found that significant reductions in food intake and egg production were observed when feeding ferrous sulphate treated meals to hens (1,567 to 1,703 mg/kg Fe in food), but the effect size on egg production was relatively small, ranging from 0 to 14% reduction in egg production depending on the endpoint representation of egg production. Assuming a feed intake of 120 grams per day, and test animal weight of 1.5 kilograms, this converts to 125 to 136 mg/kg-day. The lower range was used as the avian TRV and was considered intermediate between a lower-TRV and upper-TRV given the low level of effect observed (i.e., depending on the endpoint, the effect ranged from 0% to 14%). The NOEAL 105 mg/kg-day of determined from the study by Anwar et al. (2008) of iron toxicity in quails supported this TRV selection.
Manganese (Mn)	179	348	A geometric mean of the NOAEL values for reproduction and growth in studies conducted with chicken and Japanese quail was calculated to be 179 mg/kg-day. The lowest LOAEL for growth, reproduction, and survival above the NOAEL provided by the U.S. EPA (2007b) is 348 mg/kg-day. The LOAEL is based on a study by Southern and Baker (1983; as cited in U.S. EPA 2007b), that administered manganese chloride tertahydrate to chicks via food for 14 days. The LOAEL was for an effect on growth.
Nickel (Ni)	6.71	8.16	A geometric mean of the NOAEL values for reproduction and growth conducted using standard laboratory avian species was determined to be 6.71 mg/kg-day (U.S. EPA 2007c). The lowest LOAEL for growth, reproduction, and survival above the NOAEL provided by the U.S. EPA (2007c) is 8.16 mg/kg-day. The LOAEL is based on a study by Meluzzi et al. (1996; as cited in U.S. EPA 2007c), that administered nickel sulphate to chicken via food for 60 days. The LOAEL was for an effect on reproduction.
Selenium (Se)	0.29	0.31	A geometric mean of the NOAEL values for reproduction and growth was calculated at 0.606 mg selenium/kg bw/day U.S. EPA 2007d). This value, however, is higher than the lowest bounded LOAEL for reproduction, growth, or survival. Therefore, the TRV is equal to the highest bounded NOAEL lower than the lowest bounded LOAEL for reproduction, growth or survival and is equal to 0.290 mg selenium/kg bw/day (U.S. EPA 2007d). The lowest LOAEL for growth, reproduction, and survival above the NOAEL provided by the U.S. EPA is 0.306 mg/kg-day (U.S. EPA 2007d). The LOAEL is based on a study by Dafalla and Adam (1986; as cited in U.S. EPA 2007d), that administered selenium to juvenile chickens via food for 2 weeks. The LOAEL was based on a reduction in body weight (Dafalla and Adam 1986).

Table V-2 Toxicity Test Data Used to Calculate Toxicity Reference Values for Birds (continued)

Parameters	Lower-TRV	Upper-TRV	Details of Toxicity Study
Zinc (Zn)	66.1	66.5	A geometric mean of the NOAEL values for reproduction and growth based on multiple studies conducted with standard laboratory avian species was calculated at 66.1 mg/kg-day. Since this value is lower than the lowest bounded LOAEL for reproduction, growth, or survival, it was retained as the TRV (U.S. EPA 2007e). The lowest LOAEL for growth, reproduction, and survival above the NOAEL provided by the U.S. EPA (2007e) is 66.5 mg/kg-day. The LOAEL is based on a study by Gibson et al. (1986; as cited in U.S. EPA 2007e), that administered zinc acetate to chicken via food for 10 weeks. The LOAEL was for an effect on reproduction.

Notes: Eco-SSL = ecological soil screening level; ERA = Ecological Risk Assessment; LOAEL = lowest observed adverse effect level; mg/kg-day = milligrams per kilogram-day; mg/kg bw/d = milligrams per kilogram body weight per day; n/a = not available; NOAEL = no observable adverse effect level; PCB = polychlorinated biphenyls; TRV = toxicity reference values; U.S. EPA = United States Environmental Protection Agency; ww = wet weight.

3 IRON TOXICITY REFERENCE VALUE

No Eco-SSL value was available from U.S. EPA, and iron was not evaluated in Sample et al. (1996). As an essential element for the growth, development, and long-term survival of most organisms, iron is generally considered to be a micronutrient and is internally regulated. Nevertheless, iron can be toxic to cells in excessive amounts, and acute iron poisoning is common and potentially lethal in dogs, cats, and many other animals. Therefore, a literature review was conducted to identify potential thresholds for chronic iron toxicity.

3.1 MAMMALIAN

The available relevant studies for chronic toxicity of iron to mammals included:

- Albretsen (2006) discusses the toxicity of iron to animals. He states that: "No clinical signs of toxicosis are expected in dogs ingesting less than 20 mg/kg of elemental iron. Dogs ingesting between 20 and 60 mg/kg of elemental iron can develop mild clinical signs. When the amount of elemental iron ingested is greater than 60 mg/kg, serious clinical signs can develop. In all animals, oral doses between 100 and 200 mg/kg are potentially lethal." These thresholds refer to acute doses of iron; chronic doses are unknown but could be an order of magnitude lower than those described above.
- An eight-generation reproduction study was carried out in Wistar rats in which contaminated food containing 570 mg of iron per pound of food was provided continuously (Carnation Co. 1967). Rats ate an estimated 25 mg of iron per day, assuming 20 g/day of dog food consumption. Assuming a normal adult Wistar rat body weight of 300 grams, the daily ingestion rate is calculated as 83 mg/kg-day Fe. No signs of toxicity were evident, and reproduction performance was not adversely affected; therefore the unbounded NOAEL was 83 mg/kg-day Fe.
- Fisch et al. 1975 conducted a study in which iron (as iron dextran) was administered to groups of six-week-old Sprague-Dawley rats by intramuscular injection for a period of 6 weeks prior to breeding, with an average dosage of 40 mg/kg-week or 5.7 mg/kg-day. The same exposure treatment was applied the offspring of the next four generations. Reproduction parameters (litter size and growth) were similar for treated and non-treated animals; therefore the unbounded NOAEL was 5.7 mg/kg-day Fe.
- IPCS (1983) reports results of additional single exposure studies in rodents. Ferrous sulfate (37% elemental iron) showed no maternal toxicity or teratogenic effects at dose levels up to 160 mg/kg bw in mice and 200 mg/kg bw in rats (Food and Drug Research Laboratories 1974).

The corresponding elemental iron unbounded NOAELs are 59.2 mg/kg bw and 72 mg/kg bw. Ferric sodium pyrophosphate (30% elemental iron) showed no maternal toxicity or teratogenic effects at dose levels up to 160 mg/kg bw in mice or rats (Food and Drug Research Laboratories 1975). The corresponding elemental iron unbounded NOAEL is 48 mg/kg bw. Effects of chronic exposures were not evaluated in these studies.

- Ralston Purina Cat Care Center (1968) evaluated the effects of iron exposure to cats maintained on contaminated cat chow containing iron at a food concentration of 1,900 mg/kg (equivalent to 0.27% iron oxide) for periods of two to nine years. No adverse effects were reported. Assuming an 3.5 kilogram average body weight, and a food ingestion rate of 0.5 cups (45 grams) per day, the chronic daily intake of iron in the study is estimated to be 24.4 mg/kg-day, which is an unbounded NOAEL.
- Kellogg Co. (1968) conducted a reproductive study with mink, in which ten males and three females were fed iron oxide as 0.75% of their diet (7.5 mg/kg Fe_2O_3 in food). Reproduction, whelping, and lactation were similar to that of controls, and offspring exhibited unimpaired growth. However, the dietary exposure of iron in these studies was well below that of the other studies discussed in this section.
- Ten dogs were fed from one to nine years on diets containing iron oxide colorant (70% iron by weight) at 570 mg/lb (Carnation Co., 1963 as cited in IPCS 1983). Daily consumption was estimated at 428 mg/dog (300 mg/kg-day Fe). No significant adverse effects were observed; therefore the 300 mg/kg-day Fe ingestion rate is considered to be a chronic NOAEL.

Derivation of a reliable chronic TRV for iron in mammals is difficult given the lack of toxicity studies for this substance. In addition, there appears to be wide variation in sensitivity to ingested iron because dogs fed 300 mg/kg-day Fe exhibited no impairment, whereas Albertsen (2006) documented pronounced mortality at this exposure level. For the purpose of this ERA, a lower-TRV of 20 mg/kg-day was selected to represent a low level of risk (i.e., no effects observed in all long-term feeding studies, and no clinical signs reported in dogs by Albertsen 2006). An upper-TRV of 60 mg/kg-day was selected to represent a low to moderate level of risk (i.e., no effects observed in several long-term feeding studies, but some clinical signs reported in dogs by Albretsen 2006).

- Lower-TRV for mammals: 20 mg/kg-day (Albretsen 2006).
- Upper-TRV for mammals: 60 mg/kg-day (Albretsen 2006).

3.2 AVIAN

There are limited data on the toxicity of iron to avian wildlife. A literature review was conducted, but did not identify sufficient data to derive a dose-response relationship. Therefore, a single TRV (i.e., no distinguishing between lower-TRV and upper-TRVs) was derived using point estimates of toxicity threshold from studies of iron toxicity in Japanese quail and chickens. Two relevant studies were considered:

- Panigrahi (1992) treated control meal and cottonseed meal with a solution of ferrous sulphate and evaluated laying hen performance in 26 week-old Dekalb G-Link hens dosed over a period of 10 weeks and 41 week-old Hubbard Golden Comet hens dosed over a period of 8 weeks. The study indicated that significant reductions in food intake and egg production were observed in the ferrous sulphate treated meals (1,567 to 1,703 mg/kg Fe in food), but the effect size on egg production was relatively small, ranging from 0 to 14% reduction in egg production depending on the endpoint representation of egg production. Assuming a feed intake of 120 grams per day, and test animal weight of 1.5 kilograms, this converts to 125 to 136 mg/kg-day. The lower limit of this range was considered intermediate between a NOAEL and a LOAEL given the low level of effect observed (i.e., depending on the endpoint, the effect ranged from 0% to 14%).
- A study by Anwar et al. (2008) supports the use of this value for screening purposes. The authors administered ferrous sulphate to 40-day old Japanese quails weighing 0.15 kg on average for a period of 6 weeks. The NOAEL of $FeSO_4$ was 0.205% (2,050 mg/kg $FeSO_4$), which is equivalent to 753 mg/kg Fe. Using a study-specific ingestion rate of 0.21 kg food per day, this converts to 105 mg/kg-day. At this level of exposure, there was no statistically significant decrease in body weight, although a slower response toward feed was observed toward the end of the experiment. The iron supplementation was observed to partially ameliorate the effects of cottonseed meal on growth, feeding, and clinical signs, possibly due to its role as a gossypol detoxifying agent. On this basis, the 105 mg/kg-day exposure was considered to be a NOAEL for iron in quail.

Two other studies showed effects on birds at lower iron concentrations in feed, but they were likely influence by mould-growth in the feed preparations, these included:

- Panigrahi et al. (1989) reported that a dietary iron concentration of 100 mg/kg (8 mg/kg-day) depressed egg production when administered as ferrous sulphate heptahydrate in solution to hens via cottonseed meal. However, deterioration in feed quality resulting from addition of water to cottonseed meal (i.e., mould growth) was identified by the authors as the likely explanation for this observation. Concentrations several times this level were subsequently applied in control feed with no ill effects.

- Panigrahi and Morris (1991) observed that a dietary iron concentration of 850 mg/kg depressed egg production when administered as crystalline ferrous sulphate heptahydrate to hens via cottonseed meal; however, Panigrahi (1992) suggest, in retrospect, that these results are likely to also have influenced by mould growth.

These two studies were not considered for TRV derivation.

Derivation of a reliable chronic TRV for iron in birds is difficult given the lack of toxicity studies for this substance, and therefore, only a single TRV was derived. The lower extent of the range derived from Panigrahi (1992) was deemed to provide an adequate balance between the levels of protection offered by the lower- and upper-TRVs for other substance, and was retained as the TRV.

- TRV for birds: 125 mg/kg-day (Panigrahi 1992).

4 REFERENCES

Albretsen, J. 2006. The toxicity of iron, an essential element. Veterinary Medicine 82-90.

Allard, P., A. Fairbrother, B. K. Hope, R. N. Hull, M. S. Johnson, L. Kapustka, G. Mann, B. McDonald, and B. E. Sample. 2010. Recommendations for the development and application of wildlife toxicity reference values. Integrated Environmental Assessment and Management 6:28-37.

Allcroft, R., K. N. Burns, and G. Lewis. 1961. Effect of high levels of copper in rations for pigs. Veterinary Record 73:714.

Anwar, M. S., M. Z. Khan, I. Javed, A. Khan, and M. K. Saleemi. 2008. Pathological effects of cottonseed meal with and without ferrous sulphate in male Japanese quails (*Coturnix japonica*). Pakistan Veterinary Journal 28:51-56.

Carnation Company. 1967. Rat multigeneration reproduction study. Rat iron retention study. Unpublished studies. Submitted to WHO by the United States Food and Drug Administration.

Cunningham, G. N., M. B. Wise, and E. R. Barrick. 1966. Effect of high dietary levels of manganese on the performance and blood constituents of calves. Journal of Animal Science 25:532.

Dafalla, R., and S. E. Adam. 1986. Effects of various levels of dietary selenium on hybro-type chicks. Veterinary and Human Toxicology 28:105-108.

Davies, N. T., H. S. Soliman, W. Corrigall, and A. Fleet. 1977. The susceptibility of suckling lambs to zinc toxicity. British Journal of Nutrition 38:153-156.

Fisch, R. O., A. S. Deinard, L. J. Disch, and W. Krivit. 1975. Potential toxicity of iron overload in successive generations of rats. The American Journal of Clinical nutrition 28:36-139.

Food and Drug Research Laboratories. 1974. Teratologic evaluation of FDA 71-64 (ferrous sulphate) in mice and rats. Unpublished report from Food and Drug Research Laboratories, Inc., Waverly, N.Y., United States of America. Submitted to the World Health Organization by the United States Food and Drug Administration.

Food and Drug Research Laboratories, 1975. Teratologic evaluation of FDA 73-83 (ferric sodium pyrophosphate) in mice and rats. Unpublished report from Food and Drug Research Laboratories, Inc., Waverly, N.Y., United States of America. Submitted to the World Health Organization by the United States Food and Drug Administration.

Freundt, K. J., and H. A. Ibrahim. 1990. Growth of rats during a subchronic intake of the heavy metals Pb, Cd, Zn, Mn, Cu, Hg, and Be. Polish Journal of Occupational Medicine 3:227-232.

Gibson, S. W., M. H. Stevenson, and N. Jackson. 1986. Comparison of the effects of feeding diets supplemented with zinc oxide or zinc acetate on the performance and tissue mineral content of mature female fowls. British Poultry Science 27:391-402.

Haseltine, S. D., G. R. Sileo, D. J. Hoffman, and B. D. Mulhern. 1985. Effects of chromium on reproduction and growth in black ducks. Unpublished manuscript.

Holcman, A., and V. Stibilj. 1997. Arsenic residues in eggs from laying hens fed with a diet containing arsenic (III) oxide. Archives of Environmental Contamination and Toxicology 32:407-410.

Howell, G. O., and C. H. Hill. 1978. Biological interaction of selenium with other trace elements in chicks. Environmental Health Perspectives 25:147-150.

IPCS (International Programme on Chemical Safety). 1983. 571. Iron – WHO Food Additives Series 18. TRS 696-JECFA 27/29. Summary of Evaluations Performed by the Joint FAO/WHO Expert Committee on Food Additives. Available at: http://www.inchem.org/documents/jecfa/jecmono/v18je18.htm

Kashani, A. B., H. Samie, R. J. Emerick, and C. W. Carlson. 1986. Effect of copper with three levels of sulphur containing amino acids in diets for turkeys. Poultry Science 65:1754-1759.

Kellogg Company. 1968. Mink feeding study. Unpublished study. Submitted to WHO/FAO.

Leach Jr, R. M., K. W. Wang, and D. E. Baker. 1979. Cadmium and the food chain: The effect of dietary cadmium on tissue composition in chicks and laying hens. Journal of Nutrition 109:437-443.

Mahan, D. C., and A. L. Moxon. 1984. Effect of inorganic selenium supplementation on selenosis in postweaning swine. Journal of Animal Science 58:1216-1221.

Meluzzi A. F. S., F. Sirri, L. Vandi, G. Giordani. 1996. Feeding hens diet supplemented with heavy metals (chromium, nickel, and lead). Arch Geflugelk 60:119-125.

Mercado, R. C., B. G. Bibby. 1973. Trace element effects on enamel pigmentation, incisor growth and molar morphology in rats. Archives of Oral Biology 18:629-635.

Neiger, R. D., and G. D. Osweiler. 1989. Effect of subacute low level dietary sodium arsenite on dogs. Fundamental and Applied Toxicology 13:439-451.

Nobunaga, T., H. Satoh, and T. Suzuki. 1979. Effects of sodium selenite on methylmercury embryotoxicity and teratogenicity in mice. Toxicology and Applied Pharmacology 47:79-88.

OMOE (Ontario Ministry of Environment). 2009. Change in MOE Guidance on Use of Allometric Dose Scaling. Standards Development Branch, Ontario Ministry of Environment. May, 2009.

Panigrahi, S. 1992. Effects of treating cottonseed meal with a solution of ferrous sulphate on laying hen performance and discolourations in eggs. Animal Feed Sciences and Technology 38:89-103.

Pandey, R., and S. P. Srivastava. 2000. Spermatotoxic effect of nickel in mice. Bulletin of Environmental Contamination and Toxicology 64:161–167.

Ralston Purina Cat Care Center. 1968. Digestibility and cat maintenance ration. Unpublished studies. Submitted to WHO by the United States Food and Drug Administration.

Rastogi, R. B., Z. Merali, and R. L. Singhal. 1977. Cadmium alters behaviour and the biosynthetic capacity for catecholamines and serotonin in neonatal rat brain. Journal of Neurochemisry 28:789-794.

Sample, B. E., Opresko, D. M., and G. W. Suter II. 1996. Toxicological Benchmark for Wildlife: 1996 Revision. Oak Ridge National Laboratory, Oak Ridge TN. ES/ER/TM-86/R3.

Southern, L. L., and D. H. Baker. 1983. Excess manganese ingestion in the chick. Poultry Science 62:642-6.

U.S. EPA. 2005a. Ecological Soil Screening Level for Arsenic. Interim Final. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, Washington, DC. OSWER Directive 9285.7-62. March 2005.

U.S. EPA. 2005b. Ecological Soil Screening Level for Cadmium. Interim Final. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, Washington, DC. OSWER Directive 9285.7-65. March 2005.

U.S. EPA. 2007a. Ecological Soil Screening Level for Copper. Interim Final. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, Washington, DC. OSWER Directive 9285.7-68. February 2007.

U.S. EPA. 2007b. Ecological Soil Screening Level for Manganese. Interim Final. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, Washington, DC. OSWER Directive 9285.7-71. April 2007.

U.S. EPA. 2007c. Ecological Soil Screening Level for Nickel. Interim Final. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, Washington, DC. OSWER Directive 9285.7-76. March 2007.

U.S. EPA. 2007d. Ecological Soil Screening Level for Selenium. Interim Final. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, Washington, DC. OSWER Directive 9285.7-76. July 2007.

U.S. EPA. 2007e. Ecological Soil Screening Level for Zinc. Interim Final. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, Washington, DC. OSWER Directive 9285.7-73. June 2007.

U.S. EPA. 2008a. Ecological Soil Screening Levels. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, Washington, DC. Last updated May 21st, 2008. Available at: http://www.epa.gov/ecotox/ecossl/

U.S. EPA. 2008b. Ecological Soil Screening Level for Chromium. Interim Final. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, Washington, DC. OSWER Directive 9285.7-66. April 2008.

U.S. EPA. 2012. Ecological Soil Screening Levels. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, Washington, DC. Available at: http://www.epa.gov/ecotox/ecossl/

APPENDIX VI

DERIVATION OF ACUTE TOXICITY REFERENCE VALUES

VI.1 OVERVIEW

A stepwise procedure was used to identify acute toxicity reference values for the wildlife ecological risk assessment as outlined in greater detail below. Chemical specific derivations for acute toxicity reference values (TRVs) are provided in Section VI.1.1 and summarized in Table VI-1 at the end of this appendix.

- The Risk Assessment Information System (RAIS) – This database was used preferentially in the development of acute toxicity thresholds. The toxicity profiles in this database were developed using information taken from the U.S. EPA Integrated Risk Information System (IRIS) and Health Effects Assessment Summary Tables (HEAST) and other regulatory sources. This work has been sponsored by the U.S. Department of Energy (DOE), Office of Environmental Management, Oak Ridge Operations (ORO) Office.

Where RAIS information was lacking, the following sources were evaluated:

- Environmental Health Criteria (EHC) Monographs – Environmental health data from the International Programme on Chemical Safety (IPCS) were applied. The IPCS is a joint venture of the United Nations Environment Programme (UNEP), the International Labour Organisation (ILO), and the World Health Organization (WHO). The overall objectives of the IPCS are to establish the scientific basis for assessment of the risk to human health and the environment from exposure to chemicals, through international peer review processes.

Concise International Chemical Assessment Documents (CICADs) – CICADs are concise documents that provide summaries of the relevant scientific information concerning the potential effects of chemicals upon human health and/or the environment. They are based on selected national or regional evaluation documents or on existing EHCs. Before acceptance for publication as CICADs by IPCS, these documents have undergone extensive peer review by internationally selected experts to ensure their completeness, accuracy in the way in which the original data are represented, and the validity of the conclusions drawn. Joint FAO/WHO Expert Committee on Food Additives – The JECFA is an international scientific expert committee that is administered jointly by the Food and Agriculture Organization of the United Nations and the World Health Organization. It has been meeting since 1956, initially to evaluate the safety of food additives. Its work now also includes the evaluation of contaminants, naturally occurring toxicants and residues of veterinary drugs in food. To date, JECFA has evaluated more than 1,500 food additives, approximately 40 contaminants and naturally occurring toxicants, and residues of approximately 90 veterinary drugs. The Committee has also developed principles for the safety assessment of chemicals in food that are consistent with current thinking on risk assessment and take account of recent developments in toxicology and other relevant sciences.

VI.1.1 ACUTE TRV DERIVATIONS

VI.1.1.1 Aluminum

Information from RAIS was available (Bast 1993) and therefore was used to select an acute toxicity threshold. Aluminium compounds are only poorly absorbed after exposure by the gastrointestinal, respiratory and dermal routes, and therefore the acute toxicity of aluminium metal and aluminium compounds is relatively low (Habs et al. 1997). Bast (1993) notes that, due to the poor absorption and efficient excretion of aluminum, acute oral toxicity is observed only after relatively large doses. The reported LD50 values for aluminium included 261 mg/kg in rats (aluminum nitrate; Llobet et al. 1987), and 770 mg/kg in mice (aluminum chloride; Ondreicka et al. 1966).

In addition to the LD50 studies, there have been several repeated dose toxicity studies in which a wide range of end-points, including clinical signs, food and water consumption, growth, haematological and serum analyses. There were no treatment-related effects in rats fed up to 288 mg Al/kg body weight per day as sodium aluminium phosphate or 302 mg/kg-day Al as aluminium hydroxide in the diet for 28 days (Hicks et al. 1987). In a subchronic study in which aluminium nitrate was administered in drinking-water to rats, the only effect observed was a significant decrease in body weight gain associated with a decrease in food consumption at 261 mg/kg-day Al; the corresponding NOEL was 52 mg/kg-day Al (Domingo et al. 1987). These subchronic studies support the thresholds developed from RAIS.

- Aluminum Acute TRV – 261 mg/kg (RAIS Literature Review; Bast [1993]).

Bast, C.B. 1993. *Toxicity Summary for Aluminum*. Chemical Hazard Evaluation Group, Biomedical Environmental Information Analysis Section, Health Sciences Research Division, Oak Ridge, Tennessee. Prepared for Oak Ridge Reservation Environmental Restoration Program. September 1993.

Domingo, J.L., J.M. Llobet, M. Gomez, J.M. Tomas, and J. Corbella. 1987. Nutritional and toxicological effects of short-term ingestion of aluminum by the rat. *Res. Commun. Chem. Pathol. Pharmacol.* 56:409-419.

Habs, H., B. Simon, K.U. Thiedmann, and P. Howe. 1997. *Environmental Health Criteria 194 – Aluminum*. Published under the joint sponsorship of the United Nations Environment Programme, the International Labour Organisation, and the World Health Organization, and produced within the framework of the Inter-Organization Programme for the Sound Management of Chemicals. Geneva, 1997.

Hicks, J.S., D.S. Hackett, and G.L. Sprague. 1987. Toxicity and aluminium concentration in bone following dietary administration of two sodium aluminium phosphate formulations in rats. *Food Chem Toxicol.* 25(7):533-538.

Llobet, J.M., J.L. Domingo, M. Gomez, et al. 1987. Acute toxicity studies of aluminum compounds - antidotal efficacy of several chelating agents. *Pharmacology and Toxicology* 60:280-283.

Ondreicka, R., E. Ginter, and J. Kortus. 1966. *Chronic toxicity of aluminum in rats and mice and its effects on phosphorus metabolism*. *Brit. J. Ind. Med.* 23:305-312.

VI.1.1.2 Antimony

Information from RAIS was available (Young 1992), and therefore was used to select an acute toxicity threshold. Toxic effects ranging from gastrointestinal disorders to death have been documented for animals following acute oral exposure to antimony compounds. Bradley and Frederick (1941) reported that a single dose (300 mg/kg Sb) of potassium antimony tartrate induced myocardial infarction and death in rats. However, several studies using inorganic antimony (metallic antimony, antimony oxide, or antimony trioxide) reported that doses as high as 27,410 mg/kg Sb were not fatal to rats (ATSDR 1990).

- Antimony Acute TRV – 300 mg/kg (RAIS Literature Review; Young [1992]).

Bradley, W.R. and W. G. Frederick. 1941. *The Toxicity of Antimony - Animal Studies.* Ind. Med. 10:15-22. (Cited in ATSDR, 1990).

ATSDR (Agency for Toxic Substances and Disease Registry). 1990. *Antimony*. ATSDR/U.S. Public Health Service.

Young, R.A. 1992. *Toxicity Summary for Antimony*. Chemical Hazard Evaluation and Communication Group, Biomedical and Environmental Information Analysis Section, Health and Safety Research Division, Oak Ridge, Tennessee. Prepared for Oak Ridge Reservation Environmental Restoration Program. December 1992.

VI.1.1.3 Barium

Information from RAIS was available (Francis and Forsyth 1992), and therefore was used to select an acute toxicity threshold. The LD50 for rats is listed as 630 mg/kg for barium carbonate, 118 mg/kg for barium chloride, and 921 mg/kg for barium acetate (Lewis and Sweet 1984).

- Barium Acute TRV – 118 mg/kg (RAIS Literature Review; Francis and Forsyth [1992]).

Francis, A.A. and C.S. Forsyth. 1992. *Toxicity Summary for Barium*. Chemical Hazard Evaluation Group in the Biomedical and Environmental Information Analysis Section, Health Sciences Research Division, Oak Ridge, Tennessee. Prepared for Oak Ridge Reservation Environmental Restoration Program.

Lewis, R. J. and D. V. Sweet, eds. 1984. *Registry of Toxic Effects of Chemical Substances*, Vol. 1. U.S. Department of Health and Human Services, Public Health Service, Center for Disease Control, National Institute for Occupational Safety and Health, Cincinnati, OH.

VI.1.1.4 Boron

Information from RAIS was not available; therefore the following data were compiled from Smallwood (1998).

The oral LD50 values for boric acid and borax in laboratory animals are summarized in Smallwood (1998). Reported values for rodents are generally in the range of approximately 400 to 700 mg/kg boron (Pfeiffer et al. 1945; Weir and Fisher 1972). For guinea-pigs, Verbitskaya (1975) reported an oral LD50 of 210 mg/kg boron. Acute oral LD50 values in the range of 250 to 350 mg/kg boron for boric acid or borax exposure have also been reported for dogs, rabbits, and cats (Pfeiffer et al. 1945; Verbitskaya 1975).

Toxic signs in dogs given boric acid (200 to 2,000 mg/kg body weight) orally in combination with subcutaneous morphine to prevent vomiting were cyanosis of mucous membranes, red-violet skin colour, rigidity of legs, convulsion, and shock-like syndrome (Pfeiffer et al. 1945). Rabbits given boric acid at 800 mg/kg body weight per day for 4 days showed anorexia, weight loss, and diarrhoea; 850 and 1,000 mg/kg body weight per day for 4 days caused 100% mortality (Draize and Kelley 1959).

- Boron Acute TRV – 210 mg/kg (Environmental Health Criteria; Smallwood [1998]).

Draize, J.H. and E.A. Kelley. 1959. *The Urinary Excretion of Boric Acid Preparations Following Oral Administration and Topical Applications to Intact and Damaged Skin of Rabbits*. *Toxicol. Appl. Pharmacol.* 1: 267-276.

Green, G.H. and H.J. Weeth. 1977. Responses of Heifers Ingesting Boron in Water. J Anim Sci, 46: 812-818.

Pfeiffer, C.C., L.F. Hallman and I. Gersh. 1945. Boric Acid Ointment: A Study of Possible Intoxication in the Treatment of Burns. *J. Am Med. Assoc.* 128:266-274.

Smallwood, C. 1998. *Environmental Health Criteria 18 – Boron*. Published under the joint sponsorship of the United Nations Environment Programme, the International Labour Organisation, and the World Health Organization, and produced within the framework of the Inter-Organization Programme for the Sound Management of Chemicals. Geneva, 1998.

Verbitskaya, G.V. 1975. Experimental and field investigations concerning the hygienic evaluation of boron-containing drinking water. *Gig i Sanit.* 7:49-53.

Weir, R.J. and R.S. Fisher. 1972. Toxicologic studies on borax and boric acid. *Toxicol Appl Pharmacol.* 23:351-364.

VI.1.1.5 Cadmium

Information from RAIS was available (Young 1991), and therefore was used to select an acute toxicity threshold. Oral LD50 values for animals ranged from 225 to 890 mg/kg for elemental cadmium, 63 to 88 mg/kg for cadmium chloride, 72 mg/kg for cadmium oxide, and 590 to 1,125 mg/kg for cadmium stearate (USAF 1990).

Oral LD50 values for animals range from 225 to 890 mg/kg for elemental cadmium, (USAF 1990).

- Cadmium Acute TRV – 63 mg/kg (RAIS Literature Review; Young [1991]).

USAF (United States Air Force). 1990. Cadmium. In: *Installation Restoration Program Toxicology Guide*, Vol. 5. Harry G. Armstrong Aerospace Medical Research Laboratory, Wright Patterson AFB, OH.

Young, R.A. 1991. *Toxicity Summary for Cadmium*. Chemical Hazard Evaluation and Communication Group, Biomedical and Environmental Information Analysis Section, Health and Safety Research Division, Oak Ridge, Tennessee. Prepared for Oak Ridge Reservation Environmental Restoration Program. November 1991.

VI.1.1.6 Chromium

Information from RAIS was available (Daugherty 1992), and therefore was used to select an acute toxicity threshold. Because the gastrointestinal absorption of chromium is poor, the oral toxicity of the metal has been attributed to factors other than systemic poisoning, such gastrointestinal bleeding (Hamilton and Wetterhahn 1988). Oral LD50 values for hexavalent chromium compounds ranged from 54 mg/kg for ammonium dichromate in the rat (Gad et al. 1986) to 300 mg/kg for potassium chromate in the mouse (Shindo et al. 1989). The oral LD50 threshold for trivalent chromium in the rat is 11.26 g/kg (chromic acetate) (Smyth et al. 1969).

- Chromium Acute TRV – 54 mg/kg (RAIS Literature Review; Daugherty [1992]).

Daugherty, M.L. 1992. *Toxicity Summary for Chromium*. Chemical Hazard Evaluation and Communication Group, Biomedical and Environmental Information Analysis Section, Health and Safety Research Division, Oak Ridge, Tennessee. Prepared for Oak Ridge Reservation Environmental Restoration Program. September 1992.

Gad, S.C., W.J. Powers, B.J. Dunn, et al. 1986. Acute toxicity of four chromate salts. In: Serrone, D.M., Ed. *Proceedings of the Chromium Symposium - 1986: An Update*. May 20-21, 1986. Industrial Health Foundation, Inc., Pittsburgh, PA, pp. 43-58.

Hamilton, J.W. and K.E. Wetterhahn. 1988. Chromium. In: Seiler, H.G. and H. Sigel, Eds. *Handbook on Toxicity of Inorganic Compounds*. Marcel Dekker, Inc., New York, pp. 239-250.

Shindo, Y., Y. Toyoda, K. Kawamura et al. 1989. Micronucleus test with potassium chromate (VI) administered intraperitoneally and orally to mice. *Mutat. Res.* 223:403-406.

Smyth, H.F., C.P. Carpenter, C.S. Weil et al. 1969. Range-finding toxicity data: List VII. *Am. Ind. Hyg. Assoc. J.* 30:470-476.

VI.1.1.7 Cobalt

Information from RAIS was not available; therefore the following data were compiled from Kim et al. (2006).

Oral LD50 values are dependent on the type of cobalt compound tested and the test species. Wistar rats and Sprague-Dawley rats exhibited LD50 values ranging from 42.4 mg/kg body weight Co (as cobalt chloride) to 317 mg/kg body weight Co (as cobalt carbonate) (FDRL 1984a,b,c; Singh and Junnarkar 1991). Tricobalt tetraoxide, an insoluble compound, exhibited an LD50 in Sprague-Dawley rats of 3,672 mg/kg body weight Co (FDRL 1984c). Speijers et al. (1982) reported an LD50 of 418 mg/kg body weight for cobalt chloride in Wistar rats. In male Swiss mice, LD50 values ranged from 89.3 mg/kg body weight Co (as cobalt chloride) to 123 mg/kg body weight Co (as cobalt sulfate) (Singh and Junnarkar 1991).

Male CFY rats exposed orally to cobalt chloride at 50 mg/kg-day (equivalent to 12.4 mg/kg-day Co) for 3 weeks and co-exposed to drinking-water that contained 10% ethanol and 5% sugar exhibited cardiac damage including degeneration of myofibrils (Morvai et al. 1993). The subchronic exposures represent a longer-term exposure than would be experienced during binging exposures of mammals; however, this threshold was retained in consideration of the small number of LD50 values available in the literature.

- Cobalt Acute TRV – 12.4 mg/kg (Inter-Organization Programme for the Sound Management of Chemicals; Kim et al. [2006]).

FDRL (Food and Drug Research Laboratories, Inc). 1984a. *Acute Oral LD50 Study of Cobalt Sulphate Lot No. S88336/A in Sprague-Dawley Rats*. Waverly, NY, Food and Drug Research Laboratories, Inc. April 11 1984 (FDRL Study No. 8005D).

FDRL. 1984b. *Study of Cobalt (II) Carbonate Tech Grade $CoCO_3$, Lot #030383 in Sprague-Dawley Rats*. Waverly, NY, Food and Drug Research Laboratories, Inc., 12 April 1984.

FDRL. 1984c. Acute Oral Toxicity Study of Cobalt Oxide Tricobalt Tetraoxide in Sprague-Dawley Rats. Waverly, NY, Food and Drug Research Laboratories, Inc., 5 April 1984.

Kim, J.H., H.J. Gibb, and P.D. Howe. 2006. *Cobalt and inorganic cobalt compounds*. Concise International Chemical Assessment Document 69. Published under the joint sponsorship of the United Nations Environment Programme, the International Labour Organization, and the World Health Organization, and produced within the framework of the Inter-Organization Programme for the Sound Management of Chemicals.

Morvai V, E. Szakmary, E. Tatrai, G. Ungvary, G. Folly. 1993. The effects of simultaneous alcohol and cobalt chloride administration on the cardiovascular system of rats. *Acta Physiologica Hungarica* 81(3):253–261.

Singh P.P. and A.Y. Junnarkar. 1991. Behavioral and toxic profile of some essential trace metal salts in mice and rats. *Indian Journal of Pharmacology* 23:153–159.

Speijers, G.J.A., E.I. Krajnc, J.M. Berkvens, and M.J. van Logten. 1982. Acute oral toxicity of inorganic cobalt compounds in rats. *Food and Chemical Toxicology* 20:311–314.

VI.1.1.8 Copper

Information from RAIS was available (Faust 1992), and was used to select an acute toxicity threshold. The threshold rat oral LD50 value for various copper compounds are 140 mg/kg for copper chloride ($CuCl_2$); 470 mg/kg for copper oxide (Cu_2O); 940 mg/kg for copper nitrate [$Cu(NO_3)_2 3H_2O$]; and 960 mg/kg for copper sulfate ($CuSO_4 5\ H_2O$) (Stokinger 1981). Deaths in animals given lethal doses of copper have been attributed to extensive hepatic centrilobular necrosis (U.S. Air Force 1990).

- Copper Acute TRV – 140 mg/kg (RAIS; Faust [1992]).

Faust, R.A. 1992. *Toxicity Summary for Copper*. Chemical Hazard Evaluation and Communication Group, Biomedical and Environmental Information Analysis

Section, Health and Safety Research Division, Oak Ridge, Tennessee. Prepared for Oak Ridge Reservation Environmental Restoration Program. December 1992.

Stokinger, H.E. 1981. Copper. In: G.D. Clayton and E. Clayton, Eds, *Patty's Industrial Hygiene and Toxicology*, Vol. 2A. John Wiley & Sons, New York, NY, pp. 1620-1630.

U.S. Air Force. 1990. Copper. In: *The Installation Program Toxicology Guide*, Vol. 5. Wright-Patterson Air Force Base, Ohio, pp. 77(1-43).

VI.1.1.9 Iron

Information from RAIS was not available for iron; therefore, the threshold was derived from a brief literature review, and from review of a technical summary of studies conducted by the World Health Organization (WHO 1983).

Albertsen (2006) described an acute study in dogs where no clinical signs were expected in dogs ingesting less than 20 mg/kg iron, whereas mild clinical symptoms developed at 60 mg/kg. Oral doses between 100 and 200 mg/kg were reported as being “potentially lethal”.

WHO (1983) described the following studies:

- The oral LD50 in mice was studied by Weaver et al. (1961). The lowest value determined was 305 mg/kg for ferrous sulfate.
- Ferrous sulfate exhibited no maternal toxicity or teratogenic effects at dose levels up to 160 mg/kg in mice and 200 mg/kg in rats (Food and Drug Research Laboratories 1974).
- Ferric sodium pyrophosphate exhibited no maternal toxicity or teratogenic effects at dose levels up to 160 mg/kg in mice and rats (Food and Drug Research Laboratories 1975).
- The lowest acute effects threshold observed was for ferric chloride in the rat (LD50 of 28 mg/kg; Hoppe et al. 1955), but this value appears anomalously low relative to the much higher LD50s observed in other studies and given the expected range of potential lethality (100 to 200 mg/kg) described by Albertsen (2006). Elemental iron was much less toxic than other forms of administered iron.
- The acute iron TRV selected is: Iron Acute TRV – 60 mg/kg; Albertsen 2006)

Albretsen, J.A. 2006. The toxicity of iron, an essential element. Vet. Med. 2006: 82-90.

Food and Drug Research Laboratories. 1974. *Teratologic evaluation of FDA 71-64 (ferrous sulphate) in mice and rats*. Unpublished report from Food and Drug Research Laboratories, Inc., Waverly, N.Y., United States of America. Submitted to the World Health Organization by the United States Food and Drug Administration.

Food and Drug Research Laboratories. 1975. *Teratologic evaluation of FDA 73-83 (ferric sodium pyrophosphate) in mice and rats*. Unpublished report from Food and Drug Research Laboratories, Inc., Waverly, N.Y., United States of America. Submitted to the World Health Organization by the United States Food and Drug Administration.

Hoppe, J.O., G.M. Marcelli, and M.L. Tainter. 1955. A review of the toxicity of iron compounds. *Am. J. Med. Sci.* 230(5):558-571.

Weaver, L.C. et al. 1961. Comparative toxicology of iron compounds. *Am. J. Med. Sci*. 241:296-302.

World Health Organization (WHO). 1983. WHO Food Additives Series 18. Joint FAO/WHO Expert Committee on Food Additives. Evaluation of certain food additives (Eighteenth report of the Joint FAO/WHO Expert Committee on Food Additives). WHO Technical Report Series, No. 557, 1983. Available at: http://www.inchem.org/documents/jecfa/jecmono/v18je18.htm.

VI.1.1.10 Lead

Information from RAIS was not available for lead; therefore, the threshold was derived from a technical summary of studies conducted by the International Programme on Chemical Safety (IPCS; Carrington et al. 2000). Lead is a classical chronic or cumulative toxicant, and health effects are generally not observed after a single exposure, therefore LD50 values are lacking in the literature. However, some short term toxic effects have been documented. The lowest observed lethal doses in animals after short-term oral exposure to lead acetate, lead chlorate, lead nitrate, lead oleate, lead oxide, and lead sulfate range from 300 to 4000 mg/kg. In these studies, the doses were provided in multiple administrations (Lewis 1992; ATSDR 1997). The wide range in toxicity threshold is attributable to differences in absorption of the various lead salts and differences in exposure (Carrington et al. 2000).

- Lead Acute TRV – 300 mg/kg (IPCS; Carrington et al. 2000).

ATSDR (Agency for Toxic Substances and Disease Registry). 1997. *Toxicological Profile for Lead*, Atlanta, GA: Department of Health and Human Services.

Carrington, C., M. Bolger, J.C. Larsen, and B. Peterson. 2000. *Safety Evaluation of Certain Food Additives Series 44*. International Programme on Chemical Safety, World Health Organization. Prepared by the Fifty-third meeting of the Joint FAO/WHO Expert Committee on Food Additives (JECFA). World Health Organization, Geneva, 2000. Available at: http://www.inchem.org/documents/jecfa/jecmono/v44jec12.htm.

Lewis, R.J., Ed. 1992. *Sax's Dangerous Properties of Industrial Chemicals*, 8th Edition. New York: Van Nostrand Rheinhold.

VI.1.1.11 Molybdenum

Information from RAIS was available (Opresko 1993) and therefore was used to select an acute toxicity threshold. Severe gastrointestinal irritation, diarrhea, coma and death from cardiac failure are the symptoms of acute molybdenosis. Oral LD50 values of 188 mg/kg (125 mg Mo/kg) for molybdenum trioxide and 680 mg/kg (370 mg Mo/kg) for ammonium molybdate have been reported for laboratory rats. Oral LD100 values of 2,200 mg/kg (1,200 mg Mo/kg), 1,870 mg/kg (1,020 mg Mo/kg), and 2,400 mg/kg (1,310 mg Mo/kg) have also been reported for guinea pigs, rabbits and cats, respectively, dosed with ammonium molybdate (Venugopal and Luckey 1978).

- Molybdenum Acute TRV of 125 mg/kg (RAIS Literature Review; Opresko [1993]).

Opresko D.M. 1993. *Toxicity Summary for Molybdenum*. Chemical Hazard Evaluation Group, Biomedical and Environmental Information Analysis Section, Health and Safety Research Division, Oak Ridge, Tennessee. Prepared for: Oak Ridge Reservation Environmental Restoration Program. January 1993.

VI.1.1.12 Nickel

Information from RAIS was available (Young 1995), and therefore was used to select an acute toxicity threshold. Reported oral LD50 values for rats ranged from 67 mg/kg Ni for nickel sulphate hexahydrate to greater than 9,000 mg/kg Ni for nickel powder (ATSDR 1988). Generally, soluble nickel compounds are more toxic than insoluble compounds.

- Nickel Acute TRV – 67 mg/kg (RAIS Literature Review; Young [1995]).

ATSDR (Agency for Toxic Substances and Disease Registry). 1988. *Toxicological Profile for Nickel*, ATSDR/U.S. Public Health Service, ATSDR/TP-88/19.

Young, R. 1995. *Toxicity Summary for Nickel and Nickel Compounds*. Chemical Hazard Evaluation Group, Biomedical and Environmental Information Analysis Section, Health Sciences Research Division, Oak Ridge, Tennessee. Prepared for Oak Ridge Reservation Environmental Restoration Program. July 1995.

VI.1.1.13 Selenium

Information from RAIS was available (Opresko 1993), and therefore was used to select an acute toxicity threshold.

The acute oral toxicity of selenium varies with the solubility of the chemical compound in which it occurs; the more soluble compounds such as sodium selenite and sodium selenate are more toxic than the less soluble elemental selenium, selenium sulfide and selenium disulfide (ATSDR 1989). Oral LD50 values for sodium selenite ranged from 1 to 7 mg/kg Se (rats, rabbits, mice, and guinea pigs), whereas an LD50 of 138 mg/kg Se has been reported for selenium disulfide, and a 10-d LD50 of 6,700 mg/kg Se has been reported for elemental selenium administered to rats (Cummins and Kimura 1971; Pletnikova 1970).

- Selenium Acute TRV – 1 mg/kg (RAIS Literature Review; Opresko [1993]).

ATSDR (Agency for Toxic Substances and Disease Registry). 1989. *Toxicological Profile for Selenium*. Agency for Toxic Substances and Disease Registry, U.S. Public Health Service, Atlanta GA.

Cummins, L.M. and E.T. Kimura. 1971. Safety evaluation of selenium sulfide antidandruff shampoos. *Toxicol. Appl. Pharmacol*. 20: 89-96. (Cited in ATSDR, 1989).

Opresko, D.M. 1993. *Toxicity Summary for Selenium*. Chemical Hazard Evaluation Group, Biomedical Environmental Information Analysis Section, Health and

Safety Research Division, Oak Ridge, Tennessee. Prepared for Oak Ridge Reservation Environmental Restoration Program. March 1993.

Pletnikova, I.P. 1970. Biological effect and safe concentration of selenium in drinking water. *Hyg. Sanit.* 35: 176-180. (Cited in ATSDR, 1989).

VI.1.1.14 Strontium

Information from RAIS was available (Talmage 1994), and therefore was used to select an acute toxicity threshold. Soluble stable strontium compounds are of a low order of acute toxicity with LD50 values for several species ranging from 1,826 mg/kg [$Sr(NO_3)$2, mouse] to 7500 mg/kg (SrCl2, rabbit) (U.S. EPA 1988).

- Strontium Acute TRV – 1826 mg/kg (RAIS Literature Review; Talmage[1994]).

U.S. EPA (United States Environmental Protection Agency). 1988. *Drinking Water Criteria Document for Stable Strontium*. ECAO-CIN-DO11, Environmental Criteria and Assessment Office, Cincinnati, OH.

Talmage, S.S. 1992. *Toxicity Summary for Strontium 90*. Chemical Hazard Evaluation and Communication Group, Biomedical and Environmental Information Analysis Section, Health and Safety Research Division, Oak Ridge, Tennessee. Prepared for Oak Ridge Reservation Environmental Restoration Program. March 1994.

VI.1.1.15 Thallium

Information from RAIS was available (Borges and Daugherty, 1994) and was used to select an acute toxicity threshold .Animal studies in various species have shown that the acute toxicity of various soluble and insoluble, organic and inorganic thallium salts (malonate, acetate, sulfate, nitrate, carbonate, and oxide) are independent of the anion, the valence (thallous or thallic), and animal species (rat, mouse, guinea pig, rabbits, and hamster) (Stokinger 1981; Aoyama 1989). The acute oral LD50s of various thallium salts, expressed as mg thallium/kg body weight, range between 15 to 50 mg/kg (Stokinger 1981; U.S. EPA 1988). Death results from respiratory failure (Munch 1928).

- Thallium Acute TRV – 15 mg/kg (RAIS Literature Review; Borges and Daugherty [1994]).

Borges T. and M.L. Daugherty. 1994. Toxicity Profile for Thallium. Chemical Hazard Evaluation Group, Biomedical and Environmental Information Analysis Section, Health Sciences Research Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee. Prepared for Oak Ridge Reservation Environmental Restoration Program. December 1994.

VI.1.1.16 Titanium

Information from RAIS was not available for titanium; therefore, the threshold was derived from a technical summary of studies conducted by the World Health Organization (WHO 1982).

Titanates suspended in corn oil showed that the intraperitoneal LD50 for rats was 3.0 g/kg body weight (bw) for barium titanate, 2.2 g/kg bw for bismuth titanate, 5.3 g/kg bw for calcium titanate, and 2.0 g/kg bw for lead titanate. The corresponding oral LD50 was more than 12 g/kg bw (12,000 mg/kg bw; Brown & Mastromatteo 1962).

- Titanium Acute TRV – 12,000 mg/kg (RAIS Literature Review; Borges and Daugherty [1994]).

Brown, J.R. and Mastromatteo, E. 1962 Acute oral and parenteral toxicity of four titanate compounds in the rat. Ind. Med. Surg., 31: 302-304.

WHO (World Health Organization). 1982. Environmental Health Criteria 24: Titanium. Available at: http://www.inchem.org/documents/ehc/ehc/ehc24.htm.

VI.1.1.17 Vanadium

Information from RAIS was available (Opresko 1991), and therefore was used to select an acute toxicity threshold. LD50 values for sodium metavanadate administered by gavage to rats and mice are 41 mg/kg V and 31 mg/kg V, respectively (ATSDR 1990).

- Vanadium Acute TRV – 31 mg/kg (RAIS Literature Review; Opresko [1991]).

ATSDR (Agency for Toxic Substances and Disease Registry). 1990. *Toxicological Profile for Vanadium*. Prepared by Clement Associates, Inc., under Contract

205-88-0608. Agency for Toxic Substances and Disease Registry, U.S. Public Health Service, Atlanta, GA. report, October 1990.

Opresko, D.M. 1991. *Toxicity Summary for Vanadium*. Chemical Hazard Evaluation and Communication Group, Biomedical and Environmental Information Analysis Section, Health and Safety Research Division Oak Ridge, Tennessee. Prepared for Oak Ridge Reservation Environmental Restoration Program. December 1991.

VI.1.1.18 Zinc

Information from RAIS was available (Opresko 1992), and therefore was used to select an acute toxicity threshold. The acute toxic effects of zinc have been observed in animals in both the field and laboratory. In laboratory studies, hepatic and gastrointestinal lesions and pancreatitis occurred in sheep treated for 13 days with 33 mg/kg-day Zn (as zinc sulfate) (Allen et al. 1983). Mortality, pancreatitis, diffuse nephrosis, intestinal hemorrhages, and anemia were observed in ferrets administered 850 mg/kg-day Zn (as zinc oxide in the diet) for 9 to 13 days (Straube et al. 1980). A dose level of 425 mg/kg-day Zn over 7 to 21 days also resulted in nephrosis, pancreatitis, and anemia, as well as fatty infiltration of the liver.

Other acute lethality values for varous zinc compounds are as follows: 250 mg/kg for zinc fluoride (guinea pigs); 1,190 mg/kg LD50 for zinc nitrate hexahydrate (rats); 2,200 mg/kg for zinc sulfate heptahydrate (rats); and 2,460 mg/kg for zinc acetate dihydrate (rats) (Stokinger, 1981).

- Zinc Acute TRV – 33 mg/kg (RAIS Literature Review; Opresko [1992]).

Allen, J.G., H.G. Master, and R.L. Peet. 1983. Zinc toxicity in ruminants. *J. Comp. Pathol.* 93:363-377. (Cited in ATSDR, 1989).

ATSDR (Agency for Toxic Substances and Disease Registry). 1989. *Toxicological Profile for Zinc*. Agency for Toxic Substances and Disease Registry, U.S. Public Health Service, Atlanta, GA. 121 pp. ATSDR/TP-89-25.

Opresko, D.M. 1992. *Toxicity Summary for Zinc*. Chemical Hazard Evaluation and Communication Group, Biomedical and Environmental Information Analysis Section, Health and Safety Research Division, Oak Ridge, Tennessee. Prepared for Oak Ridge Reservation Environmental Restoration Program. April 1992.

Stokinger, H.E. 1981. Zinc. In: *Patty's Industrial Hygiene and Toxicology*, 3rd rev. ed., vol. 2A. G.D. Clayton and E. Clayton, eds., John Wiley and Sons, New York. pp. 20332049.

Straube, E.F. N.H. Schuster, and A.J. Sinclair. 1980. Zinc toxicity in the ferret. *J. Comp. Pathol.* 90:355-361. (Cited in ATSDR, 1989).

Table VI-1 Summary of Acute Toxicity Reference Values for Mammals

Chemicals	Acute Toxicity Threshold [mg/kg bw]	Document Source
Aluminum	162	RAIS
Antimony	300	RAIS
Barium	118	RAIS
Boron	210	IPCS - Environmental Health Criteria
Cadmium	63	RAIS
Chromium	54	RAIS
Cobalt	12.4	Inter-Organization Programme for the Sound Management of Chemicals
Copper	140	RAIS
Iron	28	FAO/WHO Expert Committee on Food Additives
Lead	300	International Programme on Chemical Safety
Molybdenum	125	RAIS
Nickel	67	RAIS
Selenium	1	RAIS
Strontium	1826	RAIS
Titanium	12,000	WHO
Thallium	15	RAIS
Vanadium	31	RAIS
Zinc	33	RAIS

Note: mg/kg bw = milligram per kilogram body weight.

APPENDIX VII

2011 TERRESTRIAL BASELINE SAMPLING FOR SOIL, PLANTS AND SOIL INVERTEBRATES

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VII.1 INTRODUCTION

A soil vegetation, and soil invertebrate baseline sampling program was completed in September 2011 for the Gahcho Kué Project (Project) to support the human health and wildlife ecological risk assessments. Four vegetation types were targeted for sampling - cranberries (or crowberries), dwarf birch leaves, lichen and grass. Cranberries (or crowberries) were chosen to represent food that humans in the local community and wildlife would eat while leaves, lichen and grass were chosen to represent food that wildlife would feed on. Invertebrates (as ants) were also collected to represent the typical concentrations of chemicals that would be found in invertebrates in the area that could be consumed by terrestrial wildlife. The following is included in this report:

- a description of the soil, vegetation and invertebrate baseline sampling program methods;
- a figure with sampling locations;
- the chemistry results for the soil, vegetation and soil invertebrate sampling program; and
- a Quality Assurance and Quality Control (QA/QC) assessment for the baseline soil and vegetation data using replicate samples.

VII.2 OBJECTIVES

A baseline sampling program was completed to acquire additional soil, vegetation and soil invertebrate chemistry (metals and polycyclic aromatic hydrocarbons, [PAHs]) for use in the human health and I wildlife ecological risk assessments for Project. The data provide site-specific chemistry results that will be used in the bioaccumulation models and exposure concentrations in the human health and wildlife ecological risk assessment.

The objective for the soil, vegetation and soil invertebrate baseline sampling program were:

- To measure metals and PAHs in soil, vegetation and soil invertebrates in the Project Area for use in the human health and wildlife ecological risk assessment.

VII.2.1 Sample Locations

Field sampling was conducted from September 14 to 17 in 2011 and was conducted by Golder Associates Ltd. Mr. Pete Enzoe of Łutsel K'e assisted Golder Associates with the sample collection. Sample locations and types of samples from each location are provided in Table VII-1. Figure VII-1 depicts the sampling locations.

Table VII-1 Summary of Soil and Plant Sampling Locations in the Project Area

Date	Plot	Coordinates		Soil Sample Identification	Vegetation Sample Type	Plant Sample Identification	Plant Sample Type	Type of Analysis	Notes and Observations
		UTM N	UTM E						
Sept 14, 2011	S01	590042	7035548	2011-GK-S-01	Upland tundra	2011-GK-B-01	Cranberry	Metals/PAHs	2 to 4 cm organic soil over brown sand with some clay and grey sand
						2011-GK-LV-01	Dwarf birch leaves	Metals/PAHs	
						2011-GK-L-01	Lichen	Metals/PAHs	
	S02	590415	7035679	2011-GK-S-02, 2011-GK-S-02-D	Upland tundra	2011-GK-B-02, 2011-GK-B-02-D	Cranberry	Metals/PAHs	Duplicate; 2 to 4 cm organic soil over brown sand with some clay and grey sand
						2011-GK-B-02-Crowberry	Crowberry	Metals/PAHs	
						2011-GK-LV-02, 2011-GK-LV-02-D	Dwarf birch leaves	Metals/PAHs	
						2011-GK-L-02, 2011-GK-L-02-D	Lichen	Metals/PAHs	
	S03	591191	7035616	2011-GK-S-03	Upland tundra	2011-GK-B-03	Cranberry	Metals/PAHs	5 cm organic soil over brown and grey sand
						2011-GK-B-03-Crowberry	Crowberry	Metals/PAHs	
						2011-GK-LV-03	Dwarf birch leaves	Metals/PAHs	
						2011-GK-LV-03	Lichen	Metals/PAHs	
	S04	589568	7035738	2011-GK-S-04	Upland tundra	2011-GK-B-04	Cranberry	Metals/PAHs	10 cm black organic soil
						2011-GK-LV-04	Dwarf birch leaves	Metals/PAHs	
						2011-GK-L-04	Lichen	Metals/PAHs	
Sept 15, 2011	S05	588388	7035197	2011-GK-S-05	Upland tundra	2011-GK-B-05	Cranberry	Metals/PAHs	1 to 2 cm organic layer over gravel and sand
						2011-GK-B-05	Dwarf birch leaves	Metals/PAHs	
						2011-GK-B-05	Lichen	Metals/PAHs	
						2011-GK-G-05	Grass	Metals/PAHs	
	S06	589740	7036402	2011-GK-S-06	Upland tundra	2011-GK-B-06	Cranberry	Metals/PAHs	2 to 3 cm brown soil over light brown sand.
						2011-GK-LV-06	Dwarf birch leaves	Metals/PAHs	
						2011-GK-L-06	Lichen	Metals/PAHs	
						2011-GK-G-06	Grass	Metals/PAHs	
	S07	588699	7038283	2011-GK-S-07	Upland tundra	2011-GK-B-07	Cranberry	Metals/PAHs	Dark brown organic soil down past 12 cm.
						2011-GK-LV-07	Dwarf birch leaves	Metals/PAHs	
						2011-GK-L-07	Lichen	Metals/PAHs	

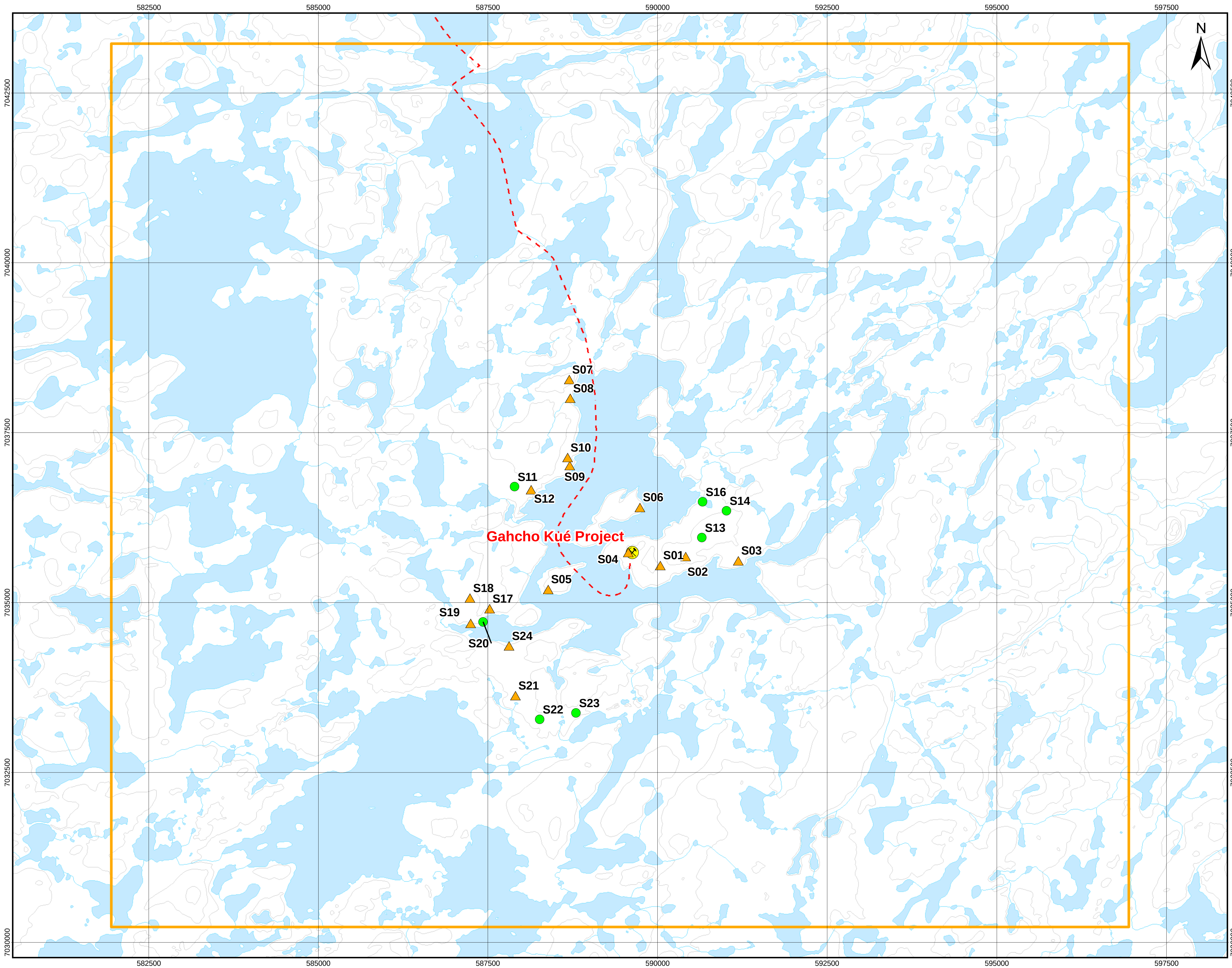
Table VII-1 Summary of Soil and Plant Sampling Locations in the Project Area (continued)

Date	Plot	Coordinates		Soil Sample Identification	Vegetation Sample Type	Plant Sample Identification	Plant Sample Type	Type of Analysis	Notes and Observations
		UTM N	UTM E						
Sept 15, 2011 (con't)	S08	588714	7038010	2011-GK-S-08	Lowland hummocks	2011-GK-G-08	Grass	Metals/PAHs	Peat. No sand or rocks.
	S09	588707	7037019	2011-GK-S-09, 2011-GK-S-09-D	Upland tundra	2011-GK-B-09, 2011-GK-B-09-D	Cranberry	Metals/PAHs	Duplicate; 2 to 4 cm organic soil over light brown sandy layer.
						2011-GK-LV-09, 2011-GK-LV-09-D	Dwarf birch leaves	Metals/PAHs	
						2011-GK-L-09, 2011-GK-L-09-D	Lichen	Metals/PAHs	
	S10	588676	7037136	2011-GK-S-10, 2011-GK-S-10-D	Lowland hummocks	2011-GK-G-10, 2011-GK-G-10-D	Grass	Metals/PAHs	Duplicate; Peat. No sand or rocks.
	S11	587891	7036707	2011-GK-S-11	Upland tundra	-	-	Metals/PAHs	1 cm organic brown soil over light brown sandy soil.
	S12	588137	7036664	2011-GK-S-12	Lowland hummocks	2011-GK-G-12	Grass	Metals/PAHs	Peat. No sand or rocks.
Sept 16, 2011	S13	590652	7035957	2011-GK-S-13	Upland tundra	-	-	Metals/PAHs	1-2 cm organic soil layer over light brown sandy soil.
	S14	519014	7036353	2011-GK-S-14	Upland tundra	-	-	Metals/PAHs	3 to 5 cm dark organic soil with sand and pebbles.
	S15								
	S16	590663	7036483	2011-GK-S-16	Lowland hummocks	-	-	Metals/PAHs	Peat. No sand or rocks.
Sept 17, 2011	S17	587525	7034911	2011-GK-S-17	Upland tundra	2011-GK-B-17	Cranberry	Metals/PAHs	4 to 6 cm organic layer with sand and pebbles.
						2011-GK-LV-17	Dwarf birch leaves	Metals/PAHs	
						2011-GK-L-17	Lichen	Metals/PAHs	
	S18	587237	7035068	2011-GK-S-18	Lowland hummocks	2011-GK-G-18	Grass	Metals/PAHs	Peat. No sand or rocks.
	S19	587246	7034695	2011-GK-S-19	Transition from upland tundra to lowland hummocks	2011-GK-B-19	Cranberry	Metals/PAHs	2 cm brown organic layer over light brown sand.
						2011-GK-LV-19	Dwarf birch leaves	Metals/PAHs	
						2011-GK-L-19	Lichen	Metals/PAHs	
						2011-GK-G-19	Grass	Metals/PAHs	

Table VII-1 Summary of Soil and Plant Sampling Locations in the Project Area (continued)

Date	Plot	Coordinates		Soil Sample Identification	Vegetation Sample Type	Plant Sample Identification	Plant Sample Type	Type of Analysis	Notes and Observations
		UTM N	UTM E						
Sept 17, 2011 (con't)	S20	587426	7034718	2011-GK-S-20, 2011-GK-S-20-D	Lowland hummocks	-	-	Metals/PAHs	Duplicate; 2 cm dark organic brown soil over light brown sandy soil.
	S21	587906	7033630	2011-GK-S-21	Lowland hummocks	2011-GK-G-21	Grass	Metals/PAHs	Peat. No sand or rocks.
	S22	588261	7033282	2011-GK-S-22	Transition from upland tundra to lowland hummocks	-	-	Metals/PAHs	Peat. No sand or rocks.
	S23	588797	7033375	2011-GK-S-23	Upland tundra	-	-	Metals/PAHs	2 cm organic layer over light brown sandy with clay layer.
	S24	587811	7034363	2011-GK-S-24, 2011-GK-S-24-D	Lowland hummocks	2011-GK-G-24, 2011-GK-G-24-D	Grass	Metals/PAHs	Duplicate; Peat. No sand or rocks.
Sept 14 – 17, 2011	Ants	Collected opportunistically throughout the sampling area							

Note: PAHs – polycyclic aromatic hydrocarbons.



LEGEND

- Gahcho Kué Project
- Contour (10m interval)
- Winter Access Road
- Watercourse
- Waterbody
- Soil Sampling Location
- Soil and Vegetation Sampling Location
- Local Study Area

NOTES

Base data source: National Topographic Base Data (NTDB) 1:50,000

GAHCHO KUÉ PROJECT

2011 SAMPLING LOCATIONS FOR SOIL AND VEGETATION

PROJECTION: UTM Zone 12	DATUM: NAD83	DE BEERS CANADA
Scale: 1:55,000 1,000 500 0 1,000 Meters		
FILE No: B2011-Soils-002-GIS		DATE: 30 July. 2012
JOB NO: 11-1365-0001	REVISION NO: 1	Figure VII-1
OFFICE: GOLD-CAL	DRAWN: GU	CHECK: JF

I:\CLIENTS\DE_BEERS\11-1365-0001\Mapping\MXD\Soil&Terrain\B2011-Soils-002-GIS.mxd

VII.3 COLLECTION METHODS

Samples were collected from a plot approximately 20 m in radius from the selected soil sample location. Collection efforts started nearest to the soil sample, and moved outwards as necessary to collect sufficient quantity and to sample from several different areas within the plot. Sites were accessed by boat and foot from the camp, between 14 and 17 September, 2011 (Figure VII-1). Sample sites were selected based on the presence of sufficient soil, and the availability and abundance of berries, leaves, lichen and grass within a 20 m radius area. The sites fell into one of three general categories which define the terrestrial landscape; dry upland tundra, moist hummock drainages, and transition areas. Berries, leaves and lichen were most common in the upland areas, and grasses in the hummock drainages. Each site was described and photographed.

The soil, plant and soil invertebrate samples were placed in a freezer within 10 hours of collection.

VII.3.1 Soil Collection Method

Soil samples were collected with a plastic hand-trowel. Surface vegetation and litter was removed and then a sufficient amount of soil (enough to fill two 250 mL glass jars) was placed in a clean, stainless steel bowl. Samples were collected from within 8 to 12 cm of the surface. Soil collection sites were selected based on the presence of at least 8 cm of accessible topsoil. For each soil sample, the soil type was documented, and then the soil samples were homogenized, and transferred to two 250 mL glass jars.

VII.3.2 Vegetation Collection Method

All plant samples were collected by hand. Knives and scissors were not used. Excess soil was removed by hand from the lichen and grass samples, if present. Nitrile gloves were used to collect plant samples, and changed between samples. At least 20 grams of each type of plant material was collected for each sample. Each sample was photographed.

Leaves were collected from swamp birch (Betula pumila) and some dwarf birch (Betula glandulosa) trees. These two species are similar in appearance and will occasionally form hybrids. They are abundant in the study area in upland tundra and transition areas. Boertje (1984) reported intensive feeding barren-ground caribou of the Denali herd on the closely related Betula nana in spring. They also have medicinal use for Aboriginal cultures (Marles et al. 2000). Birch was more abundant in the study area than willow, and was often found in both upland and lowland areas.

The lichens were collected included a number of species, ground-growing shrub lichens (i.e., crust lichens growing on rocks, or hair lichens growing on other plans), primarily reindeer lichen and similar from the Cladoina and Cladina genii (Johnson et al. 1995). Some leaf and club lichens were also obtained. Lichens were collected in clumps, each containing a community of several species. Lichens are a key component of the diet of barren-ground caribou, consumed throughout the year and constituting over 60% of the diet in winter (Boertje 1984). Lichens also have medicinal and food value for Aboriginal cultures (Marles et al. 2000).

Cranberries (Vaccinium vitis-idaea) were the primary type of berry collected. Cranberries were selected because they were abundant on the landscape, and are a traditional and contemporary food source for people (Marles et al. 2000), and are also an important food source for grizzly bears and black bears. Crowberry, alpine bearberry, bog cranberry and blueberry were also present, but these were either less abundant or are less important as a food source to humans and wildlife.

Sedge (Cyperaceae family) communities, collected without consideration to species were the primary type of grasses collected. Grasses were found in the lowland hummock areas, and usually in the transition areas. Grasses have some medicinal uses (Marles et al. 2000), and are a food source for caribou through the year, constituting up to 14% of the diet of the Denali barren-ground caribou (Boertje 1984).

VII.3.3 Invertebrate Collection Method

Ants were collected opportunistically throughout the study area. They were either collected by hand, or by a simple trap baited with strawberry jam.

VII.4 LABORATORY ANALYSES

Soil samples were submitted to ALS in Burnaby BC for analysis of the following:

- pH;
- metals and mercury; and
- PAHs.

Vegetation and soil invertebrate samples were submitted to ALS in Burnaby BC for analysis of the following:

- % moisture;
- total metals; and
- PAHs.

VII.4.1 Quality Assurance/Quality Control

For QA/QC purposes, replicate samples were collected at sites S02 (soil, berry, leaves and lichen), S09 (soil, berry, leaves and lichen), S10 (soil and grass), S20 (soil) and S24 (soil and grass). Sample replicates were collected at a rate of 10% of the total number of samples. Each duplicate was collected to provide an indication of sample variation and the reproducibility of the laboratory test methods. Replicate media samples were collected as a split quantity of the same homogenized soil sample (i.e., collected after sample homogenization in the field). Each replicate sample was submitted to the laboratory for chemical analysis under a unique sample number to prevent reporting bias.

The results of the replicate samples are often expressed as Relative Percent Difference (RPD). The RPD is used to assess variability between sample replicates and sample heterogeneity (i.e., was the soil adequately homogenized?). Lower RPD numbers indicate better precision in laboratory analysis and sample homogeneity. The formula for computing the RP is provided below:

$$\mathrm{RPD} = \frac{\mathrm{abs\ (sample - replicate)}}{\mathrm{mean}}\ \mathrm{x}\ 100$$

Where “RPD” is the relative percent difference, “abs (sample-replicate)” is the absolute value of the original sample minus the replicate sample and “mean” is the average of the duplicate samples.

Relative percent differences were not calculated if concentrations were below the detection limit. In accordance with the British Columbia Ministry of Environment Technical Guidance 19 on Contaminated Sites (BC MOE 2005), an RPD value of ± 35% for values that are ≥ 5 times the detection limit (DL) was used to identify notable differences between original and duplicate samples. Values less than five times the DL are not included in the RPD calculations because analytical variability near the MDL is much higher and does not provide a good measure of precision associated with the collection of field samples.

Although BC MOE (2005) does not specify an RPD value for organics analyses, the 35% guideline was used as a general indication of duplicate similarity.

Replicate samples which have a large RPD value may also indicate high sample variability, which can typically be attributed to laboratory analysis, sampling technique (applies to soil only and not vegetation) or natural sample heterogeneity (applies to soil and vegetation). Specific procedures were followed in the field during the collection of replicate soil samples (i.e., sample homogenization) to reduce the effect of sampling techniques on variability.

In addition to field QA/QC procedures, laboratory QA/QC indicated that the analyses conducted by ALS followed appropriate QA/QC procedures. Each analytical method and standard/certified sample has control limits that must be met to verify the results for both the standard/certified materials and the unknown samples submitted. These results were reported to Golder with each laboratory data summary report. The laboratory QA/QC analyses performed by ALS fell within acceptable control limits. With the following exceptions:

- RPD for laboratory duplicates exceed the ALS limit (30%) occasionally for individual metals in individual samples. There was no systematic bias in the limit exceedances and they were likely due to sample heterogeneity. These occasional RPD exceedances are unlikely to have affected data quality.
- Typical recommended holding times for PAHs in soils and tissues (14 days) were exceeded for most samples by approximately 1 week. This is typical of the challenges of collecting and transporting environmental samples from remote field locations. All samples were frozen within 10 hours of collection and the excess holding time is unlikely to have affected data quality.

VII.5 SAMPLING RESULTS

The following sections summarize metals and PAHs that were detected in soil, vegetation and invertebrate samples from the Project area. The analytical results for 2011 soil, vegetation and invertebrate samples are presented in Attachment A and the laboratory report is provided in Attachment B

VII.5.1 Soil

A summary of metal and PAH concentrations in soil samples collected in the Project area are presented in Table VII-2 and Table VII-3, respectively. Metals were detected in most or all of the samples except for antimony, bismuth, boron and tin; the concentrations of these metals were below their respective detection limits.

Concentrations of most of the PAHs analyzed in soil were below laboratory method detection limits (Table VII-3).

The RPD calculations for metals and PAHs in soil are presented in Table VII-4.

Table VII-4 shows the results of soil QA assessment.

The replicate sample for S20 had RPD values that were greater than 35% for barium, calcium, cobalt, mercury, strontium, titanium and zinc and the replicate sample for S24 had RPD values that were greater than 35% were titanium and vanadium. A possible explanation for such high RPD values for soil samples taken from S20 and S24 could be due to the natural heterogeneity of soils. Almost all natural soils are highly variable and rarely homogeneous. Soil heterogeneity can be classified into two main categories. The first is lithological heterogeneity, which can be manifested in the form of different lithology within a more uniform soil mass. The second source of heterogeneity can be attributed to inherent spatial soil variability, which is the variation of soil properties from one point to another in space due to different deposition conditions.

Overall, RPDs for soils were typically within QA/QC limits and the occasional exceedances did not indicate, systematic bias or poor sample quality, and the data were considered acceptable for use in the EIS.

Table VII-2 Summary Statistics of Metal Concentrations in Soil Sampled from the Project Area

Physical/Chemical Parameter	Detection Limit [mg/kg]	Number of Samples	Detection Frequency	Concentration [mg/kg dry weight]	
				Minimum	Maximum
pH	0.1	28	28	4.05	5.39
Metals					
Aluminum	50	28	28	622	6740
Antimony	0.10	28	0	<10	<10
Arsenic	0.050	28	28	0.51	2.08
Barium	0.50	28	28	11.2	140
Beryllium	0.20	28	27	<0.20	0.26
Bismuth	0.20	28	0	<0.20	<0.20
Boron	10	28	0	<10	<10
Cadmium	0.050	28	21	<0.050	0.635
Calcium	50	28	28	296	6070
Chromium	0.50	28	28	0.68	19.5
Cobalt	0.10	28	28	0.65	6.22
Copper	0.50	28	28	3.47	17.8
Iron	50	28	28	895	9020
Lead	0.50	28	28	0.51	3.86
Lithium	1.0	28	19	<1.0	14.6
Magnesium	20	28	28	399	3050
Manganese	1.0	28	28	3.6	3050

Table VII-2 Summary Statistics of Metal Concentrations in Soil Sampled from the Project Area (continued)

Physical/Chemical Parameter	Detection Limit [mg/kg]	Number of Samples	Detection Frequency	Concentration [mg/kg dry weight]	
				Minimum	Maximum
Mercury	0.0050	28	28	0.0079	0.172
Molybdenum	0.50	28	9	<0.05	1.55
Nickel	0.50	28	28	2.33	10.4
Phosphorus	50	28	28	168	1170
Potassium	100	28	28	340	1780
Selenium	0.20	28	6	<0.2	0.37
Silver	0.10	28	3	<0.10	0.13
Sodium	100	28	2	<100	110
Strontium	0.50	28	28	3.34	51.4
Thallium	0.050	28	4	<0.05	0.103
Tin	2.0	28	0	<2.0	<2.0
Titanium	1.0	28	28	9.3	455
Uranium	0.050	28	28	0.084	1.66
Vanadium	0.20	28	28	0.73	19.7
Zinc	1.0	28	28	8.5	38.5

Notes: mg/kg = milligram per kilogram; < = less than.

Table VII-3 Summary Statistics of Polycyclic Aromatic Hydrocarbon (PAH) Concentrations in the Soil Sampled from the Project Area

Chemical Parameter	Range of Detection Limits [mg/kg]	Number of Samples	Detection Frequency	Concentration [mg/kg dry weight]	
				Minimum	Maximum
Acenaphthene	0.0050-0.090	28	0	<0.0050	<0.090
Acenaphthylene	0.0050-0.020	28	0	<0.0050	<0.020
Anthracene	0.0040-0.020	28	0	<0.0040	<0.020
Benz(a)anthracene	0.010-0.030	28	0	<0.010	<0.030
Benzo(a)pyrene	0.010-0.80	28	0	<0.010	<0.80
Benzo(b)fluoranthene	0.010-0.090	28	0	<0.010	<0.090
Benzo(b+j+k)fluoranthene	0.015-0.092	28	0	<0.015	<0.092
Benzo(g,h,i)perylene	0.010-0.15	28	0	<0.010	<0.15
Benzo(k)fluoranthene	0.010-0.040	28	0	<0.010	<0.040
Chrysene	0.010-0.030	28	0	<0.010	<0.030
Dibenz(a,h)anthracene	0.0050-0.030	28	0	<0.0050	<0.030
Fluoranthene	0.010-0.020	28	1	<0.010	0.011
Fluorene	0.010-0.090	28	3	<0.010	0.162
Indeno(1,2,3-c,d)pyrene	0.010-0.040	28	0	<0.010	<0.040
2-Methylnaphthalene	0.010-0.020	28	0	<0.010	<0.020
Naphthalene	0.010-0.020	28	0	<0.010	<0.020
Phenanthrene	0.010-0.020	28	0	<0.010	<0.020
Pyrene	0.010-0.02	28	0	<0.010	<0.020

Notes: mg/kg = milligrams per kilogram; < = less than.

Table VII-4 Relative Percent Differences of Metals and Polycyclic Aromatic Hydrocarbons (PAHs) in Soil Samples

Physical/ Chemical Parameters	2011-GK-S-02	2011-GK-S-02-D	RPD (%)	2011-GK-S-09	2011-GK-S-09-D	RPD (%)	2011-GK-S-10	2011-GK-S-10-D	RPD (%)	2011-GK-S-20	2011-GK-S-20-D	RPD (%)	2011-GK-S-24	2011-GK-S-24-D	RPD (%)
pH	4.21	4.3	2.1	4.38	4.36	0.5	4.5	4.56	1.3	4.61	4.22	8.8	4.8	4.86	1.2
Metals															
Aluminum	3490	3330	4.7	6330	5690	10.6	1800	1680	6.9	2620	4000	41.7	1020	981	3.9
Antimony	<0.10	<0.10	n/a	<0.10	<0.10	n/a	<0.10	<0.10	n/a	<0.10	<0.10	n/a	<0.10	<0.10	n/a
Arsenic	1.15	1.09	5.4	1.93	1.8	7.0	1.26	1.19	5.7	1.08	1.19	9.7	0.992	0.798	21.7
Barium	40	38	5.1	54.5	51.6	5.5	64.6	58.5	9.9	18.3	29.8	47.8	82	65.4	22.5
Beryllium	<0.20	<0.20	n/a	<0.20	<0.20	n/a	<0.20	<0.20	n/a	<0.20	<0.20	n/a	0.23	<0.20	n/a
Bismuth	<0.20	<0.20	n/a	<0.20	<0.20	n/a	<0.20	<0.20	n/a	<0.20	<0.20	n/a	<0.20	<0.20	n/a
Boron	<10	<10	n/a	<10	<10	n/a	<10	<10	n/a	<10	<10	n/a	<10	<10	n/a
Cadmium	0.122	0.109	11.3	<0.050	0.06	n/a	0.282	0.269	4.7	<0.050	0.099	n/a	0.271	0.194	33.1
Calcium	936	863	8.1	1210	1090	10.4	4780	4270	11.3	539	878	47.8	6070	4970	19.9
Chromium	6.76	7.39	8.9	19.5	17.9	8.6	1.5	1.42	5.5	9.32	12	25.1	1.2	0.68	55.3
Cobalt	1.22	1.39	13.0	3.24	3.24	0.0	5.86	5.87	0.2	1.62	2.45	40.8	4.36	3.44	23.6
Copper	4.99	4.76	4.7	6.44	6.5	0.9	8.27	7.93	4.2	3.47	4.61	28.2	16.7	13.5	21.2
Iron	5330	5140	3.6	9020	8770	2.8	4790	4690	2.1	4330	5950	31.5	961	972	1.1
Lead	2.04	1.92	6.1	2.04	2.05	0.5	1.67	1.57	6.2	1.31	1.6	19.9	2.18	2.03	7.1
Lithium	4	3.7	7.8	14.6	13.1	10.8	<1.0	<1.0	n/a	7.4	8.9	18.4	<1.0	<1.0	n/a
Magnesium	843	949	11.8	3050	2680	12.9	933	907	2.8	1450	2050	34.3	1330	1130	16.3
Manganese	29.8	31.1	4.3	81	72.5	11.1	13.4	14.3	6.5	36.8	50.2	30.8	129	116	10.6
Mercury	0.0749	0.0706	5.9	0.0319	0.0392	20.5	0.168	0.17	1.2	0.0082	0.0223	92.5	0.172	0.142	19.1
Molybdenum	<0.50	<0.50	n/a	<0.50	<0.50	n/a	1.37	1.31	4.5	<0.50	<0.50	n/a	0.9	0.73	20.9
Nickel	3.89	4.36	11.4	9.69	9.67	0.2	6.72	6.12	9.3	4.55	6.17	30.2	5.44	4.17	26.4
Phosphorus	380	354	7.1	444	439	1.1	681	667	2.1	201	292	36.9	653	512	24.2
Potassium	420	440	4.7	1780	1560	13.2	720	790	9.3	660	1040	44.7	770	700	9.5
Selenium	<0.20	<0.20	n/a	<0.20	<0.20	n/a	0.21	<0.20	n/a	<0.20	<0.20	n/a	<0.20	<0.20	n/a
Silver	<0.10	<0.10	n/a	<0.10	<0.10	n/a	<0.10	<0.10	n/a	<0.10	<0.10	n/a	<0.10	<0.10	n/a
Sodium	<100	<100	n/a	110	<100	n/a	<100	<100	n/a	<100	<100	n/a	100	<100	n/a
Strontium	8.57	7.36	15.2	8.67	7.5	14.5	42.3	37.5	12.0	3.34	6.13	58.9	51.4	42.1	19.9
Thallium	<0.050	<0.050	n/a	0.078	0.071	9.4	<0.050	<0.050	n/a	<0.050	<0.050	n/a	<0.050	<0.050	n/a
Tin	<2.0	<2.0	n/a	<2.0	<2.0	n/a	<2.0	<2.0	n/a	<2.0	<2.0	n/a	<2.0	<2.0	n/a
Titanium	257	251	2.4	439	407	7.6	27.2	27.3	0.4	182	292	46.4	15.9	10.7	39.1
Uranium	0.51	0.466	9.0	0.65	0.603	7.5	0.365	0.356	2.5	0.664	0.804	19.1	0.79	0.821	3.8
Vanadium	13.6	13.2	3.0	19.7	19.4	1.5	2.08	2.02	2.9	9.85	13.3	29.8	1.67	1.17	35.2
Zinc	12.7	12.6	0.8	19.5	19.5	0.0	29.7	31.5	5.9	8.5	14.5	52.2	38.5	32.1	18.1

Table VII-4 Relative Percent Differences of Metals and Polycyclic Aromatic Hydrocarbons (PAHs) in Soil Samples (continued)

Physical/ Chemical Parameters	2011-GK-S-02	2011-GK-S-02-D	RPD (%)	2011-GK-S-09	2011-GK-S-09-D	RPD (%)	2011-GK-S-10	2011-GK-S-10-D	RPD (%)	2011-GK-S-20	2011-GK-S-20-D	RPD (%)	2011-GK-S-24	2011-GK-S-24-D	RPD (%)
Polycyclic Aromatic Hydrocarbons															
Acenaphthene	<0.0050	<0.0050	n/a	<0.0050	<0.0050	n/a	<0.015	<0.030	n/a	<0.0050	<0.0050	n/a	<0.0075	<0.0060	n/a
Acenaphthylene	<0.0050	<0.0050	n/a	<0.0050	<0.0050	n/a	<0.0075	<0.0080	n/a	<0.0050	<0.0050	n/a	<0.0075	<0.0080	n/a
Anthracene	<0.0040	<0.0040	n/a	<0.0040	<0.0040	n/a	<0.0060	<0.0064	n/a	<0.0040	<0.0040	n/a	<0.0060	<0.0040	n/a
Benz(a)anthracene	<0.010	<0.010	n/a	<0.010	<0.010	n/a	<0.015	<0.016	n/a	<0.010	<0.010	n/a	<0.015	<0.010	n/a
Benzo(a)pyrene	<0.010	<0.20	n/a	<0.010	<0.010	n/a	<0.015	<0.016	n/a	<0.010	<0.010	n/a	<0.015	<0.020	n/a
Benzo(b) fluoranthene	<0.020	<0.010	n/a	<0.020	<0.030	n/a	<0.050	<0.050	n/a	<0.010	<0.010	n/a	<0.060	<0.030	n/a
Benzo(b+j+k) fluoranthene	<0.022	<0.015	n/a	<0.022	<0.032	n/a	<0.054	<0.054	n/a	<0.015	<0.015	n/a	<0.063	<0.050	n/a
Benzo(g,h,i)perylene	<0.010	<0.080	n/a	<0.010	<0.010	n/a	<0.020	<0.020	n/a	<0.010	<0.010	n/a	<0.020	<0.15	n/a
Benzo(k) fluoranthene	<0.010	<0.010	n/a	<0.010	<0.010	n/a	<0.020	<0.020	n/a	<0.010	<0.010	n/a	<0.020	<0.040	n/a
Chrysene	<0.010	<0.010	n/a	<0.010	<0.010	n/a	<0.015	<0.016	n/a	<0.010	<0.010	n/a	<0.015	<0.010	n/a
Dibenz(a,h) anthracene	<0.0050	<0.0050	n/a	<0.0050	<0.0050	n/a	<0.020	<0.020	n/a	<0.0050	<0.0050	n/a	<0.020	<0.02	n/a
Fluoranthene	<0.010	<0.010	n/a	<0.010	<0.010	n/a	<0.015	<0.016	n/a	<0.010	<0.010	n/a	<0.015	<0.010	n/a
Fluorene	<0.040	0.016	n/a	<0.030	<0.030	n/a	0.115	<0.20	n/a	<0.020	<0.020	n/a	<0.090	<0.070	n/a
Indeno(1,2,3-c,d) pyrene	<0.010	<0.010	n/a	<0.010	<0.010	n/a	<0.015	<0.016	n/a	<0.010	<0.010	n/a	<0.020	<0.020	n/a
2-Methylnaphthalene	<0.010	<0.010	n/a	<0.010	<0.010	n/a	<0.015	<0.016	n/a	<0.010	<0.010	n/a	<0.015	<0.010	n/a
Naphthalene	<0.010	<0.010	n/a	<0.010	<0.010	n/a	<0.015	<0.016	n/a	<0.010	<0.010	n/a	<0.015	<0.020	n/a
Phenanthrene	<0.010	<0.010	n/a	<0.010	<0.010	n/a	<0.015	<0.016	n/a	<0.010	<0.010	n/a	<0.015	<0.010	n/a
Pyrene	<0.010	<0.010	n/a	<0.010	<0.010	n/a	<0.015	<0.016	n/a	<0.010	<0.010	n/a	<0.015	<0.010	n/a

VII.5.2 Vegetation Results

VII.5.2.1 Berries

A summary of metals and PAH concentrations in berries collected in the Project Area is presented in Table VII-5 and Table VII-6, respectively. Most or all of the metals were at or above the DL except for the following elements: antimony, arsenic, beryllium, bismuth, boron, lead, mercury, selenium, sodium, thallium and vanadium. In all the berry samples, PAH concentrations were below their respective detection limits except for one sample for benzo(g,h,i)perylene.

Relative percent difference values are provided in Table VII-7 and none of the duplicates collected for S2 and S9 show RPDs greater than 35% (for those COPC concentrations that were at least five times greater than the DL).

Table VII-5 Summary Statistics of Metal Concentrations in Cranberries and Crowberries Sampled from the Project Area

Physical/Chemical Parameter	Detection Limit [mg/kg]	Number of Samples	Detection Frequency	Concentration [mg/kg dry weight]	
				Minimum	Maximum
Percent Moisture	0.010	14	14	83.5	87.1
Metals					
Aluminum	10	14	11	<10	43
Antimony	0.050	14	0	<0.050	<0.050
Arsenic	0.050	14	0	<0.050	<0.050
Barium	0.050	14	14	6.48	16.1
Beryllium	0.30	14	0	<0.30	<0.30
Bismuth	0.30	14	0	<0.30	<0.30
Boron	10	14	0	<10	<10
Cadmium	0.030	14	1	<0.030	0.103
Calcium	10	14	14	675	1220
Chromium	0.50	14	13	<0.50	2.97
Cobalt	0.10	14	1	<0.10	0.16
Copper	0.050	14	14	2.36	6.54
Iron	1.0	14	14	8.4	24.8
Lead	0.10	14	0	<0.10	<0.10
Lithium	0.50	14	2	<0.50	0.87
Magnesium	0.050	14	14	385	531
Manganese	0.050	14	14	17.5	154
Mercury	0.0050	14	0	<0.0050	<0.0050
Molybdenum	0.050	14	14	0.068	0.254
Nickel	0.50	14	14	0.83	2.19
Phosphorus	20	14	14	699	840
Potassium	100	14	14	4300	8400
Selenium	1.0	14	0	<1.0	<1.0
Sodium	100	14	0	<100	<100
Strontium	0.050	14	14	0.836	5.11
Thallium	0.030	14	0	<0.030	<0.030
Tin	0.20	14	14	0.29	1.29

Table VII-5 Summary Statistics of Metal Concentrations in Cranberries and Crowberries Sampled from the Project Area (continued)

Physical/Chemical Parameter	Detection Limit [mg/kg]	Number of Samples	Detection Frequency	Concentration [mg/kg dry weight]	
				Minimum	Maximum
Titanium	0.50	14	1	<0.50	0.79
Uranium	0.010	14	0	<0.010	<0.010
Vanadium	0.50	14	0	<0.50	<0.50
Zinc	0.50	14	14	5.08	8.84

Notes: mg/kg = milligrams per kilogram; < = less than.

Table VII-6 Summary Statistics of Polycyclic Aromatic Hydrocarbons (PAH) Concentrations in Cranberries and Crowberries Sampled from the Project Area

Chemical Parameter	Range of Detection Limit	Number of Samples	Detection Frequency	Concentration [mg/kg dry weight]	
				Minimum	Maximum
Acenaphthene	0.050	14	0	<0.050	<0.050
Acenaphthylene	0.050	14	0	<0.050	<0.050
Anthracene	0.050	14	0	<0.050	<0.050
Benz(a)anthracene	0.050	14	0	<0.050	<0.050
Benzo(a)pyrene	0.05-2.0	14	0	<0.050	<0.90
Benzo(b)fluoranthene	0.050-0.40	14	0	<0.050	<0.40
Benzo(g,h,i)perylene	0.050	14	1	<0.050	0.05
Benzo(k)fluoranthene	0.050	14	0	<0.050	<0.050
Chrysene	0.050	14	0	<0.050	<0.050
Dibenz(a,h)anthracene	0.050-0.60	14	0	<0.050	<0.60
Fluoranthene	0.050	14	0	<0.050	<0.050
Fluorene	0.050-0.20	14	0	<0.050	<0.20
Indeno(1,2,3-c,d)pyrene	0.050	14	0	<0.050	<0.050
Naphthalene	0.050	14	0	<0.050	<0.050
Phenanthrene	0.050	14	0	<0.050	<0.050
Pyrene	0.050	14	0	<0.050	<0.050

Notes: mg/kg = milligram per kilogram; < = less than.

Table VII-7 Relative Percent Difference for Metals and Polycyclic Aromatic Hydrocarbon (PAHs) in Berry Samples

Physical/Chemical Parameters	2011-GK-B-02	2011-GK-B-02-D	RPD (%)	2011-GK-B-09	2011-GK-B-09-D	RPD (%)
Percent Moisture	85	84.3	0.8	83.6	83.5	0.1
Metals						
Aluminum	20	17	16.2	19	18	5.4
Antimony	<0.050	<0.050	n/a	<0.050	<0.050	n/a
Arsenic	<0.050	<0.050	n/a	<0.050	<0.050	n/a
Barium	15.3	13.3	14.0	11.6	11.4	1.7
Beryllium	<0.30	<0.30	n/a	<0.30	<0.30	n/a
Bismuth	<0.30	<0.30	n/a	<0.30	<0.30	n/a
Boron	<10	<10	n/a	<10	<10	n/a
Cadmium	<0.030	<0.030	n/a	<0.030	<0.030	n/a
Calcium	1150	1040	10.0	945	974	3.0
Chromium	1.68	1.11	40.9	0.66	<0.50	n/a
Cobalt	<0.10	<0.10	n/a	<0.10	<0.10	n/a
Copper	4.8	3.73	25.1	3.13	3.04	2.9
Iron	14.5	11.8	20.5	9.2	8.4	9.1
Lead	<0.10	<0.10	n/a	<0.10	<0.10	n/a
Lithium	<0.50	<0.50	n/a	<0.50	<0.50	n/a
Magnesium	500	448	11.0	443	453	2.2
Manganese	100	86.7	14.2	68.9	80.5	15.5
Mercury	<0.0050	<0.0050	n/a	<0.0050	<0.0050	n/a
Molybdenum	0.088	0.084	4.7	0.13	0.098	28.1
Nickel	1.55	1.11	33.1	1.03	1	3.0
Phosphorus	819	783	4.5	730	714	2.2
Potassium	5310	4920	7.6	4960	5000	0.8
Selenium	<1.0	<1.0	n/a	<1.0	<1.0	n/a
Sodium	<100	<100	n/a	<100	<100	n/a
Strontium	2.99	3	0.3	2.19	2.44	10.8
Thallium	<0.030	<0.030	n/a	<0.030	<0.030	n/a
Tin	0.7	1.06	40.9	0.51	0.33	42.9
Titanium	<0.50	<0.50	n/a	<0.50	<0.50	n/a
Uranium	<0.010	<0.010	n/a	<0.010	<0.010	n/a
Vanadium	<0.50	<0.50	n/a	<0.50	<0.50	n/a
Zinc	8.84	8.03	9.6	6.28	5.98	4.9
Polycyclic Aromatic Hydrocarbons						
Acenaphthene	<0.050	<0.050	n/a	<0.050	<0.050	n/a
Acenaphthylene	<0.050	<0.050	n/a	<0.050	<0.050	n/a
Anthracene	<0.050	<0.050	n/a	<0.050	<0.050	n/a
Benz(a)anthracene	<0.050	<0.050	n/a	<0.050	<0.050	n/a
Benzo(a)pyrene	<0.050	<0.060	n/a	<0.60	<0.90	n/a
Benzo(b)fluoranthene	<0.050	<0.050	n/a	<0.050	<0.050	n/a
Benzo(g,h,i)perylene	<0.050	<0.050	n/a	<0.050	<0.050	n/a
Benzo(k)fluoranthene	<0.050	<0.050	n/a	<0.050	<0.050	n/a
Chrysene	<0.050	<0.050	n/a	<0.050	<0.050	n/a
Dibenz(a,h)anthracene	<0.080	<0.080	n/a	<0.30	<0.30	n/a
Fluoranthene	<0.050	<0.050	n/a	<0.050	<0.050	n/a
Fluorene	<0.050	<0.050	n/a	<0.050	<0.050	n/a
Indeno(1,2,3-c,d)pyrene	<0.050	<0.050	n/a	<0.050	<0.050	n/a
Naphthalene	<0.050	<0.050	n/a	<0.050	<0.050	n/a
Phenanthrene	<0.050	<0.050	n/a	<0.050	<0.050	n/a
Pyrene	<0.050	<0.050	n/a	<0.050	<0.050	n/a

Notes: % = percent; < = less than; n/a = not available.

VII.5.2.2 Leaves

A summary the metal and PAH concentrations in dwarf birch leaves collected in the Project area are presented in Table VII-8 and Table VII-9, respectively. The following metals concentrations are below their respective detection limits in all dwarf birch leave samples that were collected and analyzed: antimony, arsenic, beryllium, bismuth, selenium, sodium, thallium, tin, titanium, uranium and vanadium. Polycyclic Aromatic Hydrocarbon (PAH) concentrations were below their respective detection limits in the leaf samples collected.

Relative percent differences are shown in Table VII-10. None of the metals had RPD values greater than 35 percent and RPD values are not available for PAHs because PAH concentrations are below laboratory method detection limits.

Table VII-8 Summary Statistics of Metal Concentrations in Dwarf Birch Leaves Sampled from the Project Area

Physical/Chemical Parameter	Detection Limit [mg/kg]	Number of Samples	Detection Frequency	Concentration [mg/kg dry weight]	
				Minimum	Maximum
Percent Moisture	0.10	12	12	53.9	66.3
Metals					
Aluminum	10	12	11	<10	52
Antimony	0.050	12	0	<0.050	<0.050
Arsenic	0.050	12	0	<0.050	<0.050
Barium	0.050	12	12	49.4	76.5
Beryllium	0.30	12	0	<0.30	<0.30
Bismuth	0.30	12	0	<0.30	<0.30
Boron	10	12	3	<10	17
Cadmium	0.030	12	12	0.035	0.122
Calcium	10	12	12	3,250	7,170
Chromium	0.50	12	3	<0.50	1.14
Cobalt	0.10	12	12	0.22	0.99
Copper	0.050	12	12	3.14	4.48
Iron	1.0	12	12	21.9	46.8
Lead	0.10	12	1	<0.10	0.17
Lithium	0.50	12	2	<0.50	0.64
Magnesium	3.0	12	12	2,350	4,110
Manganese	0.050	12	12	86.9	583
Mercury	0.0050	12	12	0.0106	0.0133
Molybdenum	0.050	12	1	<0.050	0.061
Nickel	0.50	12	12	1.16	4.58
Phosphorus	20	12	12	1,520	3,320
Potassium	100	12	12	2,650	3,910
Selenium	1.0	12	0	<1.0	<1.0
Sodium	100	12	0	<100	<100
Strontium	0.050	12	12	17.8	37.7
Thallium	0.030	12	0	<0.030	<0.030
Tin	0.20	12	0	<0.20	<0.20
Titanium	0.50	12	0	0.79	1.17
Uranium	0.010	12	0	<0.010	<0.010
Vanadium	0.50	12	0	<0.50	<0.50
Zinc	0.50	12	12	47.1	204

Notes: mg/kg = milligram per kilogram; < = less than.

Table VII-9 Summary Statistics of Polycyclic Aromatic Hydrocarbon (PAH) Concentrations in Dwarf Birch Leaves Sampled from the Project Area

Chemical Parameter	Range of Detection Limit	Number of Samples	Detection Frequency	Concentration [mg/kg dry weight]	
				Minimum	Maximum
Acenaphthene	0.050-0.10	12	0	<0.050	<0.10
Acenaphthylene	0.05-0.20	12	0	<0.050	<0.20
Anthracene	0.050-0.10	12	0	<0.050	<0.10
Benz(a)anthracene	0.050-0.10	12	0	<0.050	<0.10
Benzo(a)pyrene	0.50-5.0	12	0	<0.50	<5.0
Benzo(b)fluoranthene	0.050-0.10	12	0	<0.050	<0.10
Benzo(g,h,i)perylene	0.05-0.10	12	0	<0.050	<0.10
Benzo(k)fluoranthene	0.05-0.40	12	0	<0.050	<0.40
Chrysene	0.050-0.20	12	0	<0.050	<0.20
Dibenz(a,h)anthracene	0.050-0.70	12	0	<0.050	<0.70
Fluoranthene	0.050-0.10	12	0	<0.050	<0.10
Fluorene	0.20-0.50	12	0	<0.20	<0.50
Indeno(1,2,3-c,d)pyrene	0.050-0.20	12	0	<0.050	<0.20
Naphthalene	0.050-0.20	12	0	<0.050	<0.20
Phenanthrene	0.050-0.10	12	0	<0.050	<0.10
Pyrene	0.050-0.10	12	0	<0.050	<0.10

Notes: mg/kg = milligram per kilogram; < = less than.

Table VII-10 Relative Percent Differences for Metals and Polycyclic Aromatic Hydrocarbons (PAHs) in Dwarf Birch Leaves

Physical/Chemical Parameters	2011-GK-LV-02	2011-GK-LV-02-D	RPD (%)	2011-GK-LV-09	2011-GK-LV-09-D	RPD (%)
Percent Moisture	57.4	58.3	1.6	58.1	57.8	0.5
Metals						
Aluminum	36	29	21.5	20	22	9.5
Antimony	<0.050	<0.050	n/a	<0.050	<0.050	n/a
Arsenic	<0.050	<0.050	n/a	<0.050	<0.050	n/a
Barium	51	49.4	3.2	59.9	57.5	4.1
Beryllium	<0.30	<0.30	n/a	<0.30	<0.30	n/a
Bismuth	<0.30	<0.30	n/a	<0.30	<0.30	n/a
Boron	<10	<10	n/a	<10	<10	n/a
Cadmium	0.065	0.063	3.1	0.062	0.057	8.4
Calcium	4,510	4,290	5.0	5,020	4,920	2.0
Chromium	0.65	<0.50	n/a	<0.50	<0.50	n/a
Cobalt	0.68	0.67	1.5	0.55	0.51	7.5
Copper	3.56	3.47	2.6	3.81	3.75	1.6
Iron	34.6	31.1	10.7	45.8	46.8	2.2
Lead	<0.10	<0.10	n/a	<0.10	<0.10	n/a
Lithium	<0.50	<0.50	n/a	0.64	0.52	20.7
Magnesium	3,150	2,990	5.2	2,780	2,730	1.8
Manganese	207	205	1.0	328	300	8.9
Mercury	0.0127	0.0128	0.8	0.0122	0.0117	4.2
Molybdenum	<0.050	<0.050	n/a	<0.050	<0.050	n/a
Nickel	4.48	3.9	13.8	2.46	2.57	4.4

Table VII-10 Relative Percent Differences for Metals and Polycyclic Aromatic Hydrocarbons (PAHs) in Dwarf Birch Leaves (continued)

Physical/Chemical Parameters	2011-GK-LV-02	2011-GK-LV-02-D	RPD (%)	2011-GK-LV-09	2011-GK-LV-09-D	RPD (%)
Phosphorus	1,650	1,680	1.8	2,150	2,070	3.8
Potassium	3,380	3,540	4.6	3,780	3,620	4.3
Selenium	<1.0	<1.0	n/a	<1.0	<1.0	n/a
Sodium	<100	<100	n/a	<100	<100	n/a
Strontium	24.2	22.9	5.5	20.9	20.4	2.4
Thallium	<0.030	<0.030	n/a	<0.030	<0.030	n/a
Tin	<0.20	<0.20	n/a	<0.20	<0.20	n/a
Titanium	0.86	0.85	1.2	1.09	0.91	18.0
Uranium	<0.010	<0.010	n/a	<0.010	<0.010	n/a
Vanadium	<0.50	<0.50	n/a	<0.50	<0.50	n/a
Zinc	87.2	92.9	6.3	121	123	1.6
Polycyclic Aromatic Hydrocarbons						
Acenaphthene	<0.050	<0.050	n/a	<0.050	<0.050	n/a
Acenaphthylene	<0.060	<0.050	n/a	<0.050	<0.050	n/a
Anthracene	<0.050	<0.050	n/a	<0.050	<0.050	n/a
Benz(a)anthracene	<0.050	<0.050	n/a	<0.050	<0.050	n/a
Benzo(a)pyrene	<3.0	<3.0	n/a	<3.0	<3.0	n/a
Benzo(b)fluoranthene	<0.050	<0.050	n/a	<0.050	<0.050	n/a
Benzo(g,h,i)perylene	<0.050	<0.050	n/a	<0.050	<0.050	n/a
Benzo(k)fluoranthene	<0.050	<0.050	n/a	<0.050	<0.050	n/a
Chrysene	<0.050	<0.050	n/a	<0.050	<0.050	n/a
Dibenz(a,h)anthracene	<0.30	<0.30	n/a	<0.30	<0.20	n/a
Fluoranthene	<0.050	<0.050	n/a	<0.050	<0.050	n/a
Fluorene	<0.30	<0.30	n/a	<0.30	<0.20	n/a
Indeno(1,2,3-c,d)pyrene	<0.050	<0.050	n/a	<0.050	<0.050	n/a
Naphthalene	<0.050	<0.050	n/a	<0.050	<0.050	n/a
Phenanthrene	<0.050	<0.050	n/a	<0.050	<0.050	n/a
Pyrene	<0.050	<0.050	n/a	<0.050	<0.050	n/a

Notes: % = percent; < = less than; n/a = not available.

VII.5.2.3 Lichen

A summary of the metal and PAH concentrations in lichen are presented in Table VII-11 and Table VII-12, respectively. The following metal concentrations in lichen are below their respective laboratory method detection limits in all samples that were collected and analyzed: antimony, beryllium, bismuth, selenium, thallium and tin (Table VII-11). All PAH concentrations are below their respective laboratory method detection limits in all lichen samples

Relative percent differences of duplicate samples taken from S2 and S9 are shown in Table VII-13. Metals that had RPD values greater than 35 percent are: aluminum (both), barium (S9), calcium (S9), copper (S9), iron (both), lead (both), manganese (S9), mercury (S9), strontium (S9), titanium (S9) and zinc (S9).

These results suggest some sample heterogeneity for lichen and could reflect close association of lichen with rock and soil surfaces results in a higher quantity of soil or rock material on the surfaces of the samples. Relative percent differences (RPD) ranged up to 75% for the lichen samples, and was above 35% primarily for COPCs analyzed in the sample from S9. This suggests some unquantified but small, uncertainty in the lichen metals concentrations (i.e., less than 20 fold). Any bias introduced by the present of soil/rock material on the samples would tend to increase the apparent concentrations of metals in lichen, leading to a more conservative (i.e., protective) estimate of the dose to animals which consume lichen. Therefore, the lichen data were considered appropriate for use in the wildlife ecological risk assessment.

Table VII-11 Summary Statistics of Metal Concentrations of Lichen Sampled from the Project Area

Physical/Chemical Parameter	Detection Limit [mg/kg]	Number of Samples	Detection Frequency	Concentration [mg/kg dry weight]	
				Minimum	Maximum
Percent Moisture	0.10	12	12	11.5	39.4
Metals					
Aluminum	10	12	12	301	1120
Antimony	0.050	12	0	<0.050	<0.050
Arsenic	0.050	12	12	0.149	0.453
Barium	0.050	12	12	19	110
Beryllium	0.30	12	0	<0.30	<0.30
Bismuth	0.30	12	0	<0.30	<0.30
Boron	10	12	11	<10	48
Cadmium	0.030	12	12	0.036	0.19
Calcium	10	12	12	1,350	3,300
Chromium	0.50	12	12	1.37	16.7
Cobalt	0.10	12	12	0.18	1.62
Copper	0.050	12	12	1.21	4.53
Iron	1.0	12	12	237	1,640
Lead	0.10	12	12	0.37	5.50
Lithium	0.50	12	3	<0.50	2.42
Magnesium	3.0	12	12	370	3,520
Manganese	0.050	12	12	46.4	237
Mercury	0.0050	12	12	0.0419	0.0970
Molybdenum	0.050	12	8	<0.050	0.212
Nickel	0.50	12	12	1.47	25.0
Phosphorus	20	12	12	414	833
Potassium	100	12	12	860	1,890
Selenium	1.0	12	0	<1.0	<1.0
Sodium	100	12	4	<100	200
Strontium	0.050	12	12	5.58	26.9
Thallium	0.030	12	0	<0.030	<0.030
Tin	0.20	12	0	<0.20	<0.20
Titanium	0.50	12	12	9.72	69.9
Uranium	0.010	12	12	0.018	0.143
Vanadium	0.50	12	12	0.53	3.01
Zinc	0.50	12	12	18.7	37.4

Notes: mg/kg = milligram per kilogram; < = less than.

Table VII-12 Summary Statistics of Polycyclic Aromatic Hydrocarbon (PAH) Concentrations in Lichen Sampled from the Project Area

Chemical Parameter	Range of Detection Limits [mg/kg]	Number of Samples	Detection Frequency	Concentration [mg/kg dry weight]	
				Minimum	Maximum
Acenaphthene	0.050	12	0	<0.050	<0.050
Acenaphthylene	0.050	12	0	<0.050	<0.050
Anthracene	0.050	12	0	<0.050	<0.050
Benz(a)anthracene	0.050	12	0	<0.050	<0.050
Benzo(a)pyrene	0.40-1.5	12	0	<0.40	<1.5
Benzo(b)fluoranthene	0.050	12	0	<0.050	<0.050
Benzo(g,h,i)perylene	0.050	12	0	<0.050	<0.050
Benzo(k)fluoranthene	0.050-0.30	12	0	<0.050	<0.30
Chrysene	0.050	12	0	<0.050	<0.050
Dibenz(a,h)anthracene	0.050	12	0	<0.050	<0.050
Fluoranthene	0.050	12	0	<0.050	<0.050
Fluorene	0.050	12	0	<0.050	<0.050
Indeno(1,2,3-c,d)pyrene	0.050	12	0	<0.050	<0.050
Naphthalene	0.050	12	0	<0.050	<0.050
Phenanthrene	0.050	12	0	<0.050	<0.050
Pyrene	0.050	12	0	<0.050	<0.050

Notes: mg/kg = milligram per kilogram; < = less than.

Table VII-13 Relative Percent Differences of Metals and Polycyclic Aromatic Hydrocarbons (PAHs) in Lichen

Physical/Chemical Parameters	2011-GK-L-02	2011-GK-L-02-D	RPD (%)	2011-GK-L-09	2011-GK-L-09-D	RPD (%)
Percent Moisture	16.2	30.4	60.9	11.8	17.9	41.1
Metals						
Aluminum	531	339	44.1	540	301	56.8
Antimony	<0.050	<0.050	n/a	<0.050	<0.050	n/a
Arsenic	0.266	0.172	42.9	0.278	0.182	41.7
Barium	45.1	37.8	17.6	43.9	22.6	64.1
Beryllium	<0.30	<0.30	n/a	<0.30	<0.30	n/a
Bismuth	<0.30	<0.30	n/a	<0.30	<0.30	n/a
Boron	16	14	13.3	24	11	74.3
Cadmium	0.127	0.125	1.6	0.074	0.043	53.0
Calcium	2,010	2,120	5.3	2,070	1,350	42.1
Chromium	1.95	1.37	34.9	1.95	1.52	24.8
Cobalt	0.5	0.42	17.4	0.33	0.18	58.8
Copper	2.53	2.75	8.3	2.64	1.79	38.4
Iron	494	303	47.9	406	259	44.2
Lead	0.96	0.62	43.0	0.99	0.45	75.0
Lithium	<0.50	<0.50	n/a	<0.50	<0.50	n/a
Magnesium	446	466	4.4	468	374	22.3
Manganese	68.7	67.3	2.1	106	71.5	38.9
Mercury	0.064	0.0493	25.9	0.0749	0.0436	52.8
Molybdenum	<0.050	<0.050	n/a	0.055	<0.050	n/a
Nickel	2.64	2.09	23.3	1.93	1.52	23.8
Phosphorus	623	657	5.3	675	595	12.6

Table VII-13 Relative Percent Differences of Metals and Polycyclic Aromatic Hydrocarbons (PAHs) in Lichen (continued)

Physical/Chemical Parameters	2011-GK-L-02	2011-GK-L-02-D	RPD (%)	2011-GK-L-09	2011-GK-L-09-D	RPD (%)
Potassium	1,280	1,340	4.6	1,090	1,180	7.9
Selenium	<1.0	<1.0	n/a	<1.0	<1.0	n/a
Sodium	<100	100	n/a	<100	<100	n/a
Strontium	12.1	12.1	0.0	8.93	5.58	46.2
Thallium	<0.030	<0.030	n/a	<0.030	<0.030	n/a
Tin	<0.20	<0.20	n/a	<0.20	<0.20	n/a
Titanium	22.4	14.6	42.2	18.4	9.72	61.7
Uranium	0.058	0.028	69.8	0.034	0.021	47.3
Vanadium	1.01	0.64	44.8	1.04	0.53	65.0
Zinc	24	27.6	14.0	30.2	19.4	43.5
Polycyclic Aromatic Hydrocarbons						
Acenaphthene	<0.050	<0.050	n/a	<0.050	<0.050	n/a
Acenaphthylene	<0.050	<0.050	n/a	<0.050	<0.050	n/a
Anthracene	<0.050	<0.050	n/a	<0.050	<0.050	n/a
Benz(a)anthracene	<0.050	<0.050	n/a	<0.050	<0.050	n/a
Benzo(a)pyrene	<0.60	<0.50	n/a	<0.60	<0.40	n/a
Benzo(b)fluoranthene	<0.050	<0.050	n/a	<0.050	<0.050	n/a
Benzo(g,h,i)perylene	<0.050	<0.050	n/a	<0.050	<0.050	n/a
Benzo(k)fluoranthene	<0.10	<0.20	n/a	<0.060	<0.10	n/a
Chrysene	<0.050	<0.050	n/a	<0.050	<0.050	n/a
Dibenz(a,h)anthracene	<0.050	<0.050	n/a	<0.050	<0.050	n/a
Fluoranthene	<0.050	<0.050	n/a	<0.050	<0.050	n/a
Fluorene	<0.050	<0.050	n/a	<0.050	<0.050	n/a
Indeno(1,2,3-c,d)pyrene	<0.050	<0.050	n/a	<0.050	<0.050	n/a
Naphthalene	<0.050	<0.050	n/a	<0.050	<0.050	n/a
Phenanthrene	<0.050	<0.050	n/a	<0.050	<0.050	n/a
Pyrene	<0.050	<0.050	n/a	<0.050	<0.050	n/a

Notes: % = percent: < = less than; n/a = not available.

VII.5.2.4 Grass

A metal and PAH concentrations in grass collected from the Project Area are present in Table VII-14 and 15, respectively. The following metals are have concentrations below their respective laboratory method detection limits in all grass samples that were collected and analyzed: antimony, beryllium, bismuth, lithium, selenium, sodium, thallium, tin and vanadium. PAH concentrations are below their respective DLs in all samples.

Relative percent differences are shown in Table VII-16. Only grass sampled from S10 had metal RPD values greater than 35% for manganese, phosphorus and potassium while none of the metals in grass collected from S24 had RPDs greater than 35%. Relative percent difference (RPD) values for PAHs were not calculated because the concentrations were all below the detection limit. These RPD results indicate only minor variability for a few metals in analysis of grass samples and the data were considered appropriate for use in the wildlife ecological risk assessment.

Table VII-14 Summary Statistics of Metal Concentration in Grass Sampled in the Project Area

Physical/Chemical Parameters	Detection Limit [mg/kg]	Number of Samples	Detection Frequency	Concentration [mg/kg dry weight]	
				Minimum	Maximum
Percent Moisture	0.10	11	11	26.4	43.9
Metals					
Aluminum	10	11	11	19	154
Antimony	0.050	11	0	<0.050	<0.050
Arsenic	0.050	11	3	<0.050	0.082
Barium	0.050	11	11	26.7	42.9
Beryllium	0.30	11	0	<0.30	<0.30
Bismuth	0.30	11	0	<0.30	<0.30
Boron	10	11	5	<10	26
Cadmium	0.030	11	3	<0.030	0.055
Calcium	10	11	11	2,110	3,130
Chromium	0.50	11	10	<0.50	3.59
Cobalt	0.10	11	7	<0.10	0.44
Copper	0.050	11	11	1.86	4.14
Iron	1.0	11	11	54.2	214
Lead	0.10	11	9	<0.10	0.4
Lithium	0.50	11	0	<0.50	<0.50
Magnesium	3.0	11	11	512	798
Manganese	0.050	11	11	82.3	482
Mercury	0.0050	11	11	0.0149	0.0283
Molybdenum	0.050	11	11	0.469	2.70
Nickel	0.50	11	10	<0.50	2.25
Phosphorus	20	11	11	314	595
Potassium	100	11	11	1,400	4,030
Selenium	1.0	11	0	<1.0	<1.0
Sodium	100	11	0	<100	<100
Strontium	0.050	11	11	8.70	13.6
Thallium	0.030	11	0	<0.030	<0.030
Tin	0.20	11	0	<0.20	<0.20
Titanium	0.50	11	11	0.84	5.12
Uranium	0.010	11	1	<0.010	0.145
Vanadium	0.50	11	0	<0.50	<0.50
Zinc	0.50	11	11	31.3	101

Notes: mg/kg = milligrams per kilogram; < = less than.

Table VII-15 Summary Statistics of Polycyclic Aromatic Hydrocarbon (PAH) Concentration in Grass Sampled in the Project Area

Chemical Parameters	Range of Detection Limits [mg/kg]	Number of Samples	Detection Frequency	Concentration [mg/kg dry weight]	
				Minimum	Maximum
Acenaphthene	0.050-0.060	11	0	<0.050	<0.060
Acenaphthylene	0.050	11	0	<0.050	<0.050
Anthracene	0.050-0.060	11	0	<0.050	<0.050
Benz(a)anthracene	0.050	11	0	<0.050	<0.050
Benzo(a)pyrene	0.20-5.0	11	0	<0.20	<5.0
Benzo(b)fluoranthene	0.050-0.090	11	0	<0.050	<0.090
Benzo(g,h,i)perylene	0.050-3.0	11	0	<0.050	<3.0
Benzo(k)fluoranthene	0.050-0.20	11	0	<0.050	<0.20
Chrysene	0.050	11	0	<0.050	<0.050
Dibenz(a,h)anthracene	0.050-0.40	11	0	<0.050	<0.050
Fluoranthene	0.050-0.070	11	0	<0.050	<0.050
Fluorene	0.050-0.30	11	0	<0.050	<0.050
Indeno(1,2,3-c,d)pyrene	0.050-0.40	11	0	<0.050	<0.050
Naphthalene	0.050-0.070	11	0	<0.050	<0.050
Phenanthrene	0.050-0.30	11	0	<0.050	<0.050
Pyrene	0.050-0.070	11	0	<0.050	<0.050

Notes: mg/kg = milligrams per kilograms; < = less than.

Table VII-16 Relative Percent Differences of Metals and Polycyclic Aromatic Hydrocarbons (PAHs) in Grass Samples

Physical/Chemical Parameters	2011-GK-G-10	2011-GK-G-10-D	RPD (%)	2011-GK-G-24	2011-GK-G-24-D	RPD (%)
Percent Moisture	29.7	27.1	9.2	40.8	36.1	12.2
Metals						
Aluminum	43	19	77.4	19	21	10.0
Antimony	<0.050	<0.050	n/a	<0.050	<0.050	n/a
Arsenic	<0.050	<0.050	n/a	<0.050	<0.050	n/a
Barium	34.8	38	8.8	30.6	26.7	13.6
Beryllium	<0.30	<0.30	n/a	<0.30	<0.30	n/a
Bismuth	<0.30	<0.30	n/a	<0.30	<0.30	n/a
Boron	<10	<10	n/a	<10	17	n/a
Cadmium	<0.030	<0.030	n/a	<0.030	<0.030	n/a
Calcium	2,870	2,360	19.5	2,350	2,370	0.8
Chromium	1.19	1.36	13.3	0.6	<0.50	n/a
Cobalt	0.19	0.13	37.5	<0.10	<0.10	n/a
Copper	2.93	2.11	32.5	2.27	1.91	17.2
Iron	95.3	54.2	55.0	73.6	84.5	13.8
Lead	0.14	<0.10	n/a	<0.10	0.11	n/a
Lithium	<0.50	<0.50	n/a	<0.50	<0.50	n/a
Magnesium	654	798	19.8	728	644	12.2
Manganese	162	482	99.4	185	167	10.2
Mercury	0.0199	0.0149	28.7	0.0212	0.022	3.7
Molybdenum	1.79	1.26	34.8	1.33	1.56	15.9
Nickel	1.62	1.05	42.7	0.61	<0.50	n/a

Table VII-16 Relative Percent Differences of Metals and Polycyclic Aromatic Hydrocarbons (PAHs) in Grass Samples (continued)

Physical/Chemical Parameters	2011-GK-G-10	2011-GK-G-10-D	RPD (%)	2011-GK-G-24	2011-GK-G-24-D	RPD (%)
Phosphorus	347	570	48.6	451	376	18.1
Potassium	2,090	2,980	35.1	2,180	1,670	26.5
Selenium	<1.0	<1.0	n/a	<1.0	<1.0	n/a
Sodium	<100	<100	n/a	<100	<100	n/a
Strontium	10.5	9.62	8.7	10.9	10.5	3.7
Thallium	<0.030	<0.030	n/a	<0.030	<0.030	n/a
Tin	<0.20	<0.20	n/a	<0.20	<0.20	n/a
Titanium	1.17	0.84	32.8	0.95	0.95	0.0
Uranium	<0.010	<0.010	n/a	<0.010	<0.010	n/a
Vanadium	<0.50	<0.50	n/a	<0.50	<0.50	n/a
Zinc	52.1	44.7	15.3	46.5	51.3	9.8
Polycyclic Aromatic Hydrocarbons						
Acenaphthene	<0.050	<0.060	n/a	<0.050	<0.050	n/a
Acenaphthylene	<0.050	<0.050	n/a	<0.050	<0.050	n/a
Anthracene	<0.050	<0.060	n/a	<0.050	<0.050	n/a
Benz(a)anthracene	<0.050	<0.050	n/a	<0.050	<0.050	n/a
Benzo(a)pyrene	<4.0	<5.0	n/a	<0.50	<2.0	n/a
Benzo(b)fluoranthene	<0.050	<0.090	n/a	<0.050	<0.050	n/a
Benzo(g,h,i)perylene	<0.050	<3.0	n/a	<0.080	<0.050	n/a
Benzo(k)fluoranthene	<0.050	<0.060	n/a	<0.050	<0.050	n/a
Chrysene	<0.050	<0.050	n/a	<0.050	<0.050	n/a
Dibenz(a,h)anthracene	<0.050	<0.40	n/a	<0.060	<0.050	n/a
Fluoranthene	<0.050	<0.070	n/a	<0.050	<0.050	n/a
Fluorene	<0.30	<0.060	n/a	<0.050	<0.20	n/a
Indeno(1,2,3-c,d)pyrene	<0.050	<0.40	n/a	<0.060	<0.050	n/a
Naphthalene	<0.050	<0.070	n/a	<0.050	<0.050	n/a
Phenanthrene	<0.050	<0.30	n/a	<0.070	<0.050	n/a
Pyrene	<0.050	<0.070	n/a	<0.050	<0.050	n/a

Notes: % = percent; < = less than; n/a = not available.

VII.5.3 Soil Invertebrates

VII.5.3.1 Ants

A summary of metal and PAH concentrations in ants are presented in Table VII-17 and 18, respectively. The following metals were below their respective detection limits in all ant samples that were collected and analyzed: antimony, bismuth, lithium, mercury, selenium, thallium, tin, titanium, uranium and vanadium. Polycyclic Aromatic Hydrocarbon (PAH) concentrations were below laboratory method detection limits in all the samples collected and analyzed.

Relative percent differences were not calculated for ant samples because duplicate samples could not be collected due to the limited availability of ants in the study area.

Table VII-17 Summary Statistics of Metal Concentrations in Ants Collected from the Project Area

Physical/Chemical Parameter	Detection Limit [mg/kg]	Number of Samples	Frequency of Samples	Concentration [mg/kg dry weight]	
				Minimum	Maximum
Percent Moisture	0.10	3	3	27.1	40.9
Metals					
Aluminum	10	3	3	15	104
Antimony	0.050	3	0	<0.050	<0.050
Arsenic	0.050	3	1	<0.050	0.052
Barium	0.050	3	3	0.163	46.7
Beryllium	0.30	3	3	<0.30	<0.30
Bismuth	0.30	3	0	<0.30	<0.30
Boron	10	3	1	<10	14
Cadmium	0.030	3	2	<0.030	0.511
Calcium	10	3	3	68	4730
Chromium	0.50	3	1	<0.50	0.89
Cobalt	0.10	3	1	<0.10	0.19
Copper	0.050	3	3	0.319	6.54
Iron	1.0-20	3	3	2.7	59
Lead	0.10	3	2	0.15	0.17
Lithium	0.50	3	0	<0.50	<0.50
Magnesium	3.0	3	3	76.3	1120
Manganese	0.050	3	3	1.69	406
Mercury	0.0050-0.10	3	0	<0.0050	<0.10
Molybdenum	0.050	3	2	<0.050	0.263
Nickel	0.50	3	2	<0.50	1.62
Phosphorus	20-400	3	3	111	3,740
Potassium	100-2,000	3	2	<2,000(860)	5,700
Selenium	1.0	3	0	<1.0	<1.0
Sodium	100-2,000	3	1	<2,000 (130)	<2,000 (130)
Strontium	0.050	3	3	0.203	13
Thallium	0.030	3	0	<0.030	<0.030
Tin	0.20	3	0	<0.20	<0.20
Titanium	0.50-10	3	0	<0.50	<10
Uranium	0.010	3	0	<0.010	<0.010
Vanadium	0.050	3	0	<0.50	<0.50
Zinc	0.50	3	3	1.24	87.7

Notes: mg/kg = milligram per kilogram; < = less than.

Table VII-18 Summary Statistics of Polycyclic Aromatic Hydrocarbon (PAH) Concentrations in Ants Collected in the Project Area

Chemical Parameter	Detection Limit [mg/kg]	Number of Samples	Detection Frequency	Concentration [mg/kg dry weight]	
				Minimum	Maximum
Acenaphthene	0.050	1	0	<0.050	<0.050
Acenaphthylene	0.050	1	0	<0.050	<0.050
Anthracene	0.050	1	0	<0.050	<0.050
Benz(a)anthracene	0.050	1	0	<0.050	<0.050
Benzo(a)pyrene	0.090	1	0	<0.090	<0.090
Benzo(b)fluoranthene	0.050	1	0	<0.050	<0.050
Benzo(g,h,i)perylene	0.050	1	0	<0.050	<0.050
Benzo(k)fluoranthene	0.050	1	0	<0.050	<0.050
Chrysene	0.050	1	0	<0.050	<0.050
Dibenz(a,h)anthracene	0.050	1	0	<0.050	<0.050
Fluoranthene	0.050	1	0	<0.050	<0.050
Fluorene	0.050	1	0	<0.050	<0.050
Indeno(1,2,3-c,d)pyrene	0.050	1	0	<0.050	<0.050
Naphthalene	0.050	1	0	<0.050	<0.050
Phenanthrene	0.050	1	0	<0.050	<0.050
Pyrene	0.050	1	0	<0.050	<0.050

Notes: mg/kg = milligrams per kilogram; < = less than.

VII.6 SUMMARY

The purpose of the baseline sampling program was to fill data gaps for identified for soil and tissue chemistry to provide exposure concentration inputs to the human health and wildlife ecological risk assessments. Baseline concentrations of metals and PAHs in soil, berries, leaves, lichen, grass and ants were determined in the Project Area. In addition, based on a review of the methods, detection limits and QA/QC where applicable, the data are considered suitable for use in the human health and wildlife ecological risk assessments.

VII.7 REFERENCES

Boertje, R.D. 1984. *Seasonal diets of the Denali caribou herd, Alaska. Arctic, 37*: 161 to 165.

Marles, R.J., C. Clavelle, L. Monteleone, N. Tays and D. Burns. 2000. *Aboriginal plant use in Canada's northwest forest.* UBC Press, Vancouver, BC.

Johnson, D., L. Kershaw, A. MacKinnon and J. Pojar. 1995*. Plants of the western boreal forest and aspen parkland.* Lone Pine Publishing. Edmonton, AB.

ATTACHMENT A

ALL DATA

Table A-1 Metals and Polycyclic Aromatic Hydrocarbon (PAHs) Baseline Data for Soil Sampled in 2011.

Sample ID	2011-GK-S-01	2011-GK-S-02	2011-GK-S-02-D	2011-GK-S-03	2011-GK-S-04	2011-GK-S-05	2011-GK-S-06	2011-GK-S-07	2011-GK-S-08	2011-GK-S-09	2011-GK-S-09-D	2011-GK-S-10	2011-GK-S-10-D	2011-GK-S-11	2011-GK-S-12	2011-GK-S-13	2011-GK-S-14	2011-GK-S-16	2011-GK-S-17	2011-GK-S-18	2011-GK-S-19	2011-GK-S-20	2011-GK-S-20-D	2011-GK-S-21	2011-GK-S-22	2011-GK-S-23	2011-GK-S-24	2011-GK-S-24-D
Date Sampled	14-SEP-11	14-SEP-11	14-SEP-11	14-SEP-11	14-SEP-11	15-SEP-11	15-SEP-11	15-SEP-11	15-SEP-11	15-SEP-11	15-SEP-11	15-SEP-11	15-SEP-11	15-SEP-11	15-SEP-11	16-SEP-11	16-SEP-11	16-SEP-11	17-SEP-11	17-SEP-11	17-SEP-11	17-SEP-11	17-SEP-11	17-SEP-11	17-SEP-11	17-SEP-11	17-SEP-11	17-SEP-11
ALS Sample ID	L1067095-1	L1067095-5	L1067095-6	L1067095-13	L1067095-17	L1067095-21	L1067095-26	L1067095-31	L1067095-35	L1067095-37	L1067095-38	L1067095-45	L1067095-46	L1067095-49	L1067095-50	L1067095-52	L1067095-53	L1067095-54	L1067095-55	L1067095-59	L1067095-61	L1067095-66	L1067095-67	L1067095-68	L1067095-70	L1067095-71	L1067095-72	L1067095-73
Matrix	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Physical Tests																												
pH (1:2 soil:water)	5.10	4.21	4.30	4.05	4.10	4.74	4.39	4.43	4.54	4.38	4.36	4.50	4.56	4.50	4.15	5.39	4.77	4.50	4.56	4.81	4.82	4.61	4.22	4.51	4.10	4.92	4.80	4.86
Metals																												
Aluminum (Al)	4070	3490	3330	3500	5130	4090	5610	4160	2170	6330	5690	1800	1680	3940	622	4110	6740	1940	4750	4130	3840	2620	4000	728	2040	5500	1020	981
Antimony (Sb)	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Arsenic (As)	1.49	1.15	1.09	0.824	1.12	1.44	2.08	1.01	1.51	1.93	1.80	1.26	1.19	1.58	0.521	1.79	1.55	1.23	0.844	1.30	1.30	1.08	1.19	0.661	0.509	1.03	0.992	0.798
Barium (Ba)	30.3	40.0	38.0	42.3	105	25.2	52.2	140	57.0	54.5	51.6	64.6	58.5	25.4	31.3	22.9	60.6	49.4	39.5	97.5	29.5	18.3	29.8	53.6	138	11.2	82.0	65.4
Beryllium (Be)	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.26	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.23	<0.20
Bismuth (Bi)	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Boron (B)	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Cadmium (Cd)	0.053	0.122	0.109	0.235	0.444	<0.050	<0.050	0.192	0.181	<0.050	0.060	0.282	0.269	0.054	0.320	<0.050	0.246	0.341	0.148	0.261	<0.050	<0.050	0.099	0.190	0.635	<0.050	0.271	0.194
Calcium (Ca)	540	936	863	403	2230	767	1150	2400	3200	1210	1090	4780	4270	781	3070	1040	1820	3730	794	3400	1170	539	878	4740	3670	296	6070	4970
Chromium (Cr)	11.1	6.76	7.39	4.37	5.16	11.9	18.4	6.22	3.73	19.5	17.9	1.50	1.42	11.7	0.94	11.2	15.9	3.53	14.1	3.33	10.9	9.32	12.0	0.92	1.64	13.5	1.20	0.68
Cobalt (Co)	1.30	1.22	1.39	0.65	2.94	2.17	3.51	2.07	2.57	3.24	3.24	5.86	5.87	1.94	3.08	2.34	6.22	4.37	1.35	4.11	2.49	1.62	2.45	3.26	5.07	1.24	4.36	3.44
Copper (Cu)	4.15	4.99	4.76	3.55	10.2	3.75	9.06	9.81	9.27	6.44	6.50	8.27	7.93	4.69	5.12	8.14	9.88	12.7	10.9	17.8	8.68	3.47	4.61	3.68	9.61	5.22	16.7	13.5
Iron (Fe)	5900	5330	5140	4040	4410	6070	8790	4250	8920	9020	8770	4790	4690	6270	895	6100	8190	4880	5180	5940	5390	4330	5950	4210	1620	7930	961	972
Lead (Pb)	2.63	2.04	1.92	2.40	3.86	1.46	1.89	2.41	2.27	2.04	2.05	1.67	1.57	1.74	0.51	1.66	1.73	1.56	3.20	1.38	1.92	1.31	1.60	1.04	0.88	2.23	2.18	2.03
Lithium (Li)	6.3	4.0	3.7	1.8	1.6	9.6	13.6	1.5	<1.0	14.6	13.1	<1.0	<1.0	8.4	<1.0	9.9	9.6	<1.0	5.2	<1.0	10.0	7.4	8.9	<1.0	<1.0	8.4	<1.0	<1.0
Magnesium (Mg)	1280	843	949	417	889	2110	2930	576	617	3050	2680	933	907	1820	759	1820	2610	716	1380	752	2070	1450	2050	1040	399	1150	1330	1130
Manganese (Mn)	31.4	29.8	31.1	20.7	16.4	53.8	97.8	23.8	18.2	81.0	72.5	13.4	14.3	46.1	3.6	54.4	59.5	10.3	32.8	7.6	45.7	36.8	50.2	26.1	5.6	29.3	129	116
Mercury (Hg)	0.0420	0.0749	0.0706	0.0552	0.163	0.0149	0.0317	0.157	0.0938	0.0319	0.0392	0.168	0.170	0.0172	0.110	0.0079	0.0702	0.0878	0.0552	0.0965	0.0199	0.0082	0.0223	0.0537	0.0971	0.0258	0.172	0.142
Molybdenum (Mo)	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	1.01	<0.50	<0.50	1.37	1.31	<0.50	1.55	<0.50	<0.50	0.88	<0.50	1.05	<0.50	<0.50	<0.50	0.96	0.56	<0.50	0.90	0.73
Nickel (Ni)	4.99	3.89	4.36	2.33	9.88	5.92	9.59	8.79	6.92	9.69	9.67	6.72	6.12	5.92	4.33	6.88	10.4	6.39	5.83	8.57	6.79	4.55	6.17	5.09	6.17	4.22	5.44	4.17
Phosphorus (P)	203	380	354	318	947	295	484	746	953	444	439	681	667	324	474	327	538	892	319	1170	347	201	292	334	691	168	653	512
Potassium (K)	640	420	440	360	810	1090	1720	470	430	1780	1560	720	790	640	370	760	1170	450	640	590	900	660	1040	350	390	340	770	700
Selenium (Se)	<0.20	<0.20	<0.20	<0.20	0.28	<0.20	<0.20	0.22	0.32	<0.20	<0.20	0.21	<0.20	<0.20	<0.20	<0.20	<0.20	0.37	<0.20	0.30	<0.20	<0.20	<0.20	<0.20	0.23	<0.20	<0.20	<0.20
Silver (Ag)	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.12	<0.10	0.13	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Sodium (Na)	<100	<100	<100	<100	100	<100	<100	<100	<100	110	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	100	<100
Strontium (Sr)	5.50	8.57	7.36	6.99	32.2	4.23	5.89	30.3	28.6	8.67	7.50	42.3	37.5	4.43	31.6	4.85	17.8	31.9	7.12	35.0	8.07	3.34	6.13	47.1	39.2	3.34	51.4	42.1
Thallium (Tl)	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.103	<0.050	<0.050	0.078	0.071	<0.050	<0.050	<0.050	<0.050	<0.050	0.076	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Tin (Sn)	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Titanium (Ti)	299	257	251	158	127	333	455	166	40.9	439	407	27.2	27.3	273	12.7	281	325	50.5	281	70.4	232	182	292	9.3	31.1	413	15.9	10.7
Uranium (U)	0.846	0.510	0.466	0.413	0.427	0.488	0.618	0.952	0.822	0.650	0.603	0.365	0.356	0.676	0.084	0.590	0.868	1.11	0.727	1.26	1.66	0.664	0.804	0.444	1.18	0.535	0.790	0.821
Vanadium (V)	13.9	13.6	13.2	9.85	5.47	14.3	19.2	7.01	2.13	19.7	19.4	2.08	2.02	13.9	1.22	13.6	14.4	2.74	11.7	3.78	11.0	9.85	13.3	0.73	1.22	18.9	1.67	1.17
Zinc (Zn)	8.7	12.7	12.6	10.1	20.6	11.8	21.8	10.1	27.9	19.5	19.5	29.7	31.5	10.0	34.6	10.3	23.3	19.6	13.3	19.7	10.1	8.5	14.5	29.4	26.4	9.0	38.5	32.1
Polycyclic Aromatic Hydrocarbons																												
Acenaphthene	<0.0050	<0.0050	<0.0050	<0.0050	<0.0060	<0.0050	<0.0050	<0.0050	<0.040	<0.0050	<0.0050	<0.015	<0.030	<0.0050	<0.090	<0.0050	<0.0050	<0.010	<0.0085	<0.020	<0.0050	<0.0050	<0.0050	<0.0085	<0.050	<0.0050	<0.0075	<0.0060
Acenaphthylene	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.020	<0.0050	<0.0050	<0.0075	<0.0080	<0.0050	<0.0050	<0.0050	<0.0050	<0.0070	<0.0085	<0.0050	<0.0050	<0.0050	<0.0050	<0.0085	<0.0060	<0.0050	<0.0075	<0.0080
Anthracene	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.020	<0.0040	<0.0040	<0.0060	<0.0064	<0.0040	<0.0040	<0.0040	<0.0040	<0.0056	<0.0068	<0.0040	<0.0040	<0.0040	<0.0040	<0.0068	<0.0040	<0.0040	<0.0060	<0.0040
Benz(a) anthracene	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.030	<0.010	<0.010	<0.015	<0.016	<0.010	<0.010	<0.010	<0.010	<0.014	<0.017	<0.010	<0.010	<0.010	<0.010	<0.017	<0.010	<0.010	<0.015	<0.010
Benzo(a)pyrene	<0.010	<0.010	<0.20	<0.010	<0.010	<0.010	<0.010	<0.010	<0.80	<0.010	<0.010	<0.015	<0.016	<0.010	<0.010	<0.010	<0.010	<0.014	<0.017	<0.010	<0.010	<0.010	<0.010	<0.017	<0.010	<0.010	<0.015	<0.020
Benzo(b) fluoranthene	<0.020	<0.020	<0.010	<0.020	<0.060	<0.030	<0.010	<0.060	<0.030	<0.020	<0.030	<0.050	<0.050	<0.010	<0.060	<0.010	<0.030	<0.060	<0.030	<0.090	<0.010	<0.010	<0.010	<0.040	<0.070	<0.010	<0.060	<0.030

Table A-1 Metals and Polycyclic Aromatic Hydrocarbon (PAHs) Baseline Data for Soil Sampled in 2011 (continued)

Sample ID	2011-GK-S-01	2011-GK-S-02	2011-GK-S-02-D	2011-GK-S-03	2011-GK-S-04	2011-GK-S-05	2011-GK-S-06	2011-GK-S-07	2011-GK-S-08	2011-GK-S-09	2011-GK-S-09-D	2011-GK-S-10	2011-GK-S-10-D	2011-GK-S-11
Date Sampled	14-SEP-11	14-SEP-11	14-SEP-11	14-SEP-11	14-SEP-11	15-SEP-11	15-SEP-11	15-SEP-11	15-SEP-11	15-SEP-11	15-SEP-11	15-SEP-11	15-SEP-11	15-SEP-11
ALS Sample ID	L1067095-1	L1067095-5	L1067095-6	L1067095-13	L1067095-17	L1067095-21	L1067095-26	L1067095-31	L1067095-35	L1067095-37	L1067095-38	L1067095-45	L1067095-46	L1067095-49
Matrix	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Benzo(b+j+k) fluoranthene	<0.022	<0.022	<0.015	<0.022	<0.061	<0.032	<0.015	<0.061	<0.036	<0.022	<0.032	<0.054	<0.054	<0.015
Benzo(g,h,i) perylene	<0.010	<0.010	<0.080	<0.010	<0.010	<0.020	<0.010	<0.010	<0.070	<0.010	<0.010	<0.020	<0.020	<0.010
Benzo(k) fluoranthene	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.020	<0.010	<0.010	<0.020	<0.020	<0.010
Chrysene	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.030	<0.010	<0.010	<0.015	<0.016	<0.010
Dibenz(a,h) anthracene	<0.0050	<0.0050	<0.0050	<0.0050	<0.0080	<0.0050	<0.0050	<0.0060	<0.030	<0.0050	<0.0050	<0.020	<0.020	<0.0050
Fluoranthene	<0.010	<0.010	<0.010	<0.010	<0.010	0.011	<0.010	<0.010	<0.020	<0.010	<0.010	<0.015	<0.016	<0.010
Fluorene	<0.030	<0.040	0.016	<0.030	<0.20	<0.020	<0.020	<0.20	0.162	<0.030	<0.030	0.115	<0.20	<0.020
Indeno (1,2,3-c,d) pyrene	<0.010	<0.010	<0.010	<0.010	<0.030	<0.020	<0.010	<0.020	<0.040	<0.010	<0.010	<0.015	<0.016	<0.010
2-Methylnaphthalene	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.020	<0.010	<0.010	<0.015	<0.016	<0.010
Naphthalene	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.020	<0.010	<0.010	<0.015	<0.016	<0.010
Phenanthrene	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.020	<0.010	<0.010	<0.015	<0.016	<0.010
Pyrene	<0.010	<0.010	<0.010	<0.010	<0.010	0.010	<0.010	<0.010	<0.020	<0.010	<0.010	<0.015	<0.016	<0.010

Sample ID	2011-GK-S-12	2011-GK-S-13	2011-GK-S-14	2011-GK-S-16	2011-GK-S-17	2011-GK-S-18	2011-GK-S-19	2011-GK-S-20	2011-GK-S-20-D	2011-GK-S-21	2011-GK-S-22	2011-GK-S-23	2011-GK-S-24	2011-GK-S-24-D
Date Sampled	15-SEP-11	16-SEP-11	16-SEP-11	16-SEP-11	17-SEP-11	17-SEP-11	17-SEP-11	17-SEP-11	17-SEP-11	17-SEP-11	17-SEP-11	17-SEP-11	17-SEP-11	17-SEP-11
ALS Sample ID	L1067095-50	L1067095-52	L1067095-53	L1067095-54	L1067095-55	L1067095-59	L1067095-61	L1067095-66	L1067095-67	L1067095-68	L1067095-70	L1067095-71	L1067095-72	L1067095-73
Matrix	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Benzo(b+j+k) fluoranthene	<0.061	<0.015	<0.032	<0.062	<0.034	<0.092	<0.015	<0.015	<0.015	<0.045	<0.073	<0.015	<0.063	<0.050
Benzo(g,h,i) perylene	<0.020	<0.010	<0.010	<0.020	<0.017	<0.030	<0.010	<0.010	<0.010	<0.030	<0.020	<0.010	<0.020	<0.15
Benzo(k) fluoranthene	<0.010	<0.010	<0.010	<0.014	<0.017	<0.020	<0.010	<0.010	<0.010	<0.020	<0.020	<0.010	<0.020	<0.040
Chrysene	<0.010	<0.010	<0.010	<0.014	<0.017	<0.010	<0.010	<0.010	<0.010	<0.017	<0.010	<0.010	<0.015	<0.010
Dibenz(a,h) anthracene	<0.010	<0.0050	<0.010	<0.030	<0.0085	<0.030	<0.0050	<0.0050	<0.0050	<0.020	<0.030	<0.0050	<0.020	<0.02
Fluoranthene	<0.010	<0.010	<0.010	<0.014	<0.017	<0.010	<0.010	<0.010	<0.010	<0.017	<0.010	<0.010	<0.015	<0.010
Fluorene	<0.20	<0.010	<0.080	<0.20	<0.030	<0.30	<0.010	<0.020	<0.020	<0.080	<0.30	<0.010	<0.090	<0.070
Indeno (1,2,3-c,d) pyrene	<0.020	<0.010	<0.010	<0.020	<0.017	<0.020	<0.010	<0.010	<0.010	<0.020	<0.030	<0.010	<0.020	<0.020
2-Methylnaphthalene	<0.010	<0.010	<0.010	<0.014	<0.017	<0.010	<0.010	<0.010	<0.010	<0.017	<0.010	<0.010	<0.015	<0.010
Naphthalene	<0.010	<0.010	<0.010	<0.014	<0.017	<0.010	<0.010	<0.010	<0.010	<0.017	<0.010	<0.010	<0.015	<0.020
Phenanthrene	<0.010	<0.010	<0.010	<0.014	<0.017	<0.010	<0.010	<0.010	<0.010	<0.017	<0.010	<0.010	<0.015	<0.010
Pyrene	<0.010	<0.010	<0.010	<0.014	<0.017	<0.010	<0.010	<0.010	<0.010	<0.017	<0.010	<0.010	<0.015	<0.010

Note: Units are in mg/kg unless otherwise specified.

Table A-2 Metal and Polycyclic Aromatic Hydrocarbon Concentrations in Berry Samples Collected from the Project Area in 2011

Sample ID	2011-GK-B-01	2011-GK-B-02	2011-GK-B-02-D	2011-GK-B-02 CROWBERRY	2011-GK-B-03	2011-GK-B-03 CROWBERRY	2011-GK-B-04	2011-GK-B-05	2011-GK-B-06	2011-GK-B-07	2011-GK-B-09	2011-GK-B-09-D	2011-GK-B-17	2011-GK-B-19
Date Sampled	14-SEP-11	14-SEP-11	14-SEP-11	14-SEP-11	14-SEP-11	14-SEP-11	14-SEP-11	15-SEP-11	15-SEP-11	15-SEP-11	15-SEP-11	15-SEP-11	17-SEP-11	17-SEP-11
ALS Sample ID	L1067095-2	L1067095-7	L1067095-8	L1067095-79	L1067095-14	L1067095-80	L1067095-18	L1067095-22	L1067095-27	L1067095-32	L1067095-39	L1067095-40	L1067095-56	L1067095-65
Matrix	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue
Physical Tests														
% Moisture	84.1	85.0	84.3	87.1	83.6	86.6	84.1	84.1	84.2	84.5	83.6	83.5	85.7	84.2
Metals														
Aluminum (Al)-Total	22	20	17	<10	19	<10	43	21	15	16	19	18	16	<10
Antimony (Sb)-Total	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Arsenic (As)-Total	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Barium (Ba)-Total	12.9	15.3	13.3	6.48	10.2	11.8	13.0	11.8	7.66	14.6	11.6	11.4	16.1	8.97
Beryllium (Be)-Total	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Bismuth (Bi)-Total	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Boron (B)-Total	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Cadmium (Cd)-Total	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	0.103	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
Calcium (Ca)-Total	1080	1150	1040	675	876	876	857	1040	869	1220	945	974	1110	917
Chromium (Cr)-Total	0.77	1.68	1.11	2.14	1.31	2.97	0.95	0.89	1.32	2.17	0.66	<0.50	0.94	1.02
Cobalt (Co)-Total	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.16	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Copper (Cu)-Total	3.43	4.80	3.73	4.99	3.69	6.54	3.41	3.77	4.81	3.62	3.13	3.04	2.36	2.89
Iron (Fe)-Total	12.5	14.5	11.8	18.2	12.3	22.8	24.8	10.3	12.8	15.6	9.2	8.4	10.5	9.6
Lead (Pb)-Total	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Lithium (Li)-Total	<0.50	<0.50	<0.50	0.87	<0.50	0.52	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Magnesium (Mg)-Total	531	500	448	434	385	461	414	449	458	479	443	453	488	396
Manganese (Mn)-Total	37.6	100	86.7	17.3	57.5	22.4	104	140	154	71.5	68.9	80.5	69.2	115
Mercury (Hg)-Total	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Molybdenum (Mo)-Total	0.104	0.088	0.084	0.091	0.091	0.105	0.167	0.180	0.254	0.132	0.130	0.098	0.068	0.188
Nickel (Ni)-Total	1.33	1.55	1.11	2.00	1.12	2.19	1.19	0.83	1.18	1.88	1.03	1.00	0.98	0.87
Phosphorus (P)-Total	749	819	783	741	699	717	778	827	806	840	730	714	770	757
Potassium (K)-Total	6150	5310	4920	8400	4300	7280	4840	6120	6400	5710	4960	5000	5200	5150
Selenium (Se)-Total	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Sodium (Na)-Total	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100
Strontium (Sr)-Total	3.05	2.99	3.00	2.67	2.98	4.26	2.88	1.61	0.836	5.11	2.19	2.44	3.60	1.90
Thallium (Tl)-Total	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
Tin (Sn)-Total	0.55	0.70	1.06	0.37	0.73	0.41	0.38	0.29	1.29	0.94	0.51	0.33	0.49	0.33
Titanium (Ti)-Total	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.79	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Uranium (U)-Total	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Vanadium (V)-Total	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Zinc (Zn)-Total	5.98	8.84	8.03	5.08	6.68	6.39	6.76	6.97	7.78	5.84	6.28	5.98	7.67	5.49
Polycyclic Aromatic Hydrocarbons														
Acenaphthene	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Acenaphthylene	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Anthracene	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Benz(a)anthracene	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Benzo(a)pyrene	<0.060	<0.050	<0.060	<1.0	<0.60	<2.0	<0.40	<0.60	<0.60	<0.40	<0.60	<0.90	<0.60	<0.70
Benzo(b)fluoranthene	<0.050	<0.050	<0.050	<0.40	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Benzo(g,h,i)perylene	<0.050	<0.050	<0.050	<0.050	0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Benzo(k)fluoranthene	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Chrysene	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Dibenz(a,h)anthracene	<0.050	<0.080	<0.080	<0.050	<0.60	<0.050	<0.50	<0.20	<0.20	<0.30	<0.30	<0.30	<0.070	<0.60
Fluoranthene	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Fluorene	<0.050	<0.050	<0.050	<0.070	<0.050	<0.20	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Indeno(1,2,3-c,d)pyrene	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Naphthalene	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Phenanthrene	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Pyrene	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050

Note: Units are in mg/kg unless otherwise specified.

Table A-3 Metal and Polycyclic Aromatic Hydrocarbon Concentrations in Leaf Samples Collected from the Project Area in 2011

Sample ID	2011-GK-LV-01	2011-GK-LV-02	2011-GK-LV-02-D	2011-GK-LV-03	2011-GK-LV-04	2011-GK-LV-05	2011-GK-LV-06	2011-GK-LV-07	2011-GK-LV-09	2011-GK-LV-09-D	2011-GK-LV-17	2011-GK-LV-19
Date Sampled	14-SEP-11	14-SEP-11	14-SEP-11	14-SEP-11	14-SEP-11	15-SEP-11	15-SEP-11	15-SEP-11	15-SEP-11	15-SEP-11	17-SEP-11	17-SEP-11
ALS Sample ID	L1067095-3	L1067095-9	L1067095-10	L1067095-15	L1067095-19	L1067095-23	L1067095-28	L1067095-33	L1067095-43	L1067095-44	L1067095-58	L1067095-62
Matrix	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue
Physical Tests												
% Moisture	56.6	57.4	58.3	61.3	53.9	55.9	61.1	61.3	58.1	57.8	57.7	66.3
Metals												
Aluminum (Al)-Total	52	36	29	44	39	11	12	35	20	22	31	<10
Antimony (Sb)-Total	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Arsenic (As)-Total	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Barium (Ba)-Total	74.8	51.0	49.4	76.5	72.2	54.3	50.6	72.1	59.9	57.5	55.7	62.1
Beryllium (Be)-Total	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Bismuth (Bi)-Total	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Boron (B)-Total	<10	<10	<10	<10	17	12	10	<10	<10	<10	<10	<10
Cadmium (Cd)-Total	0.038	0.065	0.063	0.078	0.039	0.103	0.035	0.072	0.062	0.057	0.122	0.056
Calcium (Ca)-Total	4740	4510	4290	4720	4950	5780	6810	5110	5020	4920	3250	7170
Chromium (Cr)-Total	1.14	0.65	<0.50	<0.50	<0.50	<0.50	<0.50	0.64	<0.50	<0.50	<0.50	<0.50
Cobalt (Co)-Total	0.22	0.68	0.67	0.36	0.32	0.99	0.52	0.38	0.55	0.51	0.79	0.62
Copper (Cu)-Total	3.47	3.56	3.47	3.76	3.93	3.42	3.14	3.77	3.81	3.75	4.48	3.51
Iron (Fe)-Total	45.0	34.6	31.1	30.3	40.4	21.9	37.1	36.6	45.8	46.8	35.2	33.2
Lead (Pb)-Total	<0.10	<0.10	<0.10	<0.10	0.17	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Lithium (Li)-Total	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.64	0.52	<0.50	<0.50
Magnesium (Mg)-Total	4110	3150	2990	2570	3400	3580	3480	3240	2780	2730	2350	4070
Manganese (Mn)-Total	86.9	207	205	329	122	583	491	268	328	300	116	364
Mercury (Hg)-Total	0.0121	0.0127	0.0128	0.0120	0.0106	0.0110	0.0106	0.0125	0.0122	0.0117	0.0133	0.0124
Molybdenum (Mo)-Total	0.061	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Nickel (Ni)-Total	4.38	4.48	3.90	1.16	4.58	2.52	2.24	3.83	2.46	2.57	2.38	2.37
Phosphorus (P)-Total	2250	1650	1680	2190	2240	2310	3320	1520	2150	2070	1580	2670
Potassium (K)-Total	2960	3380	3540	3420	3290	3070	3910	2650	3780	3620	2660	2880
Selenium (Se)-Total	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Sodium (Na)-Total	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100
Strontium (Sr)-Total	30.3	24.2	22.9	25.0	36.9	19.4	17.8	31.7	20.9	20.4	24.7	37.7
Thallium (Tl)-Total	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
Tin (Sn)-Total	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Titanium (Ti)-Total	1.16	0.86	0.85	0.83	0.86	0.92	0.96	0.84	1.09	0.91	0.79	1.17
Uranium (U)-Total	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Vanadium (V)-Total	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Zinc (Zn)-Total	56.4	87.2	92.9	106	47.1	197	204	149	121	123	132	172
Polycyclic Aromatic Hydrocarbons												
Acenaphthene	<0.060	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.070	<0.050	<0.050	<0.070	<0.10
Acenaphthylene	<0.050	<0.060	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.080	<0.20
Anthracene	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.080	<0.050	<0.050	<0.050	<0.10
Benz(a)anthracene	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.10
Benzo(a)pyrene	<3.0	<3.0	<3.0	<2.0	<2.0	<2.0	<3.0	<5.0	<3.0	<3.0	<4.0	<0.50
Benzo(b)fluoranthene	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.060	<0.050	<0.050	<0.050	<0.10
Benzo(g,h,i)perylene	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.060	<0.050	<0.050	<0.070	<0.10
Benzo(k)fluoranthene	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.40
Chrysene	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.070	<0.050	<0.050	<0.050	<0.20
Dibenz(a,h)anthracene	<0.050	<0.30	<0.30	<0.20	<0.20	<0.30	<0.30	<0.70	<0.30	<0.20	<0.70	<0.20
Fluoranthene	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.10
Fluorene	<0.30	<0.30	<0.30	<0.30	<0.20	<0.30	<0.30	<0.50	<0.30	<0.20	<0.40	<0.20
Indeno(1,2,3-c,d)pyrene	<0.050	<0.050	<0.050	<0.070	<0.090	<0.070	<0.050	<0.050	<0.050	<0.050	<0.050	<0.20
Naphthalene	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.060	<0.050	<0.050	<0.10	<0.20
Phenanthrene	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.10	<0.050	<0.050	<0.080	<0.10
Pyrene	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.10

Note: Units are in mg/kg unless otherwise specified.

Table A-4 Metal and Polycyclic Aromatic Hydrocarbon Concentrations in Lichen Samples Collected from the Project Area in 2011

Sample ID	2011-GK-L-01	2011-GK-L-02	2011-GK-L-02-D	2011-GK-L-03	2011-GK-L-04	2011-GK-L-05	2011-GK-L-06	2011-GK-L-07	2011-GK-L-09	2011-GK-L-09-D	2011-GK-L-17	2011-GK-L-19
Date Sampled	**14-SEP-11**	**14-SEP-11**	**14-SEP-11**	**14-SEP-11**	**14-SEP-11**	**15-SEP-11**	**15-SEP-11**	**15-SEP-11**	**15-SEP-11**	**15-SEP-11**	**17-SEP-11**	**17-SEP-11**
ALS Sample ID	**L1067095-4**	**L1067095-11**	**L1067095-12**	**L1067095-16**	**L1067095-20**	**L1067095-24**	**L1067095-29**	**L1067095-34**	**L1067095-41**	**L1067095-42**	**L1067095-57**	**L1067095-63**
Matrix	**Tissue**	**Tissue**	**Tissue**	**Tissue**	**Tissue**	**Tissue**	**Tissue**	**Tissue**	**Tissue**	**Tissue**	**Tissue**	**Tissue**
Physical Tests												
% Moisture	23.4	16.2	30.4	12.5	34.4	39.4	23.9	12.9	11.8	17.9	11.5	29.1
Metals												
Aluminum (Al)-Total	1120	531	339	492	833	415	563	311	540	301	1020	608
Antimony (Sb)-Total	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Arsenic (As)-Total	0.345	0.266	0.172	0.310	0.372	0.228	0.346	0.149	0.278	0.182	0.364	0.453
Barium (Ba)-Total	59.9	45.1	37.8	49.4	45.7	19.0	33.5	42.2	43.9	22.6	110	42.5
Beryllium (Be)-Total	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Bismuth (Bi)-Total	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Boron (B)-Total	23	16	14	17	15	48	<10	38	24	11	18	22
Cadmium (Cd)-Total	0.060	0.127	0.125	0.106	0.093	0.036	0.044	0.081	0.074	0.043	0.190	0.099
Calcium (Ca)-Total	2960	2010	2120	2030	1910	1740	2240	2490	2070	1350	3300	2350
Chromium (Cr)-Total	16.7	1.95	1.37	2.22	13.3	1.39	2.54	1.41	1.95	1.52	5.12	2.70
Cobalt (Co)-Total	1.62	0.50	0.42	0.22	0.94	0.39	0.64	0.24	0.33	0.18	0.57	0.44
Copper (Cu)-Total	4.53	2.53	2.75	3.06	4.12	1.21	3.80	2.10	2.64	1.79	4.10	3.35
Iron (Fe)-Total	1640	494	303	455	1200	347	621	237	406	259	875	537
Lead (Pb)-Total	1.28	0.96	0.62	2.03	5.50	0.37	0.78	0.47	0.99	0.45	1.86	2.50
Lithium (Li)-Total	2.42	<0.50	<0.50	<0.50	1.22	<0.50	<0.50	<0.50	<0.50	<0.50	0.72	<0.50
Magnesium (Mg)-Total	3520	446	466	370	1180	424	619	508	468	374	462	500
Manganese (Mn)-Total	105	68.7	67.3	89.5	58.8	46.4	237	85.9	106	71.5	53.8	102
Mercury (Hg)-Total	0.0436	0.0640	0.0493	0.0970	0.0483	0.0419	0.0690	0.0462	0.0749	0.0436	0.0820	0.0913
Molybdenum (Mo)-Total	0.179	<0.050	<0.050	0.059	0.179	0.064	0.128	<0.050	0.055	<0.050	0.094	0.212
Nickel (Ni)-Total	25.0	2.64	2.09	1.75	13.0	1.60	2.78	1.47	1.93	1.52	4.50	2.41
Phosphorus (P)-Total	699	623	657	669	769	414	682	833	675	595	731	548
Potassium (K)-Total	1550	1280	1340	1080	1440	860	1610	1890	1090	1180	1040	1050
Selenium (Se)-Total	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Sodium (Na)-Total	120	<100	100	<100	110	<100	<100	200	<100	<100	<100	<100
Strontium (Sr)-Total	18.3	12.1	12.1	10.7	14.3	12.2	7.67	14.0	8.93	5.58	26.9	13.1
Thallium (Tl)-Total	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
Tin (Sn)-Total	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Titanium (Ti)-Total	69.9	22.4	14.6	29.4	47.9	10.2	26.5	10.9	18.4	9.72	59.9	28.9
Uranium (U)-Total	0.121	0.058	0.028	0.117	0.080	0.018	0.143	0.022	0.034	0.021	0.107	0.098
Vanadium (V)-Total	3.01	1.01	0.64	1.07	1.88	0.69	1.28	0.59	1.04	0.53	2.10	1.21
Zinc (Zn)-Total	25.5	24.0	27.6	36.5	27.3	18.7	24.9	26.8	30.2	19.4	37.4	28.0
Polycyclic Aromatic Hydrocarbons												
Acenaphthene	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Acenaphthylene	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Anthracene	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Benz(a)anthracene	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Benzo(a)pyrene	<0.80	<0.60	<0.50	<1.5	<0.70	<0.50	<1.5	<0.50	<0.60	<0.40	<0.70	<1.5
Benzo(b)fluoranthene	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Benzo(g,h,i)perylene	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Benzo(k)fluoranthene	<0.080	<0.10	<0.20	<0.070	<0.080	<0.090	<0.30	<0.20	<0.060	<0.10	<0.050	<0.050
Chrysene	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Dibenz(a,h)anthracene	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Fluoranthene	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Fluorene	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Indeno(1,2,3-c,d)pyrene	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Naphthalene	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Phenanthrene	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Pyrene	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050

Note: Units are in mg/kg unless otherwise specified.

Table A-5 Metal and Polycyclic Aromatic Hydrocarbon Concentrations in Grass Samples Collected from the Project Area in 2011

Sample ID	2011-GK-G-05	2011-GK-G-06	2011-GK-G-08	2011-GK-G-10	2011-GK-G-10-D	2011-GK-G-12	2011-GK-G-18	2011-GK-G-19	2011-GK-G-21	2011-GK-G-24	2011-GK-G-24-D
Date Sampled	15-SEP-11	15-SEP-11	15-SEP-11	15-SEP-11	15-SEP-11	15-SEP-11	17-SEP-11	17-SEP-11	17-SEP-11	17-SEP-11	17-SEP-11
ALS Sample ID	L1067095-25	L1067095-30	L1067095-36	L1067095-47	L1067095-48	L1067095-51	L1067095-60	L1067095-64	L1067095-69	L1067095-74	L1067095-75
Matrix	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue
Physical Tests											
% Moisture	36.0	26.4	34.5	29.7	27.1	43.9	34.0	33.3	36.5	40.8	36.1
Metals											
Aluminum (Al)-Total	74	27	31	43	19	33	29	154	34	19	21
Antimony (Sb)-Total	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Arsenic (As)-Total	0.053	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.082	0.061	<0.050	<0.050
Barium (Ba)-Total	32.1	42.9	41.1	34.8	38.0	34.5	39.2	27.2	28.5	30.6	26.7
Beryllium (Be)-Total	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Bismuth (Bi)-Total	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Boron (B)-Total	11	<10	<10	<10	<10	12	<10	14	26	<10	17
Cadmium (Cd)-Total	<0.030	0.036	0.047	<0.030	<0.030	<0.030	<0.030	0.055	<0.030	<0.030	<0.030
Calcium (Ca)-Total	2370	2180	3130	2870	2360	2560	2180	2220	2110	2350	2370
Chromium (Cr)-Total	2.54	3.59	0.68	1.19	1.36	0.72	0.64	2.56	0.86	0.60	<0.50
Cobalt (Co)-Total	0.31	0.28	0.14	0.19	0.13	<0.10	<0.10	0.44	0.21	<0.10	<0.10
Copper (Cu)-Total	2.91	2.57	4.14	2.93	2.11	2.06	1.86	2.69	2.00	2.27	1.91
Iron (Fe)-Total	148	95.7	129	95.3	54.2	92.3	76.2	214	96.8	73.6	84.5
Lead (Pb)-Total	0.17	0.21	0.17	0.14	<0.10	0.19	0.14	0.40	0.22	<0.10	0.11
Lithium (Li)-Total	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Magnesium (Mg)-Total	679	686	755	654	798	666	619	563	512	728	644
Manganese (Mn)-Total	82.3	191	225	162	482	117	91.0	338	126	185	167
Mercury (Hg)-Total	0.0283	0.0273	0.0221	0.0199	0.0149	0.0246	0.0203	0.0253	0.0260	0.0212	0.0220
Molybdenum (Mo)-Total	0.617	0.767	1.73	1.79	1.26	2.10	2.70	0.788	0.469	1.33	1.56
Nickel (Ni)-Total	2.16	2.25	1.51	1.62	1.05	0.95	0.76	1.93	1.69	0.61	<0.50
Phosphorus (P)-Total	424	507	333	347	570	314	374	595	327	451	376
Potassium (K)-Total	2400	4030	1700	2090	2980	1530	1400	3340	2830	2180	1670
Selenium (Se)-Total	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Sodium (Na)-Total	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100
Strontium (Sr)-Total	12.9	10.9	12.4	10.5	9.62	10.5	9.82	13.6	8.70	10.9	10.5
Thallium (Tl)-Total	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
Tin (Sn)-Total	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Titanium (Ti)-Total	1.55	1.08	1.27	1.17	0.84	1.39	1.11	5.12	1.49	0.95	0.95
Uranium (U)-Total	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.145	<0.010	<0.010	<0.010
Vanadium (V)-Total	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Zinc (Zn)-Total	52.2	43.5	101	52.1	44.7	65.6	64.6	31.3	57.1	46.5	51.3
Polycyclic Aromatic Hydrocarbons											
Acenaphthene	<0.050	<0.050	<0.050	<0.050	<0.060	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Acenaphthylene	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Anthracene	<0.050	<0.050	<0.050	<0.050	<0.060	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Benz(a)anthracene	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Benzo(a)pyrene	<2.0	<4.0	<2.0	<4.0	<5.0	<3.0	<2.0	<5.0	<0.20	<0.50	<2.0
Benzo(b)fluoranthene	<0.050	<0.050	<0.050	<0.050	<0.090	<0.050	<0.050	<0.080	<0.050	<0.050	<0.050
Benzo(g,h,i)perylene	<0.050	<0.050	0.123	<0.050	<3.0	<0.050	<0.050	<0.050	<0.20	<0.080	<0.050
Benzo(k)fluoranthene	<0.050	<0.050	<0.050	<0.050	<0.060	<0.050	<0.050	<0.050	<0.20	<0.050	<0.050
Chrysene	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Dibenz(a,h)anthracene	<0.050	<0.050	<0.050	<0.050	<0.40	<0.050	<0.050	<0.070	<0.080	<0.060	<0.050
Fluoranthene	<0.050	<0.050	<0.050	<0.050	<0.070	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Fluorene	<0.20	<0.10	<0.20	<0.30	<0.060	<0.20	<0.20	<0.20	<0.050	<0.050	<0.20
Indeno(1,2,3-c,d)pyrene	<0.050	<0.050	<0.050	<0.050	<0.40	<0.050	<0.050	<0.060	<0.050	<0.060	<0.050
Naphthalene	<0.050	<0.050	<0.050	<0.050	<0.070	<0.050	<0.050	<0.050	<0.060	<0.050	<0.050
Phenanthrene	<0.050	<0.050	<0.050	<0.050	<0.30	<0.050	<0.050	<0.060	<0.20	<0.070	<0.050
Pyrene	<0.050	<0.050	<0.050	<0.050	<0.070	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050

Note: Units are in mg/kg unless otherwise specified.

Table A-6 Metal and Polycyclic Aromatic Hydrocarbon Concentrations in Ant Samples Collected from the Project Area in 2011

Sample ID	ANTS-GK	ANTS-GK-BAIT (JAM)	ANTS-GK
Date Sampled	16-SEP-11	16-SEP-11	15-SEP-11
Time Sampled	00:00	00:00	00:00
ALS Sample ID	L1067095-76	L1067095-77	L1067095-78
Matrix	Tissue	Tissue	Tissue
Physical Tests			
% Moisture	28.7	27.1	40.9
Metals			
Aluminum (Al)-Total	15	<10	104
Antimony (Sb)-Total	<0.050	<0.050	<0.050
Arsenic (As)-Total	<0.050	<0.050	0.052
Barium (Ba)-Total	3.39	0.163	46.7
Beryllium (Be)-Total	<0.30	<0.30	<0.30
Bismuth (Bi)-Total	<0.30	<0.30	<0.30
Boron (B)-Total	<10	<10	14
Cadmium (Cd)-Total	0.201	<0.030	0.511
Calcium (Ca)-Total	202	68	4730
Chromium (Cr)-Total	<0.50	<0.50	0.89
Cobalt (Co)-Total	<0.10	<0.10	0.19
Copper (Cu)-Total	1.61	0.319	6.54
Iron (Fe)-Total	59	2.7	55
Lead (Pb)-Total	0.17	<0.10	0.15
Lithium (Li)-Total	<0.50	<0.50	<0.50
Magnesium (Mg)-Total	229	76.3	1120
Manganese (Mn)-Total	48.4	1.69	406
Mercury (Hg)-Total	<0.10	<0.0050	<0.10
Molybdenum (Mo)-Total	0.076	<0.050	0.263
Nickel (Ni)-Total	<0.50	0.50	1.62
Phosphorus (P)-Total	1300	111	3740
Potassium (K)-Total	<2000	860	5700
Selenium (Se)-Total	<1.0	<1.0	<1.0
Sodium (Na)-Total	<2000	130	<2000
Strontium (Sr)-Total	1.80	0.203	13.0
Thallium (Tl)-Total	<0.030	<0.030	<0.030
Tin (Sn)-Total	<0.20	<0.20	<0.20
Titanium (Ti)-Total	<10	<0.50	<10
Uranium (U)-Total	<0.010	<0.010	<0.010
Vanadium (V)-Total	<0.50	<0.50	<0.50
Zinc (Zn)-Total	25.1	1.24	87.7
Polycyclic Aromatic Hydrocarbons			
Acenaphthene	-	<0.050	-
Acenaphthylene	-	<0.050	-
Anthracene	-	<0.050	-
Benz(a)anthracene	-	<0.050	-
Benzo(a)pyrene	-	<0.090	-
Benzo(b)fluoranthene	-	<0.050	-
Benzo(g,h,i)perylene	-	<0.050	-
Benzo(k)fluoranthene	-	<0.050	-
Chrysene	-	<0.050	-
Dibenz(a,h)anthracene	-	<0.050	-
Fluoranthene	-	<0.050	-
Fluorene	-	<0.050	-
Indeno(1,2,3-c,d)pyrene	-	<0.050	-
Naphthalene	-	<0.050	-
Phenanthrene	-	<0.050	-
Pyrene	-	<0.050	-

Note: Units are in mg/kg unless otherwise specified.

ATTACHMENT B

ALS LAB REPORTS

GOLDER ASSOCIATES LTD.
ATTN: Audrey Wagenaar
500 - 4260 Still Creek Drive
Burnaby BC V5C 6C6

Date Received: 04-OCT-11
Report Date: 24-NOV-11 10:53 (MT)
Version: FINAL REV. 2

Client Phone: 604-297-2036

Certificate of Analysis

Lab Work Order #: L1067095

Project P.O. #:	NOT SUBMITTED
Job Reference:	11-1365-0001-2120
C of C Numbers:	1 of 7, 2 of 7, 3 of 7, 4 of 7, 5 of 7, 6 of 7, 7 of 7
Legal Site Desc:	GAHCHO KUE PROJECT

Comments: There was insufficient material available to run PAHs for samples L1067095 - 76 & 78.

November 24 - COC attachment has been corrected.

Amber Springer
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID / Description / Sampled Date / Sampled Time / Client ID		L1067095-1 SOIL 14-SEP-11 2011-GK-S-01	L1067095-5 SOIL 14-SEP-11 2011-GK-S-02	L1067095-6 SOIL 14-SEP-11 2011-GK-S-02-D	L1067095-13 SOIL 14-SEP-11 2011-GK-S-03	L1067095-17 SOIL 14-SEP-11 2011-GK-S-04
Grouping	**Analyte**					
SOIL						
Physical Tests	Moisture (%)	24.5	36.2	34.1	32.6	58.6
	pH (1:2 soil:water) (pH)	5.10	4.21	4.30	4.05	4.10
Metals	Aluminum (Al) (mg/kg)	4070	3490	3330	3500	5130
	Antimony (Sb) (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Arsenic (As) (mg/kg)	1.49	1.15	1.09	0.824	1.12
	Barium (Ba) (mg/kg)	30.3	40.0	38.0	42.3	105
	Beryllium (Be) (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
	Bismuth (Bi) (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
	Boron (B) (mg/kg)	<10	<10	<10	<10	<10
	Cadmium (Cd) (mg/kg)	0.053	0.122	0.109	0.235	0.444
	Calcium (Ca) (mg/kg)	540	936	863	403	2230
	Chromium (Cr) (mg/kg)	11.1	6.76	7.39	4.37	5.16
	Cobalt (Co) (mg/kg)	1.30	1.22	1.39	0.65	2.94
	Copper (Cu) (mg/kg)	4.15	4.99	4.76	3.55	10.2
	Iron (Fe) (mg/kg)	5900	5330	5140	4040	4410
	Lead (Pb) (mg/kg)	2.63	2.04	1.92	2.40	3.86
	Lithium (Li) (mg/kg)	6.3	4.0	3.7	1.8	1.6
	Magnesium (Mg) (mg/kg)	1280	843	949	417	889
	Manganese (Mn) (mg/kg)	31.4	29.8	31.1	20.7	16.4
	Mercury (Hg) (mg/kg)	0.0420	0.0749	0.0706	0.0552	0.163
	Molybdenum (Mo) (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
	Nickel (Ni) (mg/kg)	4.99	3.89	4.36	2.33	9.88
	Phosphorus (P) (mg/kg)	203	380	354	318	947
	Potassium (K) (mg/kg)	640	420	440	360	810
	Selenium (Se) (mg/kg)	<0.20	<0.20	<0.20	<0.20	0.28
	Silver (Ag) (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Sodium (Na) (mg/kg)	<100	<100	<100	<100	100
	Strontium (Sr) (mg/kg)	5.50	8.57	7.36	6.99	32.2
	Thallium (Tl) (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Tin (Sn) (mg/kg)	<2.0	<2.0	<2.0	<2.0	<2.0
	Titanium (Ti) (mg/kg)	299	257	251	158	127
	Uranium (U) (mg/kg)	0.846	0.510	0.466	0.413	0.427
	Vanadium (V) (mg/kg)	13.9	13.6	13.2	9.85	5.47
	Zinc (Zn) (mg/kg)	8.7	12.7	12.6	10.1	20.6
Polycyclic Aromatic Hydrocarbons	Acenaphthene (mg/kg)	<0.0050	<0.0050	<0.0050	<0.0050	DLM <0.0060
	Acenaphthylene (mg/kg)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1067095-21	L1067095-26	L1067095-31	L1067095-35	L1067095-37
	Description	SOIL	SOIL	SOIL	SOIL	SOIL
	Sampled Date	15-SEP-11	15-SEP-11	15-SEP-11	15-SEP-11	15-SEP-11
	Sampled Time					
	Client ID	2011-GK-S-05	2011-GK-S-06	2011-GK-S-07	2011-GK-S-08	2011-GK-S-09
Grouping	**Analyte**					
SOIL						
Physical Tests	Moisture (%)	50.4	17.0	50.2	86.3	22.0
	pH (1:2 soil:water) (pH)	4.74	4.39	4.43	4.54	4.38
Metals	Aluminum (Al) (mg/kg)	4090	5610	4160	2170	6330
	Antimony (Sb) (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Arsenic (As) (mg/kg)	1.44	2.08	1.01	1.51	1.93
	Barium (Ba) (mg/kg)	25.2	52.2	140	57.0	54.5
	Beryllium (Be) (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
	Bismuth (Bi) (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
	Boron (B) (mg/kg)	<10	<10	<10	<10	<10
	Cadmium (Cd) (mg/kg)	<0.050	<0.050	0.192	0.181	<0.050
	Calcium (Ca) (mg/kg)	767	1150	2400	3200	1210
	Chromium (Cr) (mg/kg)	11.9	18.4	6.22	3.73	19.5
	Cobalt (Co) (mg/kg)	2.17	3.51	2.07	2.57	3.24
	Copper (Cu) (mg/kg)	3.75	9.06	9.81	9.27	6.44
	Iron (Fe) (mg/kg)	6070	8790	4250	8920	9020
	Lead (Pb) (mg/kg)	1.46	1.89	2.41	2.27	2.04
	Lithium (Li) (mg/kg)	9.6	13.6	1.5	<1.0	14.6
	Magnesium (Mg) (mg/kg)	2110	2930	576	617	3050
	Manganese (Mn) (mg/kg)	53.8	97.8	23.8	18.2	81.0
	Mercury (Hg) (mg/kg)	0.0149	0.0317	0.157	0.0938	0.0319
	Molybdenum (Mo) (mg/kg)	<0.50	<0.50	<0.50	1.01	<0.50
	Nickel (Ni) (mg/kg)	5.92	9.59	8.79	6.92	9.69
	Phosphorus (P) (mg/kg)	295	484	746	953	444
	Potassium (K) (mg/kg)	1090	1720	470	430	1780
	Selenium (Se) (mg/kg)	<0.20	<0.20	0.22	0.32	<0.20
	Silver (Ag) (mg/kg)	<0.10	<0.10	0.10	<0.10	<0.10
	Sodium (Na) (mg/kg)	<100	<100	<100	<100	110
	Strontium (Sr) (mg/kg)	4.23	5.89	30.3	28.6	8.67
	Thallium (Tl) (mg/kg)	<0.050	0.103	<0.050	<0.050	0.078
	Tin (Sn) (mg/kg)	<2.0	<2.0	<2.0	<2.0	<2.0
	Titanium (Ti) (mg/kg)	333	455	166	40.9	439
	Uranium (U) (mg/kg)	0.488	0.618	0.952	0.822	0.650
	Vanadium (V) (mg/kg)	14.3	19.2	7.01	2.13	19.7
	Zinc (Zn) (mg/kg)	11.8	21.8	10.1	27.9	19.5
Polycyclic Aromatic Hydrocarbons	Acenaphthene (mg/kg)	<0.0050	<0.0050	<0.0050	<0.040 DLM	<0.0050
	Acenaphthylene (mg/kg)	<0.0050	<0.0050	<0.0050	<0.020 DLHM	<0.0050

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1067095-38	L1067095-45	L1067095-46	L1067095-49	L1067095-50
	Description	SOIL	SOIL	SOIL	SOIL	SOIL
	Sampled Date	15-SEP-11	15-SEP-11	15-SEP-11	15-SEP-11	15-SEP-11
	Sampled Time					
	Client ID	2011-GK-S-09-D	2011-GK-S-10	2011-GK-S-10-D	2011-GK-S-11	2011-GK-S-12
Grouping	**Analyte**					
SOIL						
Physical Tests	Moisture (%)	22.9	86.1	87.2	15.9	78.3
	pH (1:2 soil:water) (pH)	4.36	4.50	4.56	4.50	4.15
Metals	Aluminum (Al) (mg/kg)	5690	1800	1680	3940	622
	Antimony (Sb) (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Arsenic (As) (mg/kg)	1.80	1.26	1.19	1.58	0.521
	Barium (Ba) (mg/kg)	51.6	64.6	58.5	25.4	31.3
	Beryllium (Be) (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
	Bismuth (Bi) (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
	Boron (B) (mg/kg)	<10	<10	<10	<10	<10
	Cadmium (Cd) (mg/kg)	0.060	0.282	0.269	0.054	0.320
	Calcium (Ca) (mg/kg)	1090	4780	4270	781	3070
	Chromium (Cr) (mg/kg)	17.9	1.50	1.42	11.7	0.94
	Cobalt (Co) (mg/kg)	3.24	5.86	5.87	1.94	3.08
	Copper (Cu) (mg/kg)	6.50	8.27	7.93	4.69	5.12
	Iron (Fe) (mg/kg)	8770	4790	4690	6270	895
	Lead (Pb) (mg/kg)	2.05	1.67	1.57	1.74	0.51
	Lithium (Li) (mg/kg)	13.1	<1.0	<1.0	8.4	<1.0
	Magnesium (Mg) (mg/kg)	2680	933	907	1820	759
	Manganese (Mn) (mg/kg)	72.5	13.4	14.3	46.1	3.6
	Mercury (Hg) (mg/kg)	0.0392	0.168	0.170	0.0172	0.110
	Molybdenum (Mo) (mg/kg)	<0.50	1.37	1.31	<0.50	1.55
	Nickel (Ni) (mg/kg)	9.67	6.72	6.12	5.92	4.33
	Phosphorus (P) (mg/kg)	439	681	667	324	474
	Potassium (K) (mg/kg)	1560	720	790	640	370
	Selenium (Se) (mg/kg)	<0.20	0.21	<0.20	<0.20	<0.20
	Silver (Ag) (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Sodium (Na) (mg/kg)	<100	<100	<100	<100	<100
	Strontium (Sr) (mg/kg)	7.50	42.3	37.5	4.43	31.6
	Thallium (Tl) (mg/kg)	0.071	<0.050	<0.050	<0.050	<0.050
	Tin (Sn) (mg/kg)	<2.0	<2.0	<2.0	<2.0	<2.0
	Titanium (Ti) (mg/kg)	407	27.2	27.3	273	12.7
	Uranium (U) (mg/kg)	0.603	0.365	0.356	0.676	0.084
	Vanadium (V) (mg/kg)	19.4	2.08	2.02	13.9	1.22
	Zinc (Zn) (mg/kg)	19.5	29.7	31.5	10.0	34.6
Polycyclic Aromatic Hydrocarbons	Acenaphthene (mg/kg)	<0.0050	<0.015 DLM	<0.030 DLM	<0.0050	<0.090 DLM
	Acenaphthylene (mg/kg)	<0.0050	<0.0075 DLHM	<0.0080 DLHM	<0.0050	<0.0050

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1067095-52	L1067095-53	L1067095-54	L1067095-55	L1067095-59
	Description	SOIL	SOIL	SOIL	SOIL	SOIL
	Sampled Date	16-SEP-11	16-SEP-11	16-SEP-11	17-SEP-11	17-SEP-11
	Sampled Time					
	Client ID	2011-GK-S-13	2011-GK-S-14	2011-GK-S-16	2011-GK-S-17	2011-GK-S-18
Grouping	**Analyte**					
SOIL						
Physical Tests	Moisture (%)	8.71	63.1	83.7	30.2	85.4
	pH (1:2 soil:water) (pH)	5.39	4.77	4.50	4.56	4.81
Metals	Aluminum (Al) (mg/kg)	4110	6740	1940	4750	4130
	Antimony (Sb) (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Arsenic (As) (mg/kg)	1.79	1.55	1.23	0.844	1.30
	Barium (Ba) (mg/kg)	22.9	60.6	49.4	39.5	97.5
	Beryllium (Be) (mg/kg)	<0.20	<0.20	<0.20	0.26	<0.20
	Bismuth (Bi) (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
	Boron (B) (mg/kg)	<10	<10	<10	<10	<10
	Cadmium (Cd) (mg/kg)	<0.050	0.246	0.341	0.148	0.261
	Calcium (Ca) (mg/kg)	1040	1820	3730	794	3400
	Chromium (Cr) (mg/kg)	11.2	15.9	3.53	14.1	3.33
	Cobalt (Co) (mg/kg)	2.34	6.22	4.37	1.35	4.11
	Copper (Cu) (mg/kg)	8.14	9.88	12.7	10.9	17.8
	Iron (Fe) (mg/kg)	6100	8190	4880	5180	5940
	Lead (Pb) (mg/kg)	1.66	1.73	1.56	3.20	1.38
	Lithium (Li) (mg/kg)	9.9	9.6	<1.0	5.2	<1.0
	Magnesium (Mg) (mg/kg)	1820	2610	716	1380	752
	Manganese (Mn) (mg/kg)	54.4	59.5	10.3	32.8	7.6
	Mercury (Hg) (mg/kg)	0.0079	0.0702	0.0878	0.0552	0.0965
	Molybdenum (Mo) (mg/kg)	<0.50	<0.50	0.88	<0.50	1.05
	Nickel (Ni) (mg/kg)	6.88	10.4	6.39	5.83	8.57
	Phosphorus (P) (mg/kg)	327	538	892	319	1170
	Potassium (K) (mg/kg)	760	1170	450	640	590
	Selenium (Se) (mg/kg)	<0.20	<0.20	0.37	<0.20	0.30
	Silver (Ag) (mg/kg)	<0.10	<0.10	0.12	<0.10	0.13
	Sodium (Na) (mg/kg)	<100	<100	<100	<100	<100
	Strontium (Sr) (mg/kg)	4.85	17.8	31.9	7.12	35.0
	Thallium (Tl) (mg/kg)	<0.050	0.076	<0.050	<0.050	<0.050
	Tin (Sn) (mg/kg)	<2.0	<2.0	<2.0	<2.0	<2.0
	Titanium (Ti) (mg/kg)	281	325	50.5	281	70.4
	Uranium (U) (mg/kg)	0.590	0.868	1.11	0.727	1.26
	Vanadium (V) (mg/kg)	13.6	14.4	2.74	11.7	3.78
	Zinc (Zn) (mg/kg)	10.3	23.3	19.6	13.3	19.7
Polycyclic Aromatic Hydrocarbons	Acenaphthene (mg/kg)	<0.0050	<0.0050	DLM <0.010	DLHM <0.0085	DLM <0.020
	Acenaphthylene (mg/kg)	<0.0050	<0.0050	DLHM <0.0070	DLHM <0.0085	<0.0050

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1067095-61	L1067095-66	L1067095-67	L1067095-68	L1067095-70
	Description	SOIL	SOIL	SOIL	SOIL	SOIL
	Sampled Date	17-SEP-11	17-SEP-11	17-SEP-11	17-SEP-11	17-SEP-11
	Sampled Time					
	Client ID	2011-GK-S-19	2011-GK-S-20	2011-GK-S-20-D	2011-GK-S-21	2011-GK-S-22
Grouping	**Analyte**					
SOIL						
Physical Tests	Moisture (%)	16.6	27.5	29.2	89.2	82.1
	pH (1:2 soil:water) (pH)	4.82	4.61	4.22	4.51	4.10
Metals	Aluminum (Al) (mg/kg)	3840	2620	4000	728	2040
	Antimony (Sb) (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Arsenic (As) (mg/kg)	1.30	1.08	1.19	0.661	0.509
	Barium (Ba) (mg/kg)	29.5	18.3	29.8	53.6	138
	Beryllium (Be) (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
	Bismuth (Bi) (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
	Boron (B) (mg/kg)	<10	<10	<10	<10	<10
	Cadmium (Cd) (mg/kg)	<0.050	<0.050	0.099	0.190	0.635
	Calcium (Ca) (mg/kg)	1170	539	878	4740	3670
	Chromium (Cr) (mg/kg)	10.9	9.32	12.0	0.92	1.64
	Cobalt (Co) (mg/kg)	2.49	1.62	2.45	3.26	5.07
	Copper (Cu) (mg/kg)	8.68	3.47	4.61	3.68	9.61
	Iron (Fe) (mg/kg)	5390	4330	5950	4210	1620
	Lead (Pb) (mg/kg)	1.92	1.31	1.60	1.04	0.88
	Lithium (Li) (mg/kg)	10.0	7.4	8.9	<1.0	<1.0
	Magnesium (Mg) (mg/kg)	2070	1450	2050	1040	399
	Manganese (Mn) (mg/kg)	45.7	36.8	50.2	26.1	5.6
	Mercury (Hg) (mg/kg)	0.0199	0.0082	0.0223	0.0537	0.0971
	Molybdenum (Mo) (mg/kg)	<0.50	<0.50	<0.50	0.96	0.56
	Nickel (Ni) (mg/kg)	6.79	4.55	6.17	5.09	6.17
	Phosphorus (P) (mg/kg)	347	201	292	334	691
	Potassium (K) (mg/kg)	900	660	1040	350	390
	Selenium (Se) (mg/kg)	<0.20	<0.20	<0.20	<0.20	0.23
	Silver (Ag) (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Sodium (Na) (mg/kg)	<100	<100	<100	<100	<100
	Strontium (Sr) (mg/kg)	8.07	3.34	6.13	47.1	39.2
	Thallium (Tl) (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Tin (Sn) (mg/kg)	<2.0	<2.0	<2.0	<2.0	<2.0
	Titanium (Ti) (mg/kg)	232	182	292	9.3	31.1
	Uranium (U) (mg/kg)	1.66	0.664	0.804	0.444	1.18
	Vanadium (V) (mg/kg)	11.0	9.85	13.3	0.73	1.22
	Zinc (Zn) (mg/kg)	10.1	8.5	14.5	29.4	26.4
Polycyclic Aromatic Hydrocarbons	Acenaphthene (mg/kg)	<0.0050	<0.0050	<0.0050	DLM <0.0085	DLM <0.050
	Acenaphthylene (mg/kg)	<0.0050	<0.0050	<0.0050	DLHM <0.0085	DLM <0.0060

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1067095-71	L1067095-72	L1067095-73		
	Description	SOIL	SOIL	SOIL		
	Sampled Date	17-SEP-11	17-SEP-11	17-SEP-11		
	Sampled Time					
	Client ID	2011-GK-S-23	2011-GK-S-24	2011-GK-S-24-D		
Grouping	**Analyte**					
SOIL						
Physical Tests	Moisture (%)	19.2	85.7	85.6		
	pH (1:2 soil:water) (pH)	4.92	4.80	4.86		
Metals	Aluminum (Al) (mg/kg)	5500	1020	981		
	Antimony (Sb) (mg/kg)	<0.10	<0.10	<0.10		
	Arsenic (As) (mg/kg)	1.03	0.992	0.798		
	Barium (Ba) (mg/kg)	11.2	82.0	65.4		
	Beryllium (Be) (mg/kg)	<0.20	0.23	<0.20		
	Bismuth (Bi) (mg/kg)	<0.20	<0.20	<0.20		
	Boron (B) (mg/kg)	<10	<10	<10		
	Cadmium (Cd) (mg/kg)	<0.050	0.271	0.194		
	Calcium (Ca) (mg/kg)	296	6070	4970		
	Chromium (Cr) (mg/kg)	13.5	1.20	0.68		
	Cobalt (Co) (mg/kg)	1.24	4.36	3.44		
	Copper (Cu) (mg/kg)	5.22	16.7	13.5		
	Iron (Fe) (mg/kg)	7930	961	972		
	Lead (Pb) (mg/kg)	2.23	2.18	2.03		
	Lithium (Li) (mg/kg)	8.4	<1.0	<1.0		
	Magnesium (Mg) (mg/kg)	1150	1330	1130		
	Manganese (Mn) (mg/kg)	29.3	129	116		
	Mercury (Hg) (mg/kg)	0.0258	0.172	0.142		
	Molybdenum (Mo) (mg/kg)	<0.50	0.90	0.73		
	Nickel (Ni) (mg/kg)	4.22	5.44	4.17		
	Phosphorus (P) (mg/kg)	168	653	512		
	Potassium (K) (mg/kg)	340	770	700		
	Selenium (Se) (mg/kg)	<0.20	<0.20	<0.20		
	Silver (Ag) (mg/kg)	<0.10	<0.10	<0.10		
	Sodium (Na) (mg/kg)	<100	100	<100		
	Strontium (Sr) (mg/kg)	3.34	51.4	42.1		
	Thallium (Tl) (mg/kg)	<0.050	<0.050	<0.050		
	Tin (Sn) (mg/kg)	<2.0	<2.0	<2.0		
	Titanium (Ti) (mg/kg)	413	15.9	10.7		
	Uranium (U) (mg/kg)	0.535	0.790	0.821		
	Vanadium (V) (mg/kg)	18.9	1.67	1.17		
	Zinc (Zn) (mg/kg)	9.0	38.5	32.1		
Polycyclic Aromatic Hydrocarbons	Acenaphthene (mg/kg)	<0.0050	DLM <0.0075	DLM <0.0060		
	Acenaphthylene (mg/kg)	<0.0050	DLHM <0.0075	DLM <0.0080		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1067095-1	L1067095-5	L1067095-6	L1067095-13	L1067095-17
	Description	SOIL	SOIL	SOIL	SOIL	SOIL
	Sampled Date	14-SEP-11	14-SEP-11	14-SEP-11	14-SEP-11	14-SEP-11
	Sampled Time					
	Client ID	2011-GK-S-01	2011-GK-S-02	2011-GK-S-02-D	2011-GK-S-03	2011-GK-S-04
Grouping	**Analyte**					
SOIL						
Polycyclic Aromatic Hydrocarbons	Anthracene (mg/kg)	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
	Benz(a)anthracene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Benzo(a)pyrene (mg/kg)	<0.010	<0.010	<0.20 DLM	<0.010	<0.010
	Benzo(b)fluoranthene (mg/kg)	<0.020 DLM	<0.020 DLM	<0.010	<0.020 DLM	<0.060 DLM
	Benzo(b+j+k)fluoranthene (mg/kg)	<0.022	<0.022	<0.015	<0.022	<0.061
	Benzo(g,h,i)perylene (mg/kg)	<0.010	<0.010	<0.080 DLM	<0.010	<0.010
	Benzo(k)fluoranthene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Chrysene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Dibenz(a,h)anthracene (mg/kg)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0080 DLM
	Fluoranthene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Fluorene (mg/kg)	<0.030 DLM	<0.040 DLM	0.016	<0.030 DLM	<0.20 DLM
	Indeno(1,2,3-c,d)pyrene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.030 DLM
	2-Methylnaphthalene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Naphthalene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Phenanthrene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Pyrene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Surrogate: Acenaphthene d10 (%)	95.1	84.4	75.4	94.7	94.9
	Surrogate: Chrysene d12 (%)	78.1	69.4	69.1	77.3	64.7
	Surrogate: Naphthalene d8 (%)	95.7	84.0	72.7	89.7	101.3
	Surrogate: Phenanthrene d10 (%)	87.2	78.6	71.0	90.5	84.0
	B(a)P Total Potency Equivalent (mg/kg)	<0.020	<0.020	<0.10	<0.020	<0.020
	IACR (CCME) (mg/kg)	<0.15	<0.15	<0.37	<0.15	<0.27

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte					
	Sample ID	L1067095-21	L1067095-26	L1067095-31	L1067095-35	L1067095-37
	Description	SOIL	SOIL	SOIL	SOIL	SOIL
	Sampled Date	15-SEP-11	15-SEP-11	15-SEP-11	15-SEP-11	15-SEP-11
	Sampled Time					
	Client ID	2011-GK-S-05	2011-GK-S-06	2011-GK-S-07	2011-GK-S-08	2011-GK-S-09
SOIL						
Polycyclic Aromatic Hydrocarbons	Anthracene (mg/kg)	<0.0040	<0.0040	<0.0040	<0.020 DLHM	<0.0040
	Benz(a)anthracene (mg/kg)	<0.010	<0.010	<0.010	<0.030 DLM	<0.010
	Benzo(a)pyrene (mg/kg)	<0.010	<0.010	<0.010	<0.80 DLM	<0.010
	Benzo(b)fluoranthene (mg/kg)	<0.030 DLM	<0.010	<0.060 DLM	<0.030 DLM	<0.020 DLM
	Benzo(b+j+k)fluoranthene (mg/kg)	<0.032	<0.015	<0.061	<0.036	<0.022
	Benzo(g,h,i)perylene (mg/kg)	<0.020 DLM	<0.010	<0.010	<0.070 DLM	<0.010
	Benzo(k)fluoranthene (mg/kg)	<0.010	<0.010	<0.010	<0.020 DLHM	<0.010
	Chrysene (mg/kg)	<0.010	<0.010	<0.010	<0.030 DLM	<0.010
	Dibenz(a,h)anthracene (mg/kg)	<0.0050	<0.0050	<0.0060 DLM	<0.030 DLM	<0.0050
	Fluoranthene (mg/kg)	0.011	<0.010	<0.010	<0.020 DLHM	<0.010
	Fluorene (mg/kg)	<0.020 DLM	<0.020 DLM	<0.20 DLM	0.162	<0.030 DLM
	Indeno(1,2,3-c,d)pyrene (mg/kg)	<0.020 DLM	<0.010	<0.020 DLM	<0.040 DLM	<0.010
	2-Methylnaphthalene (mg/kg)	<0.010	<0.010	<0.010	<0.020 DLHM	<0.010
	Naphthalene (mg/kg)	<0.010	<0.010	<0.010	<0.020 DLHM	<0.010
	Phenanthrene (mg/kg)	<0.010	<0.010	<0.010	<0.020 DLHM	<0.010
	Pyrene (mg/kg)	0.010	<0.010	<0.010	<0.020 DLHM	<0.010
	Surrogate: Acenaphthene d10 (%)	86.9	87.6	98.8	103.7	89.6
	Surrogate: Chrysene d12 (%)	68.7	67.2	67.5	91.7	65.2
	Surrogate: Naphthalene d8 (%)	84.6	84.8	98.9	94.5	88.4
	Surrogate: Phenanthrene d10 (%)	81.5	83.1	89.3	100.7	83.9
	B(a)P Total Potency Equivalent (mg/kg)	<0.020	<0.020	<0.020	<0.42	<0.020
	IACR (CCME) (mg/kg)	<0.17	<0.15	<0.27	<1.4	<0.15

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1067095-38	L1067095-45	L1067095-46	L1067095-49	L1067095-50
	Description	SOIL	SOIL	SOIL	SOIL	SOIL
	Sampled Date	15-SEP-11	15-SEP-11	15-SEP-11	15-SEP-11	15-SEP-11
	Sampled Time					
	Client ID	2011-GK-S-09-D	2011-GK-S-10	2011-GK-S-10-D	2011-GK-S-11	2011-GK-S-12
SOIL						
Polycyclic Aromatic Hydrocarbons	Anthracene (mg/kg)	<0.0040	<0.0060 DLHM	<0.0064 DLHM	<0.0040	<0.0040
	Benz(a)anthracene (mg/kg)	<0.010	<0.015 DLHM	<0.016 DLHM	<0.010	<0.010
	Benzo(a)pyrene (mg/kg)	<0.010	<0.015 DLHM	<0.016 DLHM	<0.010	<0.010
	Benzo(b)fluoranthene (mg/kg)	<0.030 DLM	<0.050 DLM	<0.050 DLM	<0.010	<0.060 DLM
	Benzo(b+j+k)fluoranthene (mg/kg)	<0.032	<0.054	<0.054	<0.015	<0.061
	Benzo(g,h,i)perylene (mg/kg)	<0.010	<0.020 DLM	<0.020 DLM	<0.010	<0.020 DLM
	Benzo(k)fluoranthene (mg/kg)	<0.010	<0.020 DLM	<0.020 DLM	<0.010	<0.010
	Chrysene (mg/kg)	<0.010	<0.015 DLHM	<0.016 DLHM	<0.010	<0.010
	Dibenz(a,h)anthracene (mg/kg)	<0.0050	<0.020 DLM	<0.020 DLM	<0.0050	<0.010 DLM
	Fluoranthene (mg/kg)	<0.010	<0.015 DLHM	<0.016 DLHM	<0.010	<0.010
	Fluorene (mg/kg)	<0.030 DLM	0.115	<0.20 DLM	<0.020 DLM	<0.20 DLM
	Indeno(1,2,3-c,d)pyrene (mg/kg)	<0.010	<0.015	<0.016 DLHM	<0.010	<0.020 DLM
	2-Methylnaphthalene (mg/kg)	<0.010	<0.015 DLHM	<0.016 DLHM	<0.010	<0.010
	Naphthalene (mg/kg)	<0.010	<0.015 DLHM	<0.016 DLHM	<0.010	<0.010
	Phenanthrene (mg/kg)	<0.010	<0.015 DLHM	<0.016 DLHM	<0.010	<0.010
	Pyrene (mg/kg)	<0.010	<0.015 DLHM	<0.016 DLHM	<0.010	<0.010
	Surrogate: Acenaphthene d10 (%)	91.4	97.0	103.8	99.4	105.4
	Surrogate: Chrysene d12 (%)	64.1	65.6	73.1	71.5	62.7
	Surrogate: Naphthalene d8 (%)	91.3	98.8	98.7	91.5	103.6
	Surrogate: Phenanthrene d10 (%)	85.0	88.1	96.3	97.1	96.8
	B(a)P Total Potency Equivalent (mg/kg)	<0.020	<0.023	<0.023	<0.020	<0.020
	IACR (CCME) (mg/kg)	<0.17	<0.31	<0.32	<0.15	<0.28

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1067095-52	L1067095-53	L1067095-54	L1067095-55	L1067095-59
	Description	SOIL	SOIL	SOIL	SOIL	SOIL
	Sampled Date	16-SEP-11	16-SEP-11	16-SEP-11	17-SEP-11	17-SEP-11
	Sampled Time					
	Client ID	2011-GK-S-13	2011-GK-S-14	2011-GK-S-16	2011-GK-S-17	2011-GK-S-18
Grouping	**Analyte**					
SOIL						
Polycyclic Aromatic Hydrocarbons	Anthracene (mg/kg)	<0.0040	<0.0040	DLHM <0.0056	DLHM <0.0068	<0.0040
	Benz(a)anthracene (mg/kg)	<0.010	<0.010	DLHM <0.014	DLHM <0.017	<0.010
	Benzo(a)pyrene (mg/kg)	<0.010	<0.010	DLHM <0.014	DLHM <0.017	<0.010
	Benzo(b)fluoranthene (mg/kg)	<0.010	DLM <0.030	DLM <0.060	DLM <0.030	DLM <0.090
	Benzo(b+j+k)fluoranthene (mg/kg)	<0.015	<0.032	<0.062	<0.034	<0.092
	Benzo(g,h,i)perylene (mg/kg)	<0.010	<0.010	DLM <0.020	DLHM <0.017	DLM <0.030
	Benzo(k)fluoranthene (mg/kg)	<0.010	<0.010	DLHM <0.014	DLHM <0.017	DLM <0.020
	Chrysene (mg/kg)	<0.010	<0.010	DLHM <0.014	DLHM <0.017	<0.010
	Dibenz(a,h)anthracene (mg/kg)	<0.0050	DLM <0.010	DLM <0.030	DLHM <0.0085	DLM <0.030
	Fluoranthene (mg/kg)	<0.010	<0.010	DLHM <0.014	DLHM <0.017	<0.010
	Fluorene (mg/kg)	<0.010	DLM <0.080	DLM <0.20	DLM <0.030	DLM <0.30
	Indeno(1,2,3-c,d)pyrene (mg/kg)	<0.010	<0.010	DLM <0.020	DLHM <0.017	DLM <0.020
	2-Methylnaphthalene (mg/kg)	<0.010	<0.010	DLHM <0.014	DLHM <0.017	<0.010
	Naphthalene (mg/kg)	<0.010	<0.010	DLHM <0.014	DLHM <0.017	<0.010
	Phenanthrene (mg/kg)	<0.010	<0.010	DLHM <0.014	DLHM <0.017	<0.010
	Pyrene (mg/kg)	<0.010	<0.010	DLHM <0.014	DLHM <0.017	<0.010
	Surrogate: Acenaphthene d10 (%)	92.0	92.2	91.9	87.6	97.5
	Surrogate: Chrysene d12 (%)	66.0	60.5	60.2	SURR-ND 56.0	61.1
	Surrogate: Naphthalene d8 (%)	93.1	97.6	90.4	89.4	100.6
	Surrogate: Phenanthrene d10 (%)	88.7	82.8	84.1	79.1	89.7
	B(a)P Total Potency Equivalent (mg/kg)	<0.020	<0.020	<0.028	<0.020	<0.027
	IACR (CCME) (mg/kg)	<0.15	<0.18	<0.35	<0.22	<0.45

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID / Description / Sampled Date / Sampled Time / Client ID		L1067095-61	L1067095-66	L1067095-67	L1067095-68	L1067095-70
		SOIL	SOIL	SOIL	SOIL	SOIL
		17-SEP-11	17-SEP-11	17-SEP-11	17-SEP-11	17-SEP-11
		2011-GK-S-19	2011-GK-S-20	2011-GK-S-20-D	2011-GK-S-21	2011-GK-S-22
Grouping	**Analyte**					
SOIL						
Polycyclic Aromatic Hydrocarbons	Anthracene (mg/kg)	<0.0040	<0.0040	<0.0040	<0.0068 DLM	<0.0040
	Benz(a)anthracene (mg/kg)	<0.010	<0.010	<0.010	<0.017 DLHM	<0.010
	Benzo(a)pyrene (mg/kg)	<0.010	<0.010	<0.010	<0.017 DLHM	<0.010
	Benzo(b)fluoranthene (mg/kg)	<0.010	<0.010	<0.010	<0.040 DLM	<0.070 DLM
	Benzo(b+j+k)fluoranthene (mg/kg)	<0.015	<0.015	<0.015	<0.045	<0.073
	Benzo(g,h,i)perylene (mg/kg)	<0.010	<0.010	<0.010	<0.030 DLM	<0.020 DLM
	Benzo(k)fluoranthene (mg/kg)	<0.010	<0.010	<0.010	<0.020 DLM	<0.020 DLM
	Chrysene (mg/kg)	<0.010	<0.010	<0.010	<0.017 DLHM	<0.010
	Dibenz(a,h)anthracene (mg/kg)	<0.0050	<0.0050	<0.0050	<0.020 DLM	<0.030 DLM
	Fluoranthene (mg/kg)	<0.010	<0.010	<0.010	<0.017 DLHM	<0.010
	Fluorene (mg/kg)	<0.010	<0.020 DLM	<0.020 DLM	<0.080 DLM	<0.30 DLM
	Indeno(1,2,3-c,d)pyrene (mg/kg)	<0.010	<0.010	<0.010	<0.020 DLM	<0.030 DLM
	2-Methylnaphthalene (mg/kg)	<0.010	<0.010	<0.010	<0.017 DLHM	<0.010
	Naphthalene (mg/kg)	<0.010	<0.010	<0.010	<0.017 DLHM	<0.010
	Phenanthrene (mg/kg)	<0.010	<0.010	<0.010	<0.017 DLHM	<0.010
	Pyrene (mg/kg)	<0.010	<0.010	<0.010	<0.017 DLHM	<0.010
	Surrogate: Acenaphthene d10 (%)	81.5	94.4	85.7	109.5	94.9
	Surrogate: Chrysene d12 (%)	53.3 SURR-ND	60.8	55.5 SURR-ND	67.7	60.1
	Surrogate: Naphthalene d8 (%)	81.2	92.5	88.6	107.8	97.1
	Surrogate: Phenanthrene d10 (%)	77.1	87.9	79.1	99.7	84.5
	B(a)P Total Potency Equivalent (mg/kg)	<0.020	<0.020	<0.020	<0.024	<0.027
	IACR (CCME) (mg/kg)	<0.15	<0.15	<0.15	<0.29	<0.38

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1067095-71	L1067095-72	L1067095-73		
	Description	SOIL	SOIL	SOIL		
	Sampled Date	17-SEP-11	17-SEP-11	17-SEP-11		
	Sampled Time					
	Client ID	2011-GK-S-23	2011-GK-S-24	2011-GK-S-24-D		
Grouping	**Analyte**					
SOIL						
Polycyclic Aromatic Hydrocarbons	Anthracene (mg/kg)	<0.0040	DLHM <0.0060	<0.0040		
	Benz(a)anthracene (mg/kg)	<0.010	DLHM <0.015	<0.010		
	Benzo(a)pyrene (mg/kg)	<0.010	DLHM <0.015	DLM <0.020		
	Benzo(b)fluoranthene (mg/kg)	<0.010	DLM <0.060	DLM <0.030		
	Benzo(b+j+k)fluoranthene (mg/kg)	<0.015	<0.063	<0.050		
	Benzo(g,h,i)perylene (mg/kg)	<0.010	DLM <0.020	DLM <0.15		
	Benzo(k)fluoranthene (mg/kg)	<0.010	DLM <0.020	DLM <0.040		
	Chrysene (mg/kg)	<0.010	DLHM <0.015	<0.010		
	Dibenz(a,h)anthracene (mg/kg)	<0.0050	DLM <0.020	DLM <0.02		
	Fluoranthene (mg/kg)	<0.010	DLHM <0.015	<0.010		
	Fluorene (mg/kg)	<0.010	DLM <0.090	DLM <0.070		
	Indeno(1,2,3-c,d)pyrene (mg/kg)	<0.010	DLM <0.020	DLM <0.020		
	2-Methylnaphthalene (mg/kg)	<0.010	DLHM <0.015	<0.010		
	Naphthalene (mg/kg)	<0.010	DLHM <0.015	DLM <0.020		
	Phenanthrene (mg/kg)	<0.010	DLHM <0.015	<0.010		
	Pyrene (mg/kg)	<0.010	DLHM <0.015	<0.010		
	Surrogate: Acenaphthene d10 (%)	94.9	90.3	90.4		
	Surrogate: Chrysene d12 (%)	60.7	SURR-ND 57.0	83.0		
	Surrogate: Naphthalene d8 (%)	93.5	88.2	82.7		
	Surrogate: Phenanthrene d10 (%)	87.7	78.0	89.0		
	B(a)P Total Potency Equivalent (mg/kg)	<0.020	<0.023	0.033		
	IACR (CCME) (mg/kg)	<0.15	<0.35	0.35		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1067095-2	L1067095-3	L1067095-4	L1067095-7	L1067095-8
	Description	TISSUE	TISSUE	TISSUE	TISSUE	TISSUE
	Sampled Date	14-SEP-11	14-SEP-11	14-SEP-11	14-SEP-11	14-SEP-11
	Sampled Time					
	Client ID	2011-GK-B-01	2011-GK-LV-01	2011-GK-L-01	2011-GK-B-02	2011-GK-B-02-D
Grouping	**Analyte**					
TISSUE						
Physical Tests	% Moisture (%)	84.1	56.6	23.4	85.0	84.3
Metals	Aluminum (Al)-Total (mg/kg)	22	52	1120	20	17
	Antimony (Sb)-Total (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Arsenic (As)-Total (mg/kg)	<0.050	<0.050	0.345	<0.050	<0.050
	Barium (Ba)-Total (mg/kg)	12.9	74.8	59.9	15.3	13.3
	Beryllium (Be)-Total (mg/kg)	<0.30	<0.30	<0.30	<0.30	<0.30
	Bismuth (Bi)-Total (mg/kg)	<0.30	<0.30	<0.30	<0.30	<0.30
	Boron (B)-Total (mg/kg)	<10	<10	23	<10	<10
	Cadmium (Cd)-Total (mg/kg)	<0.030	0.038	0.060	<0.030	<0.030
	Calcium (Ca)-Total (mg/kg)	1080	4740	2960	1150	1040
	Chromium (Cr)-Total (mg/kg)	0.77	1.14	16.7	1.68	1.11
	Cobalt (Co)-Total (mg/kg)	<0.10	0.22	1.62	<0.10	<0.10
	Copper (Cu)-Total (mg/kg)	3.43	3.47	4.53	4.80	3.73
	Iron (Fe)-Total (mg/kg)	12.5	45.0	1640	14.5	11.8
	Lead (Pb)-Total (mg/kg)	<0.10	<0.10	1.28	<0.10	<0.10
	Lithium (Li)-Total (mg/kg)	<0.50	<0.50	2.42	<0.50	<0.50
	Magnesium (Mg)-Total (mg/kg)	531	4110	3520	500	448
	Manganese (Mn)-Total (mg/kg)	37.6	86.9	105	100	86.7
	Mercury (Hg)-Total (mg/kg)	<0.0050	0.0121	0.0436	<0.0050	<0.0050
	Molybdenum (Mo)-Total (mg/kg)	0.104	0.061	0.179	0.088	0.084
	Nickel (Ni)-Total (mg/kg)	1.33	4.38	25.0	1.55	1.11
	Phosphorus (P)-Total (mg/kg)	749	2250	699	819	783
	Potassium (K)-Total (mg/kg)	6150	2960	1550	5310	4920
	Selenium (Se)-Total (mg/kg)	<1.0	<1.0	<1.0	<1.0	<1.0
	Sodium (Na)-Total (mg/kg)	<100	<100	120	<100	<100
	Strontium (Sr)-Total (mg/kg)	3.05	30.3	18.3	2.99	3.00
	Thallium (Tl)-Total (mg/kg)	<0.030	<0.030	<0.030	<0.030	<0.030
	Tin (Sn)-Total (mg/kg)	0.55	<0.20	<0.20	0.70	1.06
	Titanium (Ti)-Total (mg/kg)	<0.50	1.16	69.9	<0.50	<0.50
	Uranium (U)-Total (mg/kg)	<0.010	<0.010	0.121	<0.010	<0.010
	Vanadium (V)-Total (mg/kg)	<0.50	<0.50	3.01	<0.50	<0.50
	Zinc (Zn)-Total (mg/kg)	5.98	56.4	25.5	8.84	8.03
Polycyclic Aromatic Hydrocarbons	Acenaphthene (mg/kg)	<0.050	<0.060 DLM	<0.050	<0.050	<0.050
	Acenaphthylene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Anthracene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Benz(a)anthracene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1067095-9	L1067095-10	L1067095-11	L1067095-12	L1067095-14
	Description	TISSUE	TISSUE	TISSUE	TISSUE	TISSUE
	Sampled Date	14-SEP-11	14-SEP-11	14-SEP-11	14-SEP-11	14-SEP-11
	Sampled Time					
	Client ID	2011-GK-LV-02	2011-GK-LV-02-D	2011-GK-L-02	2011-GK-L-02-D	2011-GK-B-03
Grouping	**Analyte**					
TISSUE						
Physical Tests	% Moisture (%)	57.4	58.3	16.2	30.4	83.6
Metals	Aluminum (Al)-Total (mg/kg)	36	29	531	339	19
	Antimony (Sb)-Total (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Arsenic (As)-Total (mg/kg)	<0.050	<0.050	0.266	0.172	<0.050
	Barium (Ba)-Total (mg/kg)	51.0	49.4	45.1	37.8	10.2
	Beryllium (Be)-Total (mg/kg)	<0.30	<0.30	<0.30	<0.30	<0.30
	Bismuth (Bi)-Total (mg/kg)	<0.30	<0.30	<0.30	<0.30	<0.30
	Boron (B)-Total (mg/kg)	<10	<10	16	14	<10
	Cadmium (Cd)-Total (mg/kg)	0.065	0.063	0.127	0.125	<0.030
	Calcium (Ca)-Total (mg/kg)	4510	4290	2010	2120	876
	Chromium (Cr)-Total (mg/kg)	0.65	<0.50	1.95	1.37	1.31
	Cobalt (Co)-Total (mg/kg)	0.68	0.67	0.50	0.42	<0.10
	Copper (Cu)-Total (mg/kg)	3.56	3.47	2.53	2.75	3.69
	Iron (Fe)-Total (mg/kg)	34.6	31.1	494	303	12.3
	Lead (Pb)-Total (mg/kg)	<0.10	<0.10	0.96	0.62	<0.10
	Lithium (Li)-Total (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
	Magnesium (Mg)-Total (mg/kg)	3150	2990	446	466	385
	Manganese (Mn)-Total (mg/kg)	207	205	68.7	67.3	57.5
	Mercury (Hg)-Total (mg/kg)	0.0127	0.0128	0.0640	0.0493	<0.0050
	Molybdenum (Mo)-Total (mg/kg)	<0.050	<0.050	<0.050	<0.050	0.091
	Nickel (Ni)-Total (mg/kg)	4.48	3.90	2.64	2.09	1.12
	Phosphorus (P)-Total (mg/kg)	1650	1680	623	657	699
	Potassium (K)-Total (mg/kg)	3380	3540	1280	1340	4300
	Selenium (Se)-Total (mg/kg)	<1.0	<1.0	<1.0	<1.0	<1.0
	Sodium (Na)-Total (mg/kg)	<100	<100	<100	100	<100
	Strontium (Sr)-Total (mg/kg)	24.2	22.9	12.1	12.1	2.98
	Thallium (Tl)-Total (mg/kg)	<0.030	<0.030	<0.030	<0.030	<0.030
	Tin (Sn)-Total (mg/kg)	<0.20	<0.20	<0.20	<0.20	0.73
	Titanium (Ti)-Total (mg/kg)	0.86	0.85	22.4	14.6	<0.50
	Uranium (U)-Total (mg/kg)	<0.010	<0.010	0.058	0.028	<0.010
	Vanadium (V)-Total (mg/kg)	<0.50	<0.50	1.01	0.64	<0.50
	Zinc (Zn)-Total (mg/kg)	87.2	92.9	24.0	27.6	6.68
Polycyclic Aromatic Hydrocarbons	Acenaphthene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Acenaphthylene (mg/kg)	<0.060 DLM	<0.050	<0.050	<0.050	<0.050
	Anthracene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Benz(a)anthracene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1067095-15	L1067095-16	L1067095-18	L1067095-19	L1067095-20
	Description	TISSUE	TISSUE	TISSUE	TISSUE	TISSUE
	Sampled Date	14-SEP-11	14-SEP-11	14-SEP-11	14-SEP-11	14-SEP-11
	Sampled Time					
	Client ID	2011-GK-LV-03	2011-GK-L-03	2011-GK-B-04	2011-GK-LV-04	2011-GK-L-04
Grouping	**Analyte**					
TISSUE						
Physical Tests	% Moisture (%)	61.3	12.5	84.1	53.9	34.4
Metals	Aluminum (Al)-Total (mg/kg)	44	492	43	39	833
	Antimony (Sb)-Total (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Arsenic (As)-Total (mg/kg)	<0.050	0.310	<0.050	<0.050	0.372
	Barium (Ba)-Total (mg/kg)	76.5	49.4	13.0	72.2	45.7
	Beryllium (Be)-Total (mg/kg)	<0.30	<0.30	<0.30	<0.30	<0.30
	Bismuth (Bi)-Total (mg/kg)	<0.30	<0.30	<0.30	<0.30	<0.30
	Boron (B)-Total (mg/kg)	<10	17	<10	17	15
	Cadmium (Cd)-Total (mg/kg)	0.078	0.106	0.103	0.039	0.093
	Calcium (Ca)-Total (mg/kg)	4720	2030	857	4950	1910
	Chromium (Cr)-Total (mg/kg)	<0.50	2.22	0.95	<0.50	13.3
	Cobalt (Co)-Total (mg/kg)	0.36	0.22	0.16	0.32	0.94
	Copper (Cu)-Total (mg/kg)	3.76	3.06	3.41	3.93	4.12
	Iron (Fe)-Total (mg/kg)	30.3	455	24.8	40.4	1200
	Lead (Pb)-Total (mg/kg)	<0.10	2.03	<0.10	0.17	5.50
	Lithium (Li)-Total (mg/kg)	<0.50	<0.50	<0.50	<0.50	1.22
	Magnesium (Mg)-Total (mg/kg)	2570	370	414	3400	1180
	Manganese (Mn)-Total (mg/kg)	329	89.5	104	122	58.8
	Mercury (Hg)-Total (mg/kg)	0.0120	0.0970	<0.0050	0.0106	0.0483
	Molybdenum (Mo)-Total (mg/kg)	<0.050	0.059	0.167	<0.050	0.179
	Nickel (Ni)-Total (mg/kg)	1.16	1.75	1.19	4.58	13.0
	Phosphorus (P)-Total (mg/kg)	2190	669	778	2240	769
	Potassium (K)-Total (mg/kg)	3420	1080	4840	3290	1440
	Selenium (Se)-Total (mg/kg)	<1.0	<1.0	<1.0	<1.0	<1.0
	Sodium (Na)-Total (mg/kg)	<100	<100	<100	<100	110
	Strontium (Sr)-Total (mg/kg)	25.0	10.7	2.88	36.9	14.3
	Thallium (Tl)-Total (mg/kg)	<0.030	<0.030	<0.030	<0.030	<0.030
	Tin (Sn)-Total (mg/kg)	<0.20	<0.20	0.38	<0.20	<0.20
	Titanium (Ti)-Total (mg/kg)	0.83	29.4	0.79	0.86	47.9
	Uranium (U)-Total (mg/kg)	<0.010	0.117	<0.010	<0.010	0.080
	Vanadium (V)-Total (mg/kg)	<0.50	1.07	<0.50	<0.50	1.88
	Zinc (Zn)-Total (mg/kg)	106	36.5	6.76	47.1	27.3
Polycyclic Aromatic Hydrocarbons	Acenaphthene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Acenaphthylene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Anthracene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Benz(a)anthracene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1067095-22	L1067095-23	L1067095-24	L1067095-25	L1067095-27
	Description	TISSUE	TISSUE	TISSUE	TISSUE	TISSUE
	Sampled Date	15-SEP-11	15-SEP-11	15-SEP-11	15-SEP-11	15-SEP-11
	Sampled Time					
	Client ID	2011-GK-B-05	2011-GK-LV-05	2011-GK-L-05	2011-GK-G-05	2011-GK-B-06
Grouping	**Analyte**					
TISSUE						
Physical Tests	% Moisture (%)	84.1	55.9	39.4	36.0	84.2
Metals	Aluminum (Al)-Total (mg/kg)	21	11	415	74	15
	Antimony (Sb)-Total (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Arsenic (As)-Total (mg/kg)	<0.050	<0.050	0.228	0.053	<0.050
	Barium (Ba)-Total (mg/kg)	11.8	54.3	19.0	32.1	7.66
	Beryllium (Be)-Total (mg/kg)	<0.30	<0.30	<0.30	<0.30	<0.30
	Bismuth (Bi)-Total (mg/kg)	<0.30	<0.30	<0.30	<0.30	<0.30
	Boron (B)-Total (mg/kg)	<10	12	48	11	<10
	Cadmium (Cd)-Total (mg/kg)	<0.030	0.103	0.036	<0.030	<0.030
	Calcium (Ca)-Total (mg/kg)	1040	5780	1740	2370	869
	Chromium (Cr)-Total (mg/kg)	0.89	<0.50	1.39	2.54	1.32
	Cobalt (Co)-Total (mg/kg)	<0.10	0.99	0.39	0.31	<0.10
	Copper (Cu)-Total (mg/kg)	3.77	3.42	1.21	2.91	4.81
	Iron (Fe)-Total (mg/kg)	10.3	21.9	347	148	12.8
	Lead (Pb)-Total (mg/kg)	<0.10	<0.10	0.37	0.17	<0.10
	Lithium (Li)-Total (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
	Magnesium (Mg)-Total (mg/kg)	449	3580	424	679	458
	Manganese (Mn)-Total (mg/kg)	140	583	46.4	82.3	154
	Mercury (Hg)-Total (mg/kg)	<0.0050	0.0110	0.0419	0.0283	<0.0050
	Molybdenum (Mo)-Total (mg/kg)	0.180	<0.050	0.064	0.617	0.254
	Nickel (Ni)-Total (mg/kg)	0.83	2.52	1.60	2.16	1.18
	Phosphorus (P)-Total (mg/kg)	827	2310	414	424	806
	Potassium (K)-Total (mg/kg)	6120	3070	860	2400	6400
	Selenium (Se)-Total (mg/kg)	<1.0	<1.0	<1.0	<1.0	<1.0
	Sodium (Na)-Total (mg/kg)	<100	<100	<100	<100	<100
	Strontium (Sr)-Total (mg/kg)	1.61	19.4	12.2	12.9	0.836
	Thallium (Tl)-Total (mg/kg)	<0.030	<0.030	<0.030	<0.030	<0.030
	Tin (Sn)-Total (mg/kg)	0.29	<0.20	<0.20	<0.20	1.29
	Titanium (Ti)-Total (mg/kg)	<0.50	0.92	10.2	1.55	<0.50
	Uranium (U)-Total (mg/kg)	<0.010	<0.010	0.018	<0.010	<0.010
	Vanadium (V)-Total (mg/kg)	<0.50	<0.50	0.69	<0.50	<0.50
	Zinc (Zn)-Total (mg/kg)	6.97	197	18.7	52.2	7.78
Polycyclic Aromatic Hydrocarbons	Acenaphthene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Acenaphthylene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Anthracene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Benz(a)anthracene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1067095-28	L1067095-29	L1067095-30	L1067095-32	L1067095-33
	Description	TISSUE	TISSUE	TISSUE	TISSUE	TISSUE
	Sampled Date	15-SEP-11	15-SEP-11	15-SEP-11	15-SEP-11	15-SEP-11
	Sampled Time					
	Client ID	2011-GK-LV-06	2011-GK-L-06	2011-GK-G-06	2011-GK-B-07	2011-GK-LV-07
TISSUE						
Physical Tests	% Moisture (%)	61.1	23.9	26.4	84.5	61.3
Metals	Aluminum (Al)-Total (mg/kg)	12	563	27	16	35
	Antimony (Sb)-Total (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Arsenic (As)-Total (mg/kg)	<0.050	0.346	<0.050	<0.050	<0.050
	Barium (Ba)-Total (mg/kg)	50.6	33.5	42.9	14.6	72.1
	Beryllium (Be)-Total (mg/kg)	<0.30	<0.30	<0.30	<0.30	<0.30
	Bismuth (Bi)-Total (mg/kg)	<0.30	<0.30	<0.30	<0.30	<0.30
	Boron (B)-Total (mg/kg)	10	<10	<10	<10	<10
	Cadmium (Cd)-Total (mg/kg)	0.035	0.044	0.036	<0.030	0.072
	Calcium (Ca)-Total (mg/kg)	6810	2240	2180	1220	5110
	Chromium (Cr)-Total (mg/kg)	<0.50	2.54	3.59	2.17	0.64
	Cobalt (Co)-Total (mg/kg)	0.52	0.64	0.28	<0.10	0.38
	Copper (Cu)-Total (mg/kg)	3.14	3.80	2.57	3.62	3.77
	Iron (Fe)-Total (mg/kg)	37.1	621	95.7	15.6	36.6
	Lead (Pb)-Total (mg/kg)	<0.10	0.78	0.21	<0.10	<0.10
	Lithium (Li)-Total (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
	Magnesium (Mg)-Total (mg/kg)	3480	619	686	479	3240
	Manganese (Mn)-Total (mg/kg)	491	237	191	71.5	268
	Mercury (Hg)-Total (mg/kg)	0.0106	0.0690	0.0273	<0.0050	0.0125
	Molybdenum (Mo)-Total (mg/kg)	<0.050	0.128	0.767	0.132	<0.050
	Nickel (Ni)-Total (mg/kg)	2.24	2.78	2.25	1.88	3.83
	Phosphorus (P)-Total (mg/kg)	3320	682	507	840	1520
	Potassium (K)-Total (mg/kg)	3910	1610	4030	5710	2650
	Selenium (Se)-Total (mg/kg)	<1.0	<1.0	<1.0	<1.0	<1.0
	Sodium (Na)-Total (mg/kg)	<100	<100	<100	<100	<100
	Strontium (Sr)-Total (mg/kg)	17.8	7.67	10.9	5.11	31.7
	Thallium (Tl)-Total (mg/kg)	<0.030	<0.030	<0.030	<0.030	<0.030
	Tin (Sn)-Total (mg/kg)	<0.20	<0.20	<0.20	0.94	<0.20
	Titanium (Ti)-Total (mg/kg)	0.96	26.5	1.08	<0.50	0.84
	Uranium (U)-Total (mg/kg)	<0.010	0.143	<0.010	<0.010	<0.010
	Vanadium (V)-Total (mg/kg)	<0.50	1.28	<0.50	<0.50	<0.50
	Zinc (Zn)-Total (mg/kg)	204	24.9	43.5	5.84	149
Polycyclic Aromatic Hydrocarbons	Acenaphthene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.070 DLM
	Acenaphthylene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Anthracene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.080 DLM
	Benz(a)anthracene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1067095-34	L1067095-36	L1067095-39	L1067095-40	L1067095-41
	Description	TISSUE	TISSUE	TISSUE	TISSUE	TISSUE
	Sampled Date	15-SEP-11	15-SEP-11	15-SEP-11	15-SEP-11	15-SEP-11
	Sampled Time					
	Client ID	2011-GK-L-07	2011-GK-G-08	2011-GK-B-09	2011-GK-B-09-D	2011-GK-L-09
Grouping	**Analyte**					
TISSUE						
Physical Tests	% Moisture (%)	12.9	34.5	83.6	83.5	11.8
Metals	Aluminum (Al)-Total (mg/kg)	311	31	19	18	540
	Antimony (Sb)-Total (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Arsenic (As)-Total (mg/kg)	0.149	<0.050	<0.050	<0.050	0.278
	Barium (Ba)-Total (mg/kg)	42.2	41.1	11.6	11.4	43.9
	Beryllium (Be)-Total (mg/kg)	<0.30	<0.30	<0.30	<0.30	<0.30
	Bismuth (Bi)-Total (mg/kg)	<0.30	<0.30	<0.30	<0.30	<0.30
	Boron (B)-Total (mg/kg)	38	<10	<10	<10	24
	Cadmium (Cd)-Total (mg/kg)	0.081	0.047	<0.030	<0.030	0.074
	Calcium (Ca)-Total (mg/kg)	2490	3130	945	974	2070
	Chromium (Cr)-Total (mg/kg)	1.41	0.68	0.66	<0.50	1.95
	Cobalt (Co)-Total (mg/kg)	0.24	0.14	<0.10	<0.10	0.33
	Copper (Cu)-Total (mg/kg)	2.10	4.14	3.13	3.04	2.64
	Iron (Fe)-Total (mg/kg)	237	129	9.2	8.4	406
	Lead (Pb)-Total (mg/kg)	0.47	0.17	<0.10	<0.10	0.99
	Lithium (Li)-Total (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
	Magnesium (Mg)-Total (mg/kg)	508	755	443	453	468
	Manganese (Mn)-Total (mg/kg)	85.9	225	68.9	80.5	106
	Mercury (Hg)-Total (mg/kg)	0.0462	0.0221	<0.0050	<0.0050	0.0749
	Molybdenum (Mo)-Total (mg/kg)	<0.050	1.73	0.130	0.098	0.055
	Nickel (Ni)-Total (mg/kg)	1.47	1.51	1.03	1.00	1.93
	Phosphorus (P)-Total (mg/kg)	833	333	730	714	675
	Potassium (K)-Total (mg/kg)	1890	1700	4960	5000	1090
	Selenium (Se)-Total (mg/kg)	<1.0	<1.0	<1.0	<1.0	<1.0
	Sodium (Na)-Total (mg/kg)	200	<100	<100	<100	<100
	Strontium (Sr)-Total (mg/kg)	14.0	12.4	2.19	2.44	8.93
	Thallium (Tl)-Total (mg/kg)	<0.030	<0.030	<0.030	<0.030	<0.030
	Tin (Sn)-Total (mg/kg)	<0.20	<0.20	0.51	0.33	<0.20
	Titanium (Ti)-Total (mg/kg)	10.9	1.27	<0.50	<0.50	18.4
	Uranium (U)-Total (mg/kg)	0.022	<0.010	<0.010	<0.010	0.034
	Vanadium (V)-Total (mg/kg)	0.59	<0.50	<0.50	<0.50	1.04
	Zinc (Zn)-Total (mg/kg)	26.8	101	6.28	5.98	30.2
Polycyclic Aromatic Hydrocarbons	Acenaphthene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Acenaphthylene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Anthracene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Benz(a)anthracene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1067095-42	L1067095-43	L1067095-44	L1067095-47	L1067095-48
	Description	TISSUE	TISSUE	TISSUE	TISSUE	TISSUE
	Sampled Date	15-SEP-11	15-SEP-11	15-SEP-11	15-SEP-11	15-SEP-11
	Sampled Time					
	Client ID	2011-GK-L-09-D	2011-GK-LV-09	2011-GK-LV-09-D	2011-GK-G-10	2011-GK-G-10-D
Grouping	**Analyte**					
TISSUE						
Physical Tests	% Moisture (%)	17.9	58.1	57.8	29.7	27.1
Metals	Aluminum (Al)-Total (mg/kg)	301	20	22	43	19
	Antimony (Sb)-Total (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Arsenic (As)-Total (mg/kg)	0.182	<0.050	<0.050	<0.050	<0.050
	Barium (Ba)-Total (mg/kg)	22.6	59.9	57.5	34.8	38.0
	Beryllium (Be)-Total (mg/kg)	<0.30	<0.30	<0.30	<0.30	<0.30
	Bismuth (Bi)-Total (mg/kg)	<0.30	<0.30	<0.30	<0.30	<0.30
	Boron (B)-Total (mg/kg)	11	<10	<10	<10	<10
	Cadmium (Cd)-Total (mg/kg)	0.043	0.062	0.057	<0.030	<0.030
	Calcium (Ca)-Total (mg/kg)	1350	5020	4920	2870	2360
	Chromium (Cr)-Total (mg/kg)	1.52	<0.50	<0.50	1.19	1.36
	Cobalt (Co)-Total (mg/kg)	0.18	0.55	0.51	0.19	0.13
	Copper (Cu)-Total (mg/kg)	1.79	3.81	3.75	2.93	2.11
	Iron (Fe)-Total (mg/kg)	259	45.8	46.8	95.3	54.2
	Lead (Pb)-Total (mg/kg)	0.45	<0.10	<0.10	0.14	<0.10
	Lithium (Li)-Total (mg/kg)	<0.50	0.64	0.52	<0.50	<0.50
	Magnesium (Mg)-Total (mg/kg)	374	2780	2730	654	798
	Manganese (Mn)-Total (mg/kg)	71.5	328	300	162	482
	Mercury (Hg)-Total (mg/kg)	0.0436	0.0122	0.0117	0.0199	0.0149
	Molybdenum (Mo)-Total (mg/kg)	<0.050	<0.050	<0.050	1.79	1.26
	Nickel (Ni)-Total (mg/kg)	1.52	2.46	2.57	1.62	1.05
	Phosphorus (P)-Total (mg/kg)	595	2150	2070	347	570
	Potassium (K)-Total (mg/kg)	1180	3780	3620	2090	2980
	Selenium (Se)-Total (mg/kg)	<1.0	<1.0	<1.0	<1.0	<1.0
	Sodium (Na)-Total (mg/kg)	<100	<100	<100	<100	<100
	Strontium (Sr)-Total (mg/kg)	5.58	20.9	20.4	10.5	9.62
	Thallium (Tl)-Total (mg/kg)	<0.030	<0.030	<0.030	<0.030	<0.030
	Tin (Sn)-Total (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
	Titanium (Ti)-Total (mg/kg)	9.72	1.09	0.91	1.17	0.84
	Uranium (U)-Total (mg/kg)	0.021	<0.010	<0.010	<0.010	<0.010
	Vanadium (V)-Total (mg/kg)	0.53	<0.50	<0.50	<0.50	<0.50
	Zinc (Zn)-Total (mg/kg)	19.4	121	123	52.1	44.7
Polycyclic Aromatic Hydrocarbons	Acenaphthene (mg/kg)	<0.050	<0.050	<0.050	<0.050	DLM <0.060
	Acenaphthylene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Anthracene (mg/kg)	<0.050	<0.050	<0.050	<0.050	DLM <0.060
	Benz(a)anthracene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1067095-51	L1067095-56	L1067095-57	L1067095-58	L1067095-60
	Description	TISSUE	TISSUE	TISSUE	TISSUE	TISSUE
	Sampled Date	15-SEP-11	17-SEP-11	17-SEP-11	17-SEP-11	17-SEP-11
	Sampled Time					
	Client ID	2011-GK-G-12	2011-GK-B-17	2011-GK-L-17	2011-GK-LV-17	2011-GK-G-18
Grouping	**Analyte**					
TISSUE						
Physical Tests	% Moisture (%)	43.9	85.7	11.5	57.7	34.0
Metals	Aluminum (Al)-Total (mg/kg)	33	16	1020	31	29
	Antimony (Sb)-Total (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Arsenic (As)-Total (mg/kg)	<0.050	<0.050	0.364	<0.050	<0.050
	Barium (Ba)-Total (mg/kg)	34.5	16.1	110	55.7	39.2
	Beryllium (Be)-Total (mg/kg)	<0.30	<0.30	<0.30	<0.30	<0.30
	Bismuth (Bi)-Total (mg/kg)	<0.30	<0.30	<0.30	<0.30	<0.30
	Boron (B)-Total (mg/kg)	12	<10	18	<10	<10
	Cadmium (Cd)-Total (mg/kg)	<0.030	<0.030	0.190	0.122	<0.030
	Calcium (Ca)-Total (mg/kg)	2560	1110	3300	3250	2180
	Chromium (Cr)-Total (mg/kg)	0.72	0.94	5.12	<0.50	0.64
	Cobalt (Co)-Total (mg/kg)	<0.10	<0.10	0.57	0.79	<0.10
	Copper (Cu)-Total (mg/kg)	2.06	2.36	4.10	4.48	1.86
	Iron (Fe)-Total (mg/kg)	92.3	10.5	875	35.2	76.2
	Lead (Pb)-Total (mg/kg)	0.19	<0.10	1.86	<0.10	0.14
	Lithium (Li)-Total (mg/kg)	<0.50	<0.50	0.72	<0.50	<0.50
	Magnesium (Mg)-Total (mg/kg)	666	488	462	2350	619
	Manganese (Mn)-Total (mg/kg)	117	69.2	53.8	116	91.0
	Mercury (Hg)-Total (mg/kg)	0.0246	<0.0050	0.0820	0.0133	0.0203
	Molybdenum (Mo)-Total (mg/kg)	2.10	0.068	0.094	<0.050	2.70
	Nickel (Ni)-Total (mg/kg)	0.95	0.98	4.50	2.38	0.76
	Phosphorus (P)-Total (mg/kg)	314	770	731	1580	374
	Potassium (K)-Total (mg/kg)	1530	5200	1040	2660	1400
	Selenium (Se)-Total (mg/kg)	<1.0	<1.0	<1.0	<1.0	<1.0
	Sodium (Na)-Total (mg/kg)	<100	<100	<100	<100	<100
	Strontium (Sr)-Total (mg/kg)	10.5	3.60	26.9	24.7	9.82
	Thallium (Tl)-Total (mg/kg)	<0.030	<0.030	<0.030	<0.030	<0.030
	Tin (Sn)-Total (mg/kg)	<0.20	0.49	<0.20	<0.20	<0.20
	Titanium (Ti)-Total (mg/kg)	1.39	<0.50	59.9	0.79	1.11
	Uranium (U)-Total (mg/kg)	<0.010	<0.010	0.107	<0.010	<0.010
	Vanadium (V)-Total (mg/kg)	<0.50	<0.50	2.10	<0.50	<0.50
	Zinc (Zn)-Total (mg/kg)	65.6	7.67	37.4	132	64.6
Polycyclic Aromatic Hydrocarbons	Acenaphthene (mg/kg)	<0.050	<0.050	<0.050	<0.070 DLM	<0.050
	Acenaphthylene (mg/kg)	<0.050	<0.050	<0.050	<0.080 DLM	<0.050
	Anthracene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Benz(a)anthracene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1067095-62	L1067095-63	L1067095-64	L1067095-65	L1067095-69
	Description	TISSUE	TISSUE	TISSUE	TISSUE	TISSUE
	Sampled Date	17-SEP-11	17-SEP-11	17-SEP-11	17-SEP-11	17-SEP-11
	Sampled Time					
	Client ID	2011-GK-LV-19	2011-GK-L-19	2011-GK-G-19	2011-GK-B-19	2011-GK-G-21
Grouping	**Analyte**					
TISSUE						
Physical Tests	% Moisture (%)	66.3	29.1	33.3	84.2	36.5
Metals	Aluminum (Al)-Total (mg/kg)	<10	608	154	<10	34
	Antimony (Sb)-Total (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Arsenic (As)-Total (mg/kg)	<0.050	0.453	0.082	<0.050	0.061
	Barium (Ba)-Total (mg/kg)	62.1	42.5	27.2	8.97	28.5
	Beryllium (Be)-Total (mg/kg)	<0.30	<0.30	<0.30	<0.30	<0.30
	Bismuth (Bi)-Total (mg/kg)	<0.30	<0.30	<0.30	<0.30	<0.30
	Boron (B)-Total (mg/kg)	<10	22	14	<10	26
	Cadmium (Cd)-Total (mg/kg)	0.056	0.099	0.055	<0.030	<0.030
	Calcium (Ca)-Total (mg/kg)	7170	2350	2220	917	2110
	Chromium (Cr)-Total (mg/kg)	<0.50	2.70	2.56	1.02	0.86
	Cobalt (Co)-Total (mg/kg)	0.62	0.44	0.44	<0.10	0.21
	Copper (Cu)-Total (mg/kg)	3.51	3.35	2.69	2.89	2.00
	Iron (Fe)-Total (mg/kg)	33.2	537	214	9.6	96.8
	Lead (Pb)-Total (mg/kg)	<0.10	2.50	0.40	<0.10	0.22
	Lithium (Li)-Total (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
	Magnesium (Mg)-Total (mg/kg)	4070	500	563	396	512
	Manganese (Mn)-Total (mg/kg)	364	102	338	115	126
	Mercury (Hg)-Total (mg/kg)	0.0124	0.0913	0.0253	<0.0050	0.0260
	Molybdenum (Mo)-Total (mg/kg)	<0.050	0.212	0.788	0.188	0.469
	Nickel (Ni)-Total (mg/kg)	2.37	2.41	1.93	0.87	1.69
	Phosphorus (P)-Total (mg/kg)	2670	548	595	757	327
	Potassium (K)-Total (mg/kg)	2880	1050	3340	5150	2830
	Selenium (Se)-Total (mg/kg)	<1.0	<1.0	<1.0	<1.0	<1.0
	Sodium (Na)-Total (mg/kg)	<100	<100	<100	<100	<100
	Strontium (Sr)-Total (mg/kg)	37.7	13.1	13.6	1.90	8.70
	Thallium (Tl)-Total (mg/kg)	<0.030	<0.030	<0.030	<0.030	<0.030
	Tin (Sn)-Total (mg/kg)	<0.20	<0.20	<0.20	0.33	<0.20
	Titanium (Ti)-Total (mg/kg)	1.17	28.9	5.12	<0.50	1.49
	Uranium (U)-Total (mg/kg)	<0.010	0.098	0.145	<0.010	<0.010
	Vanadium (V)-Total (mg/kg)	<0.50	1.21	<0.50	<0.50	<0.50
	Zinc (Zn)-Total (mg/kg)	172	28.0	31.3	5.49	57.1
Polycyclic Aromatic Hydrocarbons	Acenaphthene (mg/kg)	<0.10 DLM	<0.050	<0.050	<0.050	<0.050
	Acenaphthylene (mg/kg)	<0.20 DLM	<0.050	<0.050	<0.050	<0.050
	Anthracene (mg/kg)	<0.10 DLM	<0.050	<0.050	<0.050	<0.050
	Benz(a)anthracene (mg/kg)	<0.10 DLM	<0.050	<0.050	<0.050	<0.050

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1067095-74	L1067095-75	L1067095-76	L1067095-77	L1067095-78
	Description	TISSUE	TISSUE	TISSUE	TISSUE	TISSUE
	Sampled Date	17-SEP-11	17-SEP-11	16-SEP-11	16-SEP-11	15-SEP-11
	Sampled Time					
	Client ID	2011-GK-G-24	2011-GK-G-24-D	ANTS-GK	ANTS-GK-BAIT (JAM)	ANTS-GK
TISSUE						
Physical Tests	% Moisture (%)	40.8	36.1	28.7	27.1	40.9
Metals	Aluminum (Al)-Total (mg/kg)	19	21	15	<10	104
	Antimony (Sb)-Total (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Arsenic (As)-Total (mg/kg)	<0.050	<0.050	<0.050	<0.050	0.052
	Barium (Ba)-Total (mg/kg)	30.6	26.7	3.39	0.163	46.7
	Beryllium (Be)-Total (mg/kg)	<0.30	<0.30	<0.30	<0.30	<0.30
	Bismuth (Bi)-Total (mg/kg)	<0.30	<0.30	<0.30	<0.30	<0.30
	Boron (B)-Total (mg/kg)	<10	17	<10	<10	14
	Cadmium (Cd)-Total (mg/kg)	<0.030	<0.030	0.201	<0.030	0.511
	Calcium (Ca)-Total (mg/kg)	2350	2370	202	68	4730
	Chromium (Cr)-Total (mg/kg)	0.60	<0.50	<0.50	<0.50	0.89
	Cobalt (Co)-Total (mg/kg)	<0.10	<0.10	<0.10	<0.10	0.19
	Copper (Cu)-Total (mg/kg)	2.27	1.91	1.61	0.319	6.54
	Iron (Fe)-Total (mg/kg)	73.6	84.5	59	2.7	55
	Lead (Pb)-Total (mg/kg)	<0.10	0.11	0.17	<0.10	0.15
	Lithium (Li)-Total (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
	Magnesium (Mg)-Total (mg/kg)	728	644	229	76.3	1120
	Manganese (Mn)-Total (mg/kg)	185	167	48.4	1.69	406
	Mercury (Hg)-Total (mg/kg)	0.0212	0.0220	<0.10	<0.0050	<0.10
	Molybdenum (Mo)-Total (mg/kg)	1.33	1.56	0.076	<0.050	0.263
	Nickel (Ni)-Total (mg/kg)	0.61	<0.50	<0.50	0.50	1.62
	Phosphorus (P)-Total (mg/kg)	451	376	1300	111	3740
	Potassium (K)-Total (mg/kg)	2180	1670	<2000	860	5700
	Selenium (Se)-Total (mg/kg)	<1.0	<1.0	<1.0	<1.0	<1.0
	Sodium (Na)-Total (mg/kg)	<100	<100	<2000	130	<2000
	Strontium (Sr)-Total (mg/kg)	10.9	10.5	1.80	0.203	13.0
	Thallium (Tl)-Total (mg/kg)	<0.030	<0.030	<0.030	<0.030	<0.030
	Tin (Sn)-Total (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
	Titanium (Ti)-Total (mg/kg)	0.95	0.95	<10	<0.50	<10
	Uranium (U)-Total (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Vanadium (V)-Total (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
	Zinc (Zn)-Total (mg/kg)	46.5	51.3	25.1	1.24	87.7
Polycyclic Aromatic Hydrocarbons	Acenaphthene (mg/kg)	<0.050	<0.050		<0.050	
	Acenaphthylene (mg/kg)	<0.050	<0.050		<0.050	
	Anthracene (mg/kg)	<0.050	<0.050		<0.050	
	Benz(a)anthracene (mg/kg)	<0.050	<0.050		<0.050	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1067095-79	L1067095-80			
	Description	TISSUE	TISSUE			
	Sampled Date	14-SEP-11	14-SEP-11			
	Sampled Time					
	Client ID	2011-GK-B-02 CROWBERRY	2011-GK-B-03 CROWBERRY			
Grouping	**Analyte**					
TISSUE						
Physical Tests	% Moisture (%)	87.1	86.6			
Metals	Aluminum (Al)-Total (mg/kg)	<10	<10			
	Antimony (Sb)-Total (mg/kg)	<0.050	<0.050			
	Arsenic (As)-Total (mg/kg)	<0.050	<0.050			
	Barium (Ba)-Total (mg/kg)	6.48	11.8			
	Beryllium (Be)-Total (mg/kg)	<0.30	<0.30			
	Bismuth (Bi)-Total (mg/kg)	<0.30	<0.30			
	Boron (B)-Total (mg/kg)	<10	<10			
	Cadmium (Cd)-Total (mg/kg)	<0.030	<0.030			
	Calcium (Ca)-Total (mg/kg)	675	876			
	Chromium (Cr)-Total (mg/kg)	2.14	2.97			
	Cobalt (Co)-Total (mg/kg)	<0.10	<0.10			
	Copper (Cu)-Total (mg/kg)	4.99	6.54			
	Iron (Fe)-Total (mg/kg)	18.2	22.8			
	Lead (Pb)-Total (mg/kg)	<0.10	<0.10			
	Lithium (Li)-Total (mg/kg)	0.87	0.52			
	Magnesium (Mg)-Total (mg/kg)	434	461			
	Manganese (Mn)-Total (mg/kg)	17.3	22.4			
	Mercury (Hg)-Total (mg/kg)	<0.0050	<0.0050			
	Molybdenum (Mo)-Total (mg/kg)	0.091	0.105			
	Nickel (Ni)-Total (mg/kg)	2.00	2.19			
	Phosphorus (P)-Total (mg/kg)	741	717			
	Potassium (K)-Total (mg/kg)	8400	7280			
	Selenium (Se)-Total (mg/kg)	<1.0	<1.0			
	Sodium (Na)-Total (mg/kg)	<100	<100			
	Strontium (Sr)-Total (mg/kg)	2.67	4.26			
	Thallium (Tl)-Total (mg/kg)	<0.030	<0.030			
	Tin (Sn)-Total (mg/kg)	0.37	0.41			
	Titanium (Ti)-Total (mg/kg)	<0.50	<0.50			
	Uranium (U)-Total (mg/kg)	<0.010	<0.010			
	Vanadium (V)-Total (mg/kg)	<0.50	<0.50			
	Zinc (Zn)-Total (mg/kg)	5.08	6.39			
Polycyclic Aromatic Hydrocarbons	Acenaphthene (mg/kg)	<0.050	<0.050			
	Acenaphthylene (mg/kg)	<0.050	<0.050			
	Anthracene (mg/kg)	<0.050	<0.050			
	Benz(a)anthracene (mg/kg)	<0.050	<0.050			

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID / Description / Sampled Date / Sampled Time / Client ID		L1067095-2 TISSUE 14-SEP-11 2011-GK-B-01	L1067095-3 TISSUE 14-SEP-11 2011-GK-LV-01	L1067095-4 TISSUE 14-SEP-11 2011-GK-L-01	L1067095-7 TISSUE 14-SEP-11 2011-GK-B-02	L1067095-8 TISSUE 14-SEP-11 2011-GK-B-02-D
Grouping	**Analyte**					
TISSUE						
Polycyclic Aromatic Hydrocarbons	Benzo(a)pyrene (mg/kg)	<0.060 DLM	<3.0 DLM	<0.80 DLM	<0.050	<0.060 DLM
	Benzo(b)fluoranthene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Benzo(g,h,i)perylene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Benzo(k)fluoranthene (mg/kg)	<0.050	<0.050	<0.080 DLM	<0.050	<0.050
	Chrysene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Dibenz(a,h)anthracene (mg/kg)	<0.050	<0.050	<0.050	<0.080 DLM	<0.080 DLM
	Fluoranthene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Fluorene (mg/kg)	<0.050	<0.30 DLM	<0.050	<0.050	<0.050
	Indeno(1,2,3-c,d)pyrene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Naphthalene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Phenanthrene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Pyrene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Surrogate: Acenaphthene d10 (%)	94.5	96.9	102.2	96.0	92.1
	Surrogate: Chrysene d12 (%)	96.0	68.7	67.5	104.3	104.7
	Surrogate: Naphthalene d8 (%)	90.2	110.0	91.7	87.1	84.4
	Surrogate: Phenanthrene d10 (%)	94.2	97.5	86.5	99.2	95.1

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1067095-9	L1067095-10	L1067095-11	L1067095-12	L1067095-14
	Description	TISSUE	TISSUE	TISSUE	TISSUE	TISSUE
	Sampled Date	14-SEP-11	14-SEP-11	14-SEP-11	14-SEP-11	14-SEP-11
	Sampled Time					
	Client ID	2011-GK-LV-02	2011-GK-LV-02-D	2011-GK-L-02	2011-GK-L-02-D	2011-GK-B-03
Grouping	**Analyte**					
TISSUE						
Polycyclic Aromatic Hydrocarbons	Benzo(a)pyrene (mg/kg)	<3.0 DLM	<3.0 DLM	<0.60 DLM	<0.50 DLM	<0.60 DLM
	Benzo(b)fluoranthene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Benzo(g,h,i)perylene (mg/kg)	<0.050	<0.050	<0.050	<0.050	0.050
	Benzo(k)fluoranthene (mg/kg)	<0.050	<0.050	<0.10 DLM	<0.20 DLM	<0.050
	Chrysene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Dibenz(a,h)anthracene (mg/kg)	<0.30 DLM	<0.30 DLM	<0.050	<0.050	<0.60 DLM
	Fluoranthene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Fluorene (mg/kg)	<0.30 DLM	<0.30 DLM	<0.050	<0.050	<0.050
	Indeno(1,2,3-c,d)pyrene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Naphthalene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Phenanthrene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Pyrene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Surrogate: Acenaphthene d10 (%)	112.9	105.3	110.9	118.9	97.3
	Surrogate: Chrysene d12 (%)	69.6	65.0	65.7	63.0	101.6
	Surrogate: Naphthalene d8 (%)	101.6	105.3	96.0	104.2	91.1
	Surrogate: Phenanthrene d10 (%)	100.0	98.8	94.4	95.1	96.3

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1067095-15	L1067095-16	L1067095-18	L1067095-19	L1067095-20
	Description	TISSUE	TISSUE	TISSUE	TISSUE	TISSUE
	Sampled Date	14-SEP-11	14-SEP-11	14-SEP-11	14-SEP-11	14-SEP-11
	Sampled Time					
	Client ID	2011-GK-LV-03	2011-GK-L-03	2011-GK-B-04	2011-GK-LV-04	2011-GK-L-04
Grouping	**Analyte**					
TISSUE						
Polycyclic Aromatic Hydrocarbons	Benzo(a)pyrene (mg/kg)	<2.0 DLM	<1.5 DLM	<0.40 DLM	<2.0 DLM	<0.70 DLM
	Benzo(b)fluoranthene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Benzo(g,h,i)perylene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Benzo(k)fluoranthene (mg/kg)	<0.050	<0.070	<0.050	<0.050	<0.080 DLM
	Chrysene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Dibenz(a,h)anthracene (mg/kg)	<0.20 DLM	<0.050	<0.50 DLM	<0.20 DLM	<0.050
	Fluoranthene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Fluorene (mg/kg)	<0.30 DLM	<0.050	<0.050	<0.20 DLM	<0.050
	Indeno(1,2,3-c,d)pyrene (mg/kg)	<0.070 DLM	<0.050	<0.050	<0.090 DLM	<0.050
	Naphthalene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Phenanthrene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Pyrene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Surrogate: Acenaphthene d10 (%)	103.0	105.4	95.7	97.5	107.2
	Surrogate: Chrysene d12 (%)	62.8	54.1	101.3	61.7	52.0
	Surrogate: Naphthalene d8 (%)	89.7	105.8	89.5	106.3	92.7
	Surrogate: Phenanthrene d10 (%)	95.0	86.4	94.2	92.5	86.2

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1067095-22	L1067095-23	L1067095-24	L1067095-25	L1067095-27
	Description	TISSUE	TISSUE	TISSUE	TISSUE	TISSUE
	Sampled Date	15-SEP-11	15-SEP-11	15-SEP-11	15-SEP-11	15-SEP-11
	Sampled Time					
	Client ID	2011-GK-B-05	2011-GK-LV-05	2011-GK-L-05	2011-GK-G-05	2011-GK-B-06
Grouping	**Analyte**					
TISSUE						
Polycyclic Aromatic Hydrocarbons	Benzo(a)pyrene (mg/kg)	<0.60 DLM	<2.0 DLM	<0.50 DLM	<2.0 DLM	<0.60 DLM
	Benzo(b)fluoranthene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Benzo(g,h,i)perylene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Benzo(k)fluoranthene (mg/kg)	<0.050	<0.050	<0.090 DLM	<0.050	<0.050
	Chrysene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Dibenz(a,h)anthracene (mg/kg)	<0.20 DLM	<0.30 DLM	<0.050	<0.050	<0.20 DLM
	Fluoranthene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Fluorene (mg/kg)	<0.050	<0.30 DLM	<0.050	<0.20 DLM	<0.050
	Indeno(1,2,3-c,d)pyrene (mg/kg)	<0.050	<0.070 DLM	<0.050	<0.050	<0.050
	Naphthalene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Phenanthrene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Pyrene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Surrogate: Acenaphthene d10 (%)	97.1	110.0	101.2	94.5	93.3
	Surrogate: Chrysene d12 (%)	105.5	100.3	64.1	61.8	104.0
	Surrogate: Naphthalene d8 (%)	91.9	103.1	97.9	96.5	86.9
	Surrogate: Phenanthrene d10 (%)	96.8	100.7	92.3	90.7	96.3

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID		L1067095-28	L1067095-29	L1067095-30	L1067095-32	L1067095-33
Description		TISSUE	TISSUE	TISSUE	TISSUE	TISSUE
Sampled Date		15-SEP-11	15-SEP-11	15-SEP-11	15-SEP-11	15-SEP-11
Sampled Time						
Client ID		2011-GK-LV-06	2011-GK-L-06	2011-GK-G-06	2011-GK-B-07	2011-GK-LV-07
Grouping	**Analyte**					
TISSUE						
Polycyclic Aromatic Hydrocarbons	Benzo(a)pyrene (mg/kg)	<3.0 DLM	<1.5 DLM	<4.0 DLM	<0.40 DLM	<5.0
	Benzo(b)fluoranthene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.060 DLM
	Benzo(g,h,i)perylene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.060 DLM
	Benzo(k)fluoranthene (mg/kg)	<0.050	<0.30 DLM	<0.050	<0.050	<0.050
	Chrysene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.070 DLM
	Dibenz(a,h)anthracene (mg/kg)	<0.30 DLM	<0.050	<0.050	<0.30 DLM	<0.70 DLM
	Fluoranthene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Fluorene (mg/kg)	<0.30 DLM	<0.050	<0.10 DLM	<0.050	<0.50 DLM
	Indeno(1,2,3-c,d)pyrene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Naphthalene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.060 DLM
	Phenanthrene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.10 DLM
	Pyrene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Surrogate: Acenaphthene d10 (%)	99.6	101.0	98.7	89.1	115.3
	Surrogate: Chrysene d12 (%)	77.2	60.4	66.1	95.3	113.0
	Surrogate: Naphthalene d8 (%)	100.2	102.3	98.6	85.5	116.1
	Surrogate: Phenanthrene d10 (%)	95.3	91.9	92.5	88.2	82.7

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1067095-34	L1067095-36	L1067095-39	L1067095-40	L1067095-41
	Description	TISSUE	TISSUE	TISSUE	TISSUE	TISSUE
	Sampled Date	15-SEP-11	15-SEP-11	15-SEP-11	15-SEP-11	15-SEP-11
	Sampled Time					
	Client ID	2011-GK-L-07	2011-GK-G-08	2011-GK-B-09	2011-GK-B-09-D	2011-GK-L-09
TISSUE						
Polycyclic Aromatic Hydrocarbons	Benzo(a)pyrene (mg/kg)	<0.50 DLM	<2.0 DLM	<0.60 DLM	<0.90 DLM	<0.60 DLM
	Benzo(b)fluoranthene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Benzo(g,h,i)perylene (mg/kg)	<0.050	0.123	<0.050	<0.050	<0.050
	Benzo(k)fluoranthene (mg/kg)	<0.20 DLM	<0.050	<0.050	<0.050	<0.060 DLM
	Chrysene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Dibenz(a,h)anthracene (mg/kg)	<0.050	<0.050	<0.30 DLM	<0.30 DLM	<0.050
	Fluoranthene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Fluorene (mg/kg)	<0.050	<0.20 DLM	<0.050	<0.050	<0.050
	Indeno(1,2,3-c,d)pyrene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Naphthalene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Phenanthrene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Pyrene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Surrogate: Acenaphthene d10 (%)	100.4	98.9	94.1	95.1	102.8
	Surrogate: Chrysene d12 (%)	51.4	64.2	101.4	103.4	52.3
	Surrogate: Naphthalene d8 (%)	94.8	103.4	88.1	90.2	102.3
	Surrogate: Phenanthrene d10 (%)	84.7	95.1	95.7	100.5	83.5

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1067095-42	L1067095-43	L1067095-44	L1067095-47	L1067095-48
	Description	TISSUE	TISSUE	TISSUE	TISSUE	TISSUE
	Sampled Date	15-SEP-11	15-SEP-11	15-SEP-11	15-SEP-11	15-SEP-11
	Sampled Time					
	Client ID	2011-GK-L-09-D	2011-GK-LV-09	2011-GK-LV-09-D	2011-GK-G-10	2011-GK-G-10-D
Grouping	**Analyte**					
TISSUE						
Polycyclic Aromatic Hydrocarbons	Benzo(a)pyrene (mg/kg)	<0.40 DLM	<3.0 DLM	<3.0 DLM	<4.0 DLM	<5.0 DLM
	Benzo(b)fluoranthene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.090 DLM
	Benzo(g,h,i)perylene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<3.0 DLM
	Benzo(k)fluoranthene (mg/kg)	<0.10 DLM	<0.050	<0.050	<0.050	<0.060 DLM
	Chrysene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Dibenz(a,h)anthracene (mg/kg)	<0.050	<0.30 DLM	<0.20 DLM	<0.050	<0.40 DLM
	Fluoranthene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.070 DLM
	Fluorene (mg/kg)	<0.050	<0.30 DLM	<0.20 DLM	<0.30 DLM	<0.060 DLM
	Indeno(1,2,3-c,d)pyrene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.40 DLM
	Naphthalene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.070 DLM
	Phenanthrene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.30 DLM
	Pyrene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.070 DLM
	Surrogate: Acenaphthene d10 (%)	99.2	88.6	100.3	107.1	106.4
	Surrogate: Chrysene d12 (%)	44.8 SURR-ND	86.3	119.3	52.4	51.3
	Surrogate: Naphthalene d8 (%)	96.8	80.5	92.6	118.2	104.2
	Surrogate: Phenanthrene d10 (%)	82.5	94.0	95.2	79.7	85.6

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1067095-51	L1067095-56	L1067095-57	L1067095-58	L1067095-60
	Description	TISSUE	TISSUE	TISSUE	TISSUE	TISSUE
	Sampled Date	15-SEP-11	17-SEP-11	17-SEP-11	17-SEP-11	17-SEP-11
	Sampled Time					
	Client ID	2011-GK-G-12	2011-GK-B-17	2011-GK-L-17	2011-GK-LV-17	2011-GK-G-18
Grouping	**Analyte**					
TISSUE						
Polycyclic Aromatic Hydrocarbons	Benzo(a)pyrene (mg/kg)	<3.0 DLM	<0.60 DLM	<0.70 DLM	<4.0 DLM	<2.0 DLM
	Benzo(b)fluoranthene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Benzo(g,h,i)perylene (mg/kg)	<0.050	<0.050	<0.050	<0.070	<0.050
	Benzo(k)fluoranthene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Chrysene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Dibenz(a,h)anthracene (mg/kg)	<0.050	<0.070 DLM	<0.050	<0.70 DLM	<0.050
	Fluoranthene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Fluorene (mg/kg)	<0.20 DLM	<0.050	<0.050	<0.40 DLM	<0.20 DLM
	Indeno(1,2,3-c,d)pyrene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Naphthalene (mg/kg)	<0.050	<0.050	<0.050	<0.10 DLM	<0.050
	Phenanthrene (mg/kg)	<0.050	<0.050	<0.050	<0.080 DLM	<0.050
	Pyrene (mg/kg)	<0.050	<0.050	<0.050	<0.050	<0.050
	Surrogate: Acenaphthene d10 (%)	107.0	84.8	104.0	90.1	101.4
	Surrogate: Chrysene d12 (%)	67.7	92.7	53.9	118.0	53.5
	Surrogate: Naphthalene d8 (%)	100.2	78.3	102.8	99.6	103.0
	Surrogate: Phenanthrene d10 (%)	85.8	89.6	84.6	79.5	83.2

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1067095-62	L1067095-63	L1067095-64	L1067095-65	L1067095-69
	Description	TISSUE	TISSUE	TISSUE	TISSUE	TISSUE
	Sampled Date	17-SEP-11	17-SEP-11	17-SEP-11	17-SEP-11	17-SEP-11
	Sampled Time					
	Client ID	2011-GK-LV-19	2011-GK-L-19	2011-GK-G-19	2011-GK-B-19	2011-GK-G-21
Grouping	**Analyte**					
TISSUE						
Polycyclic Aromatic Hydrocarbons	Benzo(a)pyrene (mg/kg)	<0.50 DLM	<1.5 DLM	<5.0 DLM	<0.70 DLM	<0.20 DLM
	Benzo(b)fluoranthene (mg/kg)	<0.10 DLM	<0.050	<0.080 DLM	<0.050	<0.050
	Benzo(g,h,i)perylene (mg/kg)	<0.10 DLM	<0.050	<0.050	<0.050	<0.20 DLM
	Benzo(k)fluoranthene (mg/kg)	<0.40 DLM	<0.050	<0.050	<0.050	<0.20 DLM
	Chrysene (mg/kg)	<0.20 DLM	<0.050	<0.050	<0.050	<0.050
	Dibenz(a,h)anthracene (mg/kg)	<0.20 DLM	<0.050	<0.070 DLM	<0.60 DLM	<0.080 DLM
	Fluoranthene (mg/kg)	<0.10 DLM	<0.050	<0.050	<0.050	<0.050
	Fluorene (mg/kg)	<0.20 DLM	<0.050	<0.20 DLM	<0.050	<0.050
	Indeno(1,2,3-c,d)pyrene (mg/kg)	<0.20 DLM	<0.050	<0.060 DLM	<0.050	<0.050
	Naphthalene (mg/kg)	<0.20 DLM	<0.050	<0.050	<0.050	<0.060 DLM
	Phenanthrene (mg/kg)	<0.10 DLM	<0.050	<0.060 DLM	<0.050	<0.20 DLM
	Pyrene (mg/kg)	<0.10 DLM	<0.050	<0.050	<0.050	<0.050
	Surrogate: Acenaphthene d10 (%)	112.3	114.5	108.4	92.6	106.2
	Surrogate: Chrysene d12 (%)	126.8	51.0	58.3	101.4	53.2
	Surrogate: Naphthalene d8 (%)	126.6	119.1	115.6	86.2	104.5
	Surrogate: Phenanthrene d10 (%)	74.7	83.0	82.7	94.6	77.4

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1067095-74	L1067095-75	L1067095-76	L1067095-77	L1067095-78
	Description	TISSUE	TISSUE	TISSUE	TISSUE	TISSUE
	Sampled Date	17-SEP-11	17-SEP-11	16-SEP-11	16-SEP-11	15-SEP-11
	Sampled Time					
	Client ID	2011-GK-G-24	2011-GK-G-24-D	ANTS-GK	ANTS-GK-BAIT (JAM)	ANTS-GK
Grouping	**Analyte**					
TISSUE						
Polycyclic Aromatic Hydrocarbons	Benzo(a)pyrene (mg/kg)	<0.50 DLM	<2.0		<0.090 DLM	
	Benzo(b)fluoranthene (mg/kg)	<0.050	<0.050 DLM		<0.050	
	Benzo(g,h,i)perylene (mg/kg)	<0.080 DLM	<0.050		<0.050	
	Benzo(k)fluoranthene (mg/kg)	<0.050	<0.050		<0.050	
	Chrysene (mg/kg)	<0.050	<0.050		<0.050	
	Dibenz(a,h)anthracene (mg/kg)	<0.060 DLM	<0.050		<0.050	
	Fluoranthene (mg/kg)	<0.050	<0.050		<0.050	
	Fluorene (mg/kg)	<0.050	<0.20 DLM		<0.050	
	Indeno(1,2,3-c,d)pyrene (mg/kg)	<0.060 DLM	<0.050		<0.050	
	Naphthalene (mg/kg)	<0.050	<0.050		<0.050	
	Phenanthrene (mg/kg)	<0.070 DLM	<0.050		<0.050	
	Pyrene (mg/kg)	<0.050	<0.050		<0.050	
	Surrogate: Acenaphthene d10 (%)	99.7	103.9		118.1	
	Surrogate: Chrysene d12 (%)	50.5	49.5		68.6	
	Surrogate: Naphthalene d8 (%)	98.6	106.0		124.6	
	Surrogate: Phenanthrene d10 (%)	79.2	82.2		118.4	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1067095-79	L1067095-80			
	Description	TISSUE	TISSUE			
	Sampled Date	14-SEP-11	14-SEP-11			
	Sampled Time					
	Client ID	2011-GK-B-02 CROWBERRY	2011-GK-B-03 CROWBERRY			
Grouping	**Analyte**					
TISSUE						
Polycyclic Aromatic Hydrocarbons	Benzo(a)pyrene (mg/kg)	<1.0 DLM	<2.0 DLM			
	Benzo(b)fluoranthene (mg/kg)	<0.40 DLM	<0.050			
	Benzo(g,h,i)perylene (mg/kg)	<0.050	<0.050			
	Benzo(k)fluoranthene (mg/kg)	<0.050	<0.050			
	Chrysene (mg/kg)	<0.050	<0.050			
	Dibenz(a,h)anthracene (mg/kg)	<0.050	<0.050			
	Fluoranthene (mg/kg)	<0.050	<0.050			
	Fluorene (mg/kg)	<0.070 DLM	<0.20 DLM			
	Indeno(1,2,3-c,d)pyrene (mg/kg)	<0.050	<0.050			
	Naphthalene (mg/kg)	<0.050	<0.050			
	Phenanthrene (mg/kg)	<0.050	<0.050			
	Pyrene (mg/kg)	<0.050	<0.050			
	Surrogate: Acenaphthene d10 (%)	126.2	106.7			
	Surrogate: Chrysene d12 (%)	97.5	99.2			
	Surrogate: Naphthalene d8 (%)	115.4	104.3			
	Surrogate: Phenanthrene d10 (%)	93.5	95.3			

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

Qualifiers for Sample Submission Listed:

Qualifier	Description
SR:COC	Sample Received, Not Listed on Submitted Chain of Custody / Analytical Request Form - samples # 2011-GK-B-02 Crowberry, 2011-GK-B-03 Crowberry, 2011-GK-5-20D - extra not on CoC

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Duplicate	2-Methylnaphthalene	DLHM	L1067095-73
Duplicate	Acenaphthene	DLHM	L1067095-73
Duplicate	Acenaphthylene	DLHM	L1067095-73
Duplicate	Anthracene	DLHM	L1067095-73
Duplicate	Benz(a)anthracene	DLHM	L1067095-73
Duplicate	Benzo(a)pyrene	DLHM	L1067095-73
Duplicate	Benzo(b)fluoranthene	DLHM	L1067095-73
Duplicate	Benzo(g,h,i)perylene	DLHM	L1067095-73
Duplicate	Benzo(k)fluoranthene	DLHM	L1067095-73
Duplicate	Chrysene	DLHM	L1067095-73
Duplicate	Dibenz(a,h)anthracene	DLHM	L1067095-73
Duplicate	Fluoranthene	DLHM	L1067095-73
Duplicate	Fluorene	DLHM	L1067095-73
Duplicate	Indeno(1,2,3-c,d)pyrene	DLHM	L1067095-73
Duplicate	Phenanthrene	DLHM	L1067095-73
Duplicate	Pyrene	DLHM	L1067095-73
Duplicate	Naphthalene	DLM	L1067095-73
Duplicate	Acenaphthene	DLM	L1067095-35, -6
Duplicate	Acenaphthylene	DLM	L1067095-35, -6
Duplicate	Anthracene	DLM	L1067095-35, -6
Duplicate	Benz(a)anthracene	DLM	L1067095-35, -6
Duplicate	Benzo(k)fluoranthene	DLM	L1067095-35, -6
Duplicate	Chrysene	DLM	L1067095-35, -6
Duplicate	Fluoranthene	DLM	L1067095-35, -6
Duplicate	Indeno(1,2,3-c,d)pyrene	DLM	L1067095-35, -6
Duplicate	Benzo(a)pyrene	DLM	L1067095-14, -18, -2, -22, -27, -32, -39, -40, -56, -65, -7, -79, -8, -80
Duplicate	Benzo(b)fluoranthene	DLM	L1067095-14, -18, -2, -22, -27, -32, -39, -40, -56, -65, -7, -79, -8, -80
Duplicate	Benzo(g,h,i)perylene	DLM	L1067095-14, -18, -2, -22, -27, -32, -39, -40, -56, -65, -7, -79, -8, -80
Duplicate	Fluorene	DLM	L1067095-14, -18, -2, -22, -27, -32, -39, -40, -56, -65, -7, -79, -8, -80
Duplicate	Benzo(a)pyrene	DLM	L1067095-11, -12, -16, -20, -24, -29, -34, -4, -41, -42, -51, -57, -60, -63, -75
Duplicate	Benzo(g,h,i)perylene	DLM	L1067095-11, -12, -16, -20, -24, -29, -34, -4, -41, -42, -51, -57, -60, -63, -75
Duplicate	Dibenz(a,h)anthracene	DLM	L1067095-11, -12, -16, -20, -24, -29, -34, -4, -41, -42, -51, -57, -60, -63, -75
Duplicate	Fluorene	DLM	L1067095-11, -12, -16, -20, -24, -29, -34, -4, -41, -42, -51, -57, -60, -63, -75
Duplicate	Moisture	DUP-H	L1067095-73
Duplicate	Barium (Ba)-Total	DUP-H	L1067095-14, -18, -2, -22, -27, -32, -39, -40, -56, -65, -7, -79, -8, -80
Duplicate	Lead (Pb)-Total	DUP-H	L1067095-14, -18, -2, -22, -27, -32, -39, -40, -56, -65, -7, -79, -8, -80
Duplicate	Zinc (Zn)-Total	DUP-H	L1067095-14, -18, -2, -22, -27, -32, -39, -40, -56, -65, -7, -79, -8, -80
Duplicate	Nickel (Ni)	DUP-H,J	L1067095-35
Duplicate	Zinc (Zn)	DUP-H,J	L1067095-35

Qualifiers for Individual Parameters Listed:

Reference Information

Qualifier	Description
DLHM	Detection Limit Adjusted: Sample has High Moisture Content
DLM	Detection Limit Adjusted For Sample Matrix Effects
DUP-H	Duplicate results outside ALS DQO, due to sample heterogeneity.
DUP-H,J	Duplicate results outside ALS DQO, due to sample heterogeneity. Duplicate results and limits are expressed in terms of absolute difference.
SURR-ND	Surrogate recovery was slightly outside ALS DQO. Reported non-detect results for associated samples were unaffected.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
B-DRY-MS-VA	Tissue	Total Boron in Tissue by ICPMS (DRY)	EPA 200.3, EPA 6020A

This method is adapted from US EPA Method 200.3 "Sample Procedures for Spectrochemical Determination of Total Recoverable Elements in Biological Tissues" (1996). Tissue samples are homogenized and sub-sampled prior to hotblock digestion with nitric and hydrochloric acids, in combination with repeated additions of hydrogen peroxide. Analysis is by Inductively Coupled Plasma - Mass Spectrometry, adapted from US EPA Method 6020A. This digestion procedure was implemented on October 5, 2009.

HG-200.2-CVAF-VA	Soil	Mercury in Soil by CVAFS	EPA 200.2/245.7

This analysis is carried out using procedures from CSR Analytical Method: "Strong Acid Leachable Metals (SALM) in Soil", BC Ministry of Environment, 26 June 2009, and procedures adapted from EPA Method 200.2. The sample is manually homogenized, dried at 60 degrees Celsius, sieved through a 2 mm (10 mesh) sieve (this sieve step is omitted for international soil samples), and a representative subsample of the dry material is weighed. The sample is then digested at 95 degrees Celsius for 2 hours by block digester using concentrated nitric and hydrochloric acids. Instrumental analysis is by atomic fluorescence spectrophotometry (EPA Method 245.7).

Method Limitation: This method is not a total digestion technique. It is a very strong acid digestion that is intended to dissolve those metals that may be environmentally available. By design, elements bound in silicate structures are not normally dissolved by this procedure as they are not usually mobile in the environment.

HG-DRY-CVAFS-VA	Tissue	Mercury in Tissue by CVAFS (DRY)	EPA 200.3, EPA 245.7

This method is adapted from US EPA Method 200.3 "Sample Procedures for Spectrochemical Determination of Total Recoverable Elements in Biological Tissues" (1996). Tissue samples are homogenized and sub-sampled prior to hotblock digestion with nitric and hydrochloric acids, in combination with repeated additions of hydrogen peroxide. Analysis is by atomic fluorescence spectrophotometry, adapted from US EPA Method 245.7. This digestion procedure was implemented on October 5, 2009.

MET-200.2-CCMS-VA	Soil	Metals in Soil by CRC ICPMS	EPA 200.2/6020A

This analysis is carried out using procedures from CSR Analytical Method: "Strong Acid Leachable Metals (SALM) in Soil", BC Ministry of Environment, 26 June 2009, and procedures adapted from EPA Method 200.2. The sample is manually homogenized, dried at 60 degrees Celsius, sieved through a 2 mm (10 mesh) sieve (this sieve step is omitted for international soil samples), and a representative subsample of the dry material is weighed. The sample is then digested at 95 degrees Celsius for 2 hours by block digester using concentrated nitric and hydrochloric acids. Instrumental analysis of the digested extract is by collision cell inductively coupled plasma - mass spectrometry (modifed from EPA Method 6020A).

Method Limitation: This method is not a total digestion technique. It is a very strong acid digestion that is intended to dissolve those metals that may be environmentally available. By design, elements bound in silicate structures are not normally dissolved by this procedure as they are not usually mobile in the environment.

MET-DRY-ICP-VA	Tissue	Metals in Tissue by ICPOES (DRY)	EPA 200.3, EPA 6010B

This method is adapted from US EPA Method 200.3 "Sample Procedures for Spectrochemical Determination of Total Recoverable Elements in Biological Tissues" (1996). Tissue samples are homogenized and sub-sampled prior to hotblock digestion with nitric and hydrochloric acids, in combination with repeated additions of hydrogen peroxide. Analysis is by Inductively Coupled Plasma - Optical Emission Spectrophotometry, adapted from US EPA Method 6010B. This digestion procedure was implemented on October 5, 2009.

MET-DRY-MS-VA	Tissue	Metals in Tissue by ICPMS (DRY)	EPA 200.3, EPA 6020A

This method is adapted from US EPA Method 200.3 "Sample Procedures for Spectrochemical Determination of Total Recoverable Elements in Biological Tissues" (1996). Tissue samples are homogenized and sub-sampled prior to hotblock digestion with nitric and hydrochloric acids, in combination with repeated additions of hydrogen peroxide. Analysis is by Inductively Coupled Plasma - Mass Spectrometry, adapted from US EPA Method 6020A. This digestion procedure was implemented on October 5, 2009

MOISTURE-TISS-VA	Tissue	% Moisture in Tissues	ASTM D2974-00 Method A

This analysis is carried out gravimetrically by drying the sample at 105 C for a minimum of six hours.

MOISTURE-VA	Soil	Moisture content	ASTM D2974-00 Method A

This analysis is carried out gravimetrically by drying the sample at 105 C for a minimum of six hours.

PAH-SURR-MS-VA	Tissue	PAH Surrogates for Tissues	SURROGATE
PAH-T-DRY-SOX-MS-VA	Tissue	PAHs in Tissue - dry weight basis	EPA METHODS 3540, 3600 & 8270

This analysis is carried out using procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846, Methods 3540, 3600 & 8270, published by the United States Environmental Protection Agency (EPA). The procedure involves a dichloromethane Soxhlet extraction of a subsample

Reference Information

of the homogenized tissue which has been dried with anhydrous sodium sulphate. The extract then undergoes a reverse phase C18 clean-up to remove fats and oils. The final extract is analysed by capillary column gas chromatography with mass spectrometric detection (GC/MS). Surrogate recoveries may not be reported in cases where interferences from the sample matrix prevent accurate quantitation. Because the two isomers cannot be readily chromatographically separated, benzo(j)fluoranthene is reported as part of the benzo(b)fluoranthene parameter.

PAH-TMB-H/A-MS-VA	Soil	PAH - Rotary Extraction (Hexane/Acetone)	EPA 3570/8270

This analysis is carried out using procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846, Methods 3545 & 8270, published by the United States Environmental Protection Agency (EPA). The procedure uses a mechanical shaking technique to extract a subsample of the sediment/soil with a 1:1 mixture of hexane and acetone. The extract is then solvent exchanged to toluene. The final extract is analysed by capillary column gas chromatography with mass spectrometric detection (GC/MS). Surrogate recoveries may not be reported in cases where interferences from the sample matrix prevent accurate quantitation. Because the two isomers cannot be readily chromatographically separated, benzo(j)fluoranthene is reported as part of the benzo(b)fluoranthene parameter.

PH-1:2-VA	Soil	pH in Soil (1:2 Soil:Water Extraction)	BC WLAP METHOD: PH, ELECTROMETRIC, SOIL

This analysis is carried out in accordance with procedures described in the pH, Electrometric in Soil and Sediment method - Section B Physical/Inorganic and Misc. Constituents, BC Environmental Laboratory Manual 2007. The procedure involves mixing the dried (at <60°C) and sieved (No. 10 / 2mm) sample with deionized/distilled water at a 1:2 ratio of sediment to water. The pH of the solution is then measured using a standard pH probe.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BC, CANADA

Chain of Custody Numbers:

1 of 7	2 of 7	3 of 7	4 of 7	5 of 7
6 of 7	7 of 7			

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Quality Control Report

Client: GOLDER ASSOCIATES LTD.
500 - 4260 Still Creek Drive
Burnaby BC V5C 6C6

Contact: Audrey Wagenaar

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
HG-200.2-CVAF-VA	**Soil**							
Batch **R2267106**								
WG1365004-5 **CRM**		**VA-CANMET-TILL1**						
Mercury (Hg)			85.2		%		70-130	12-OCT-11
WG1365004-6 **CRM**		**VA-NRC-PACS2**						
Mercury (Hg)			103.8		%		70-130	12-OCT-11
WG1365047-3 **CRM**		**VA-CANMET-TILL1**						
Mercury (Hg)			96.9		%		70-130	12-OCT-11
WG1365047-4 **CRM**		**VA-NRC-PACS2**						
Mercury (Hg)			113.1		%		70-130	12-OCT-11
WG1365004-3 **DUP**		**L1067095-1**						
Mercury (Hg)		0.0420	0.0538		mg/kg	25	40	12-OCT-11
WG1367060-3 **DUP**		**L1067095-67**						
Mercury (Hg)		0.0223	0.0203		mg/kg	9.5	40	14-OCT-11
WG1365004-1 **MB**								
Mercury (Hg)			<0.0050		mg/kg		0.005	12-OCT-11
WG1365004-2 **MB**								
Mercury (Hg)			<0.0050		mg/kg		0.005	12-OCT-11
WG1365047-1 **MB**								
Mercury (Hg)			<0.0050		mg/kg		0.005	12-OCT-11
Batch **R2268916**								
WG1367060-5 **CRM**		**VA-CANMET-TILL1**						
Mercury (Hg)			94.0		%		70-130	14-OCT-11
WG1367060-6 **CRM**		**VA-NRC-PACS2**						
Mercury (Hg)			98.6		%		70-130	14-OCT-11
WG1367061-5 **CRM**		**VA-CANMET-TILL1**						
Mercury (Hg)			91.6		%		70-130	14-OCT-11
WG1367061-6 **CRM**		**VA-NRC-PACS2**						
Mercury (Hg)			94.9		%		70-130	14-OCT-11
WG1367971-3 **CRM**		**VA-CANMET-TILL1**						
Mercury (Hg)			96.8		%		70-130	14-OCT-11
WG1367971-4 **CRM**		**VA-NRC-PACS2**						
Mercury (Hg)			101.8		%		70-130	14-OCT-11
WG1367060-1 **MB**								
Mercury (Hg)			<0.0050		mg/kg		0.005	14-OCT-11
WG1367060-2 **MB**								
Mercury (Hg)			<0.0050		mg/kg		0.005	14-OCT-11
WG1367061-1 **MB**								
Mercury (Hg)			<0.0050		mg/kg		0.005	14-OCT-11
WG1367061-2 **MB**								
Mercury (Hg)			<0.0050		mg/kg		0.005	14-OCT-11

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
HG-200.2-CVAF-VA	**Soil**							
Batch R2268916								
WG1367971-1 MB								
Mercury (Hg)			<0.0050		mg/kg		0.005	14-OCT-11
Batch R2279666								
WG1380265-5 CRM		**VA-CANMET-TILL1**						
Mercury (Hg)			93.5		%		70-130	02-NOV-11
WG1380265-6 CRM		**VA-NRC-PACS2**						
Mercury (Hg)			99.3		%		70-130	02-NOV-11
WG1380265-3 DUP		**L1067095-6**						
Mercury (Hg)		0.0706	0.0762		mg/kg	7.5	40	02-NOV-11
WG1380265-1 MB								
Mercury (Hg)			<0.0050		mg/kg		0.005	02-NOV-11
WG1380265-2 MB								
Mercury (Hg)			<0.0050		mg/kg		0.005	02-NOV-11
Batch R2280450								
WG1380456-3 CRM		**VA-CANMET-TILL1**						
Mercury (Hg)			90.2		%		70-130	03-NOV-11
WG1380456-4 CRM		**VA-NRC-PACS2**						
Mercury (Hg)			102.8		%		70-130	03-NOV-11
WG1380456-1 MB								
Mercury (Hg)			<0.0050		mg/kg		0.005	03-NOV-11
MET-200.2-CCMS-VA	**Soil**							
Batch R2268262								
WG1365004-5 CRM		**VA-CANMET-TILL1**						
Aluminum (Al)			74.4		%		70-130	12-OCT-11
Antimony (Sb)			80.0		%		70-130	12-OCT-11
Arsenic (As)			83.0		%		70-130	12-OCT-11
Barium (Ba)			79.3		%		70-130	12-OCT-11
Calcium (Ca)			82.4		%		70-130	12-OCT-11
Chromium (Cr)			81.6		%		70-130	12-OCT-11
Cobalt (Co)			75.1		%		70-130	12-OCT-11
Copper (Cu)			75.2		%		70-130	12-OCT-11
Iron (Fe)			75.3		%		70-130	12-OCT-11
Lead (Pb)			72.3		%		70-130	12-OCT-11
Lithium (Li)			71.0		%		70-130	12-OCT-11
Magnesium (Mg)			76.6		%		70-130	12-OCT-11
Manganese (Mn)			74.4		%		70-130	12-OCT-11

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-CCMS-VA	**Soil**							
Batch R2268262								
WG1365004-5 CRM		**VA-CANMET-TILL1**						
Nickel (Ni)			80.1		%		70-130	12-OCT-11
Phosphorus (P)			80.0		%		70-130	12-OCT-11
Potassium (K)			80.1		%		70-130	12-OCT-11
Selenium (Se)			0.24		mg/kg		0.22-0.42	12-OCT-11
Sodium (Na)			83.6		%		70-130	12-OCT-11
Strontium (Sr)			80.8		%		70-130	12-OCT-11
Thallium (Tl)			0.101		mg/kg		0.025-0.225	12-OCT-11
Titanium (Ti)			91.4		%		70-130	12-OCT-11
Vanadium (V)			82.2		%		70-130	12-OCT-11
Zinc (Zn)			76.2		%		70-130	12-OCT-11
WG1365004-6 CRM		**VA-NRC-PACS2**						
Aluminum (Al)			89.9		%		70-130	12-OCT-11
Antimony (Sb)			79.4		%		70-130	12-OCT-11
Arsenic (As)			99.4		%		70-130	12-OCT-11
Barium (Ba)			96.6		%		70-130	12-OCT-11
Beryllium (Be)			0.34		mg/kg		0.19-0.59	12-OCT-11
Bismuth (Bi)			0.31		mg/kg		0.15-0.55	12-OCT-11
Cadmium (Cd)			101.0		%		70-130	12-OCT-11
Calcium (Ca)			94.3		%		70-130	12-OCT-11
Chromium (Cr)			93.5		%		70-130	12-OCT-11
Cobalt (Co)			85.2		%		70-130	12-OCT-11
Copper (Cu)			84.6		%		70-130	12-OCT-11
Iron (Fe)			89.0		%		70-130	12-OCT-11
Lead (Pb)			94.9		%		70-130	12-OCT-11
Lithium (Li)			81.3		%		70-130	12-OCT-11
Magnesium (Mg)			86.2		%		70-130	12-OCT-11
Manganese (Mn)			90.5		%		70-130	12-OCT-11
Molybdenum (Mo)			100.4		%		70-130	12-OCT-11
Nickel (Ni)			89.1		%		70-130	12-OCT-11
Phosphorus (P)			93.7		%		70-130	12-OCT-11
Potassium (K)			85.0		%		70-130	12-OCT-11
Selenium (Se)			100.0		%		70-130	12-OCT-11
Silver (Ag)			90.8		%		70-130	12-OCT-11
Sodium (Na)			87.3		%		70-130	12-OCT-11

ALS Environmental

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-CCMS-VA	**Soil**							
Batch R2268262								
WG1365004-6 CRM		**VA-NRC-PACS2**						
Strontium (Sr)			95.2		%		70-130	12-OCT-11
Thallium (Tl)			104.6		%		70-130	12-OCT-11
Tin (Sn)			94.6		%		70-130	12-OCT-11
Titanium (Ti)			105.0		%		70-130	12-OCT-11
Uranium (U)			88.7		%		70-130	12-OCT-11
Vanadium (V)			96.6		%		70-130	12-OCT-11
Zinc (Zn)			91.6		%		70-130	12-OCT-11
WG1365004-3 DUP		**L1067095-1**						
Aluminum (Al)		4070	4180		mg/kg	2.7	40	12-OCT-11
Antimony (Sb)		<0.10	<0.10	RPD-NA	mg/kg	N/A	30	12-OCT-11
Arsenic (As)		1.49	1.37		mg/kg	8.2	30	12-OCT-11
Barium (Ba)		30.3	30.1		mg/kg	0.55	40	12-OCT-11
Beryllium (Be)		<0.20	<0.20	RPD-NA	mg/kg	N/A	30	12-OCT-11
Bismuth (Bi)		<0.20	<0.20	RPD-NA	mg/kg	N/A	30	12-OCT-11
Boron (B)		<10	<10	RPD-NA	mg/kg	N/A	25	12-OCT-11
Cadmium (Cd)		0.053	0.074	J	mg/kg	0.020	0.1	12-OCT-11
Calcium (Ca)		540	605		mg/kg	11	30	12-OCT-11
Chromium (Cr)		11.1	11.0		mg/kg	0.41	30	12-OCT-11
Cobalt (Co)		1.30	1.32		mg/kg	1.1	30	12-OCT-11
Copper (Cu)		4.15	4.13		mg/kg	0.46	30	12-OCT-11
Iron (Fe)		5900	5720		mg/kg	3.1	30	12-OCT-11
Lead (Pb)		2.63	2.74		mg/kg	4.3	40	12-OCT-11
Lithium (Li)		6.3	5.7		mg/kg	8.7	30	12-OCT-11
Magnesium (Mg)		1280	1220		mg/kg	5.2	30	12-OCT-11
Manganese (Mn)		31.4	28.7		mg/kg	9.1	30	12-OCT-11
Molybdenum (Mo)		<0.50	<0.50	RPD-NA	mg/kg	N/A	40	12-OCT-11
Nickel (Ni)		4.99	4.97		mg/kg	0.32	30	12-OCT-11
Phosphorus (P)		203	230		mg/kg	12	30	12-OCT-11
Potassium (K)		640	600		mg/kg	7.4	40	12-OCT-11
Selenium (Se)		<0.20	<0.20	RPD-NA	mg/kg	N/A	30	12-OCT-11
Silver (Ag)		<0.10	<0.10	RPD-NA	mg/kg	N/A	40	12-OCT-11
Sodium (Na)		<100	<100	RPD-NA	mg/kg	N/A	40	12-OCT-11
Strontium (Sr)		5.50	6.83		mg/kg	22	40	12-OCT-11
Thallium (Tl)		<0.050	<0.050	RPD-NA	mg/kg	N/A	30	12-OCT-11

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-CCMS-VA	**Soil**							
Batch R2268262								
WG1365004-3 DUP		**L1067095-1**						
Tin (Sn)		<2.0	<2.0	RPD-NA	mg/kg	N/A	40	12-OCT-11
Titanium (Ti)		299	295		mg/kg	1.3	40	12-OCT-11
Uranium (U)		0.846	0.816		mg/kg	3.6	30	12-OCT-11
Vanadium (V)		13.9	13.3		mg/kg	4.5	30	12-OCT-11
Zinc (Zn)		8.7	9.2		mg/kg	6.2	30	12-OCT-11
WG1367060-3 DUP		**L1067095-67**						
Aluminum (Al)		4000	3950		mg/kg	1.2	40	12-OCT-11
Antimony (Sb)		<0.10	<0.10	RPD-NA	mg/kg	N/A	30	12-OCT-11
Arsenic (As)		1.19	1.14		mg/kg	3.7	30	12-OCT-11
Barium (Ba)		29.8	28.8		mg/kg	3.5	40	12-OCT-11
Beryllium (Be)		<0.20	<0.20	RPD-NA	mg/kg	N/A	30	12-OCT-11
Bismuth (Bi)		<0.20	<0.20	RPD-NA	mg/kg	N/A	30	12-OCT-11
Boron (B)		<10	<10	RPD-NA	mg/kg	N/A	25	12-OCT-11
Cadmium (Cd)		0.099	0.088		mg/kg	12	30	12-OCT-11
Calcium (Ca)		878	704		mg/kg	22	30	12-OCT-11
Chromium (Cr)		12.0	13.2		mg/kg	9.3	30	12-OCT-11
Cobalt (Co)		2.45	2.40		mg/kg	2.0	30	12-OCT-11
Copper (Cu)		4.61	4.36		mg/kg	5.5	30	12-OCT-11
Iron (Fe)		5950	5750		mg/kg	3.4	30	12-OCT-11
Lead (Pb)		1.60	1.47		mg/kg	8.7	40	12-OCT-11
Lithium (Li)		8.9	9.0		mg/kg	1.1	30	12-OCT-11
Magnesium (Mg)		2050	2090		mg/kg	1.9	30	12-OCT-11
Manganese (Mn)		50.2	48.9		mg/kg	2.7	30	12-OCT-11
Molybdenum (Mo)		<0.50	<0.50	RPD-NA	mg/kg	N/A	40	12-OCT-11
Nickel (Ni)		6.17	6.16		mg/kg	0.18	30	12-OCT-11
Phosphorus (P)		292	223		mg/kg	26	30	12-OCT-11
Potassium (K)		1040	1020		mg/kg	1.6	40	12-OCT-11
Selenium (Se)		<0.20	<0.20	RPD-NA	mg/kg	N/A	30	12-OCT-11
Silver (Ag)		<0.10	<0.10	RPD-NA	mg/kg	N/A	40	12-OCT-11
Sodium (Na)		<100	<100	RPD-NA	mg/kg	N/A	40	12-OCT-11
Strontium (Sr)		6.13	5.45		mg/kg	12	40	12-OCT-11
Thallium (Tl)		<0.050	<0.050	RPD-NA	mg/kg	N/A	30	12-OCT-11
Tin (Sn)		<2.0	<2.0	RPD-NA	mg/kg	N/A	40	12-OCT-11
Titanium (Ti)		292	287		mg/kg	1.6	40	12-OCT-11

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-CCMS-VA	**Soil**							
Batch R2268262								
WG1367060-3 DUP		**L1067095-67**						
Uranium (U)		0.804	0.685		mg/kg	16	30	12-OCT-11
Vanadium (V)		13.3	13.2		mg/kg	0.68	30	12-OCT-11
Zinc (Zn)		14.5	13.4		mg/kg	8.4	30	12-OCT-11
WG1365004-1 MB								
Aluminum (Al)			<50		mg/kg		50	12-OCT-11
Antimony (Sb)			<0.10		mg/kg		0.1	12-OCT-11
Arsenic (As)			<0.050		mg/kg		0.05	12-OCT-11
Barium (Ba)			<0.50		mg/kg		0.5	12-OCT-11
Beryllium (Be)			<0.20		mg/kg		0.2	12-OCT-11
Bismuth (Bi)			<0.20		mg/kg		0.2	12-OCT-11
Cadmium (Cd)			<0.050		mg/kg		0.05	12-OCT-11
Calcium (Ca)			<50		mg/kg		50	12-OCT-11
Chromium (Cr)			<0.50		mg/kg		0.5	12-OCT-11
Cobalt (Co)			<0.10		mg/kg		0.1	12-OCT-11
Copper (Cu)			<0.50		mg/kg		0.5	12-OCT-11
Iron (Fe)			<50		mg/kg		50	12-OCT-11
Lead (Pb)			<0.50		mg/kg		0.5	12-OCT-11
Lithium (Li)			<1.0		mg/kg		1	12-OCT-11
Magnesium (Mg)			<20		mg/kg		20	12-OCT-11
Manganese (Mn)			<1.0		mg/kg		1	12-OCT-11
Molybdenum (Mo)			<0.50		mg/kg		0.5	12-OCT-11
Nickel (Ni)			<0.50		mg/kg		0.5	12-OCT-11
Phosphorus (P)			<50		mg/kg		50	12-OCT-11
Potassium (K)			<100		mg/kg		100	12-OCT-11
Selenium (Se)			<0.20		mg/kg		0.2	12-OCT-11
Silver (Ag)			<0.10		mg/kg		0.1	12-OCT-11
Sodium (Na)			<100		mg/kg		100	12-OCT-11
Strontium (Sr)			<0.50		mg/kg		0.5	12-OCT-11
Thallium (Tl)			<0.050		mg/kg		0.05	12-OCT-11
Tin (Sn)			<2.0		mg/kg		2	12-OCT-11
Titanium (Ti)			<1.0		mg/kg		1	12-OCT-11
Uranium (U)			<0.050		mg/kg		0.05	12-OCT-11
Vanadium (V)			<0.20		mg/kg		0.2	12-OCT-11
Zinc (Zn)			<1.0		mg/kg		1	12-OCT-11
WG1365004-2 MB								

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-CCMS-VA	**Soil**							
Batch R2268262								
WG1365004-2 MB								
Aluminum (Al)			<50		mg/kg		50	12-OCT-11
Antimony (Sb)			<0.10		mg/kg		0.1	12-OCT-11
Arsenic (As)			<0.050		mg/kg		0.05	12-OCT-11
Barium (Ba)			<0.50		mg/kg		0.5	12-OCT-11
Beryllium (Be)			<0.20		mg/kg		0.2	12-OCT-11
Bismuth (Bi)			<0.20		mg/kg		0.2	12-OCT-11
Cadmium (Cd)			<0.050		mg/kg		0.05	12-OCT-11
Calcium (Ca)			<50		mg/kg		50	12-OCT-11
Chromium (Cr)			<0.50		mg/kg		0.5	12-OCT-11
Cobalt (Co)			<0.10		mg/kg		0.1	12-OCT-11
Copper (Cu)			<0.50		mg/kg		0.5	12-OCT-11
Iron (Fe)			<50		mg/kg		50	12-OCT-11
Lead (Pb)			<0.50		mg/kg		0.5	12-OCT-11
Lithium (Li)			<1.0		mg/kg		1	12-OCT-11
Magnesium (Mg)			<20		mg/kg		20	12-OCT-11
Manganese (Mn)			<1.0		mg/kg		1	12-OCT-11
Molybdenum (Mo)			<0.50		mg/kg		0.5	12-OCT-11
Nickel (Ni)			<0.50		mg/kg		0.5	12-OCT-11
Phosphorus (P)			<50		mg/kg		50	12-OCT-11
Potassium (K)			<100		mg/kg		100	12-OCT-11
Selenium (Se)			<0.20		mg/kg		0.2	12-OCT-11
Silver (Ag)			<0.10		mg/kg		0.1	12-OCT-11
Sodium (Na)			<100		mg/kg		100	12-OCT-11
Strontium (Sr)			<0.50		mg/kg		0.5	12-OCT-11
Thallium (Tl)			<0.050		mg/kg		0.05	12-OCT-11
Tin (Sn)			<2.0		mg/kg		2	12-OCT-11
Titanium (Ti)			<1.0		mg/kg		1	12-OCT-11
Uranium (U)			<0.050		mg/kg		0.05	12-OCT-11
Vanadium (V)			<0.20		mg/kg		0.2	12-OCT-11
Zinc (Zn)			<1.0		mg/kg		1	12-OCT-11
Batch R2268973								
WG1367060-5 CRM		**VA-CANMET-TILL1**						
Aluminum (Al)			95.1		%		70-130	14-OCT-11
Antimony (Sb)			99.9		%		70-130	14-OCT-11

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-CCMS-VA	**Soil**							
Batch R2268973								
WG1367060-5 CRM		**VA-CANMET-TILL1**						
Arsenic (As)			101.1		%		70-130	14-OCT-11
Barium (Ba)			96.8		%		70-130	14-OCT-11
Calcium (Ca)			107.4		%		70-130	14-OCT-11
Chromium (Cr)			102.1		%		70-130	14-OCT-11
Cobalt (Co)			96.6		%		70-130	14-OCT-11
Copper (Cu)			92.3		%		70-130	14-OCT-11
Iron (Fe)			93.9		%		70-130	14-OCT-11
Lead (Pb)			95.3		%		70-130	14-OCT-11
Lithium (Li)			88.9		%		70-130	14-OCT-11
Magnesium (Mg)			95.4		%		70-130	14-OCT-11
Manganese (Mn)			93.3		%		70-130	14-OCT-11
Nickel (Ni)			96.3		%		70-130	14-OCT-11
Phosphorus (P)			94.0		%		70-130	14-OCT-11
Potassium (K)			104.0		%		70-130	14-OCT-11
Selenium (Se)			0.30		mg/kg		0.22-0.42	14-OCT-11
Sodium (Na)			106.5		%		70-130	14-OCT-11
Strontium (Sr)			107.4		%		70-130	14-OCT-11
Thallium (Tl)			0.130		mg/kg		0.025-0.225	14-OCT-11
Titanium (Ti)			123.4		%		70-130	14-OCT-11
Vanadium (V)			104.0		%		70-130	14-OCT-11
Zinc (Zn)			96.8		%		70-130	14-OCT-11
WG1367060-6 CRM		**VA-NRC-PACS2**						
Aluminum (Al)			92.3		%		70-130	14-OCT-11
Antimony (Sb)			78.5		%		70-130	14-OCT-11
Arsenic (As)			96.8		%		70-130	14-OCT-11
Barium (Ba)			111.8		%		70-130	14-OCT-11
Beryllium (Be)			0.38		mg/kg		0.19-0.59	14-OCT-11
Bismuth (Bi)			0.31		mg/kg		0.15-0.55	14-OCT-11
Cadmium (Cd)			100.4		%		70-130	14-OCT-11
Calcium (Ca)			95.7		%		70-130	14-OCT-11
Chromium (Cr)			94.0		%		70-130	14-OCT-11
Cobalt (Co)			88.5		%		70-130	14-OCT-11
Copper (Cu)			86.0		%		70-130	14-OCT-11
Iron (Fe)			89.8		%		70-130	14-OCT-11

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-CCMS-VA	**Soil**							
Batch R2268973								
WG1367060-6 CRM		**VA-NRC-PACS2**						
Lead (Pb)			94.5		%		70-130	14-OCT-11
Lithium (Li)			82.1		%		70-130	14-OCT-11
Magnesium (Mg)			88.0		%		70-130	14-OCT-11
Manganese (Mn)			94.0		%		70-130	14-OCT-11
Molybdenum (Mo)			98.0		%		70-130	14-OCT-11
Nickel (Ni)			91.0		%		70-130	14-OCT-11
Phosphorus (P)			90.0		%		70-130	14-OCT-11
Potassium (K)			83.7		%		70-130	14-OCT-11
Selenium (Se)			96.6		%		70-130	14-OCT-11
Silver (Ag)			81.7		%		70-130	14-OCT-11
Sodium (Na)			86.7		%		70-130	14-OCT-11
Strontium (Sr)			96.9		%		70-130	14-OCT-11
Thallium (Tl)			106.4		%		70-130	14-OCT-11
Tin (Sn)			102.2		%		70-130	14-OCT-11
Titanium (Ti)			114.0		%		70-130	14-OCT-11
Uranium (U)			89.5		%		70-130	14-OCT-11
Vanadium (V)			98.9		%		70-130	14-OCT-11
Zinc (Zn)			92.2		%		70-130	14-OCT-11
WG1367060-1 MB								
Aluminum (Al)			<50		mg/kg		50	14-OCT-11
Antimony (Sb)			<0.10		mg/kg		0.1	14-OCT-11
Arsenic (As)			<0.050		mg/kg		0.05	14-OCT-11
Barium (Ba)			<0.50		mg/kg		0.5	14-OCT-11
Beryllium (Be)			<0.20		mg/kg		0.2	14-OCT-11
Bismuth (Bi)			<0.20		mg/kg		0.2	14-OCT-11
Cadmium (Cd)			<0.050		mg/kg		0.05	14-OCT-11
Calcium (Ca)			<50		mg/kg		50	14-OCT-11
Chromium (Cr)			<0.50		mg/kg		0.5	14-OCT-11
Cobalt (Co)			<0.10		mg/kg		0.1	14-OCT-11
Copper (Cu)			<0.50		mg/kg		0.5	14-OCT-11
Iron (Fe)			<50		mg/kg		50	14-OCT-11
Lead (Pb)			<0.50		mg/kg		0.5	14-OCT-11
Lithium (Li)			<1.0		mg/kg		1	14-OCT-11
Magnesium (Mg)			<20		mg/kg		20	14-OCT-11

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-CCMS-VA	**Soil**							
Batch R2268973								
WG1367060-1 MB								
Manganese (Mn)			<1.0		mg/kg		1	14-OCT-11
Molybdenum (Mo)			<0.50		mg/kg		0.5	14-OCT-11
Nickel (Ni)			<0.50		mg/kg		0.5	14-OCT-11
Phosphorus (P)			<50		mg/kg		50	14-OCT-11
Potassium (K)			<100		mg/kg		100	14-OCT-11
Selenium (Se)			<0.20		mg/kg		0.2	14-OCT-11
Silver (Ag)			<0.10		mg/kg		0.1	14-OCT-11
Sodium (Na)			<100		mg/kg		100	14-OCT-11
Strontium (Sr)			<0.50		mg/kg		0.5	14-OCT-11
Thallium (Tl)			<0.050		mg/kg		0.05	14-OCT-11
Tin (Sn)			<2.0		mg/kg		2	14-OCT-11
Titanium (Ti)			<1.0		mg/kg		1	14-OCT-11
Uranium (U)			<0.050		mg/kg		0.05	14-OCT-11
Vanadium (V)			<0.20		mg/kg		0.2	14-OCT-11
Zinc (Zn)			<1.0		mg/kg		1	14-OCT-11
WG1367060-2 MB								
Aluminum (Al)			<50		mg/kg		50	14-OCT-11
Antimony (Sb)			<0.10		mg/kg		0.1	14-OCT-11
Arsenic (As)			<0.050		mg/kg		0.05	14-OCT-11
Barium (Ba)			<0.50		mg/kg		0.5	14-OCT-11
Beryllium (Be)			<0.20		mg/kg		0.2	14-OCT-11
Bismuth (Bi)			<0.20		mg/kg		0.2	14-OCT-11
Cadmium (Cd)			<0.050		mg/kg		0.05	14-OCT-11
Calcium (Ca)			<50		mg/kg		50	14-OCT-11
Chromium (Cr)			<0.50		mg/kg		0.5	14-OCT-11
Cobalt (Co)			<0.10		mg/kg		0.1	14-OCT-11
Copper (Cu)			<0.50		mg/kg		0.5	14-OCT-11
Iron (Fe)			<50		mg/kg		50	14-OCT-11
Lead (Pb)			<0.50		mg/kg		0.5	14-OCT-11
Lithium (Li)			<1.0		mg/kg		1	14-OCT-11
Magnesium (Mg)			<20		mg/kg		20	14-OCT-11
Manganese (Mn)			<1.0		mg/kg		1	14-OCT-11
Molybdenum (Mo)			<0.50		mg/kg		0.5	14-OCT-11
Nickel (Ni)			<0.50		mg/kg		0.5	14-OCT-11

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-CCMS-VA	**Soil**							
Batch R2268973								
WG1367060-2 MB								
Phosphorus (P)			<50		mg/kg		50	14-OCT-11
Potassium (K)			<100		mg/kg		100	14-OCT-11
Selenium (Se)			<0.20		mg/kg		0.2	14-OCT-11
Silver (Ag)			<0.10		mg/kg		0.1	14-OCT-11
Sodium (Na)			<100		mg/kg		100	14-OCT-11
Strontium (Sr)			<0.50		mg/kg		0.5	14-OCT-11
Thallium (Tl)			<0.050		mg/kg		0.05	14-OCT-11
Tin (Sn)			<2.0		mg/kg		2	14-OCT-11
Titanium (Ti)			<1.0		mg/kg		1	14-OCT-11
Uranium (U)			<0.050		mg/kg		0.05	14-OCT-11
Vanadium (V)			<0.20		mg/kg		0.2	14-OCT-11
Zinc (Zn)			<1.0		mg/kg		1	14-OCT-11
Batch R2280603								
WG1380265-5 CRM		**VA-CANMET-TILL1**						
Aluminum (Al)			82.5		%		70-130	02-NOV-11
Antimony (Sb)			95.6		%		70-130	02-NOV-11
Arsenic (As)			98.4		%		70-130	02-NOV-11
Barium (Ba)			91.6		%		70-130	02-NOV-11
Calcium (Ca)			89.4		%		70-130	02-NOV-11
Chromium (Cr)			92.0		%		70-130	02-NOV-11
Cobalt (Co)			92.5		%		70-130	02-NOV-11
Copper (Cu)			90.5		%		70-130	02-NOV-11
Iron (Fe)			87.4		%		70-130	02-NOV-11
Lead (Pb)			84.0		%		70-130	02-NOV-11
Lithium (Li)			77.2		%		70-130	02-NOV-11
Magnesium (Mg)			89.4		%		70-130	02-NOV-11
Manganese (Mn)			89.1		%		70-130	02-NOV-11
Nickel (Ni)			95.0		%		70-130	02-NOV-11
Phosphorus (P)			94.1		%		70-130	02-NOV-11
Potassium (K)			85.4		%		70-130	02-NOV-11
Selenium (Se)			0.29		mg/kg		0.22-0.42	02-NOV-11
Sodium (Na)			87.4		%		70-130	02-NOV-11
Strontium (Sr)			86.3		%		70-130	02-NOV-11
Thallium (Tl)			0.114		mg/kg		0.025-0.225	02-NOV-11

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-CCMS-VA	**Soil**							
Batch R2280603								
WG1380265-5 CRM		**VA-CANMET-TILL1**						
Titanium (Ti)			95.7		%		70-130	02-NOV-11
Vanadium (V)			93.4		%		70-130	02-NOV-11
Zinc (Zn)			90.7		%		70-130	02-NOV-11
WG1380265-6 CRM		**VA-NRC-PACS2**						
Aluminum (Al)			88.4		%		70-130	02-NOV-11
Antimony (Sb)			83.1		%		70-130	02-NOV-11
Arsenic (As)			102.5		%		70-130	02-NOV-11
Barium (Ba)			96.3		%		70-130	02-NOV-11
Beryllium (Be)			0.36		mg/kg		0.19-0.59	02-NOV-11
Bismuth (Bi)			0.31		mg/kg		0.15-0.55	02-NOV-11
Cadmium (Cd)			102.9		%		70-130	02-NOV-11
Calcium (Ca)			94.7		%		70-130	02-NOV-11
Chromium (Cr)			95.2		%		70-130	02-NOV-11
Cobalt (Co)			92.3		%		70-130	02-NOV-11
Copper (Cu)			89.2		%		70-130	02-NOV-11
Iron (Fe)			91.7		%		70-130	02-NOV-11
Lead (Pb)			92.4		%		70-130	02-NOV-11
Lithium (Li)			79.2		%		70-130	02-NOV-11
Magnesium (Mg)			91.5		%		70-130	02-NOV-11
Manganese (Mn)			92.7		%		70-130	02-NOV-11
Molybdenum (Mo)			99.5		%		70-130	02-NOV-11
Nickel (Ni)			95.1		%		70-130	02-NOV-11
Phosphorus (P)			96.9		%		70-130	02-NOV-11
Potassium (K)			89.4		%		70-130	02-NOV-11
Selenium (Se)			92.8		%		70-130	02-NOV-11
Silver (Ag)			83.4		%		70-130	02-NOV-11
Sodium (Na)			88.2		%		70-130	02-NOV-11
Strontium (Sr)			93.7		%		70-130	02-NOV-11
Thallium (Tl)			91.6		%		70-130	02-NOV-11
Tin (Sn)			97.0		%		70-130	02-NOV-11
Titanium (Ti)			106.3		%		70-130	02-NOV-11
Uranium (U)			90.7		%		70-130	02-NOV-11
Vanadium (V)			98.8		%		70-130	02-NOV-11
Zinc (Zn)			94.2		%		70-130	02-NOV-11
WG1380265-3 DUP		**L1067095-6**						

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-CCMS-VA	**Soil**							
Batch R2280603								
WG1380265-3 DUP		**L1067095-6**						
Aluminum (Al)		3330	3830		mg/kg	14	40	02-NOV-11
Antimony (Sb)		<0.10	<0.10	RPD-NA	mg/kg	N/A	30	02-NOV-11
Arsenic (As)		1.09	1.11		mg/kg	1.7	30	02-NOV-11
Barium (Ba)		38.0	44.0		mg/kg	14	40	02-NOV-11
Beryllium (Be)		<0.20	<0.20	RPD-NA	mg/kg	N/A	30	02-NOV-11
Bismuth (Bi)		<0.20	<0.20	RPD-NA	mg/kg	N/A	30	02-NOV-11
Cadmium (Cd)		0.109	0.120		mg/kg	9.6	30	02-NOV-11
Calcium (Ca)		863	891		mg/kg	3.1	30	02-NOV-11
Chromium (Cr)		7.39	9.17		mg/kg	21	30	02-NOV-11
Cobalt (Co)		1.39	1.64		mg/kg	16	30	02-NOV-11
Copper (Cu)		4.76	5.26		mg/kg	9.9	30	02-NOV-11
Iron (Fe)		5140	5670		mg/kg	9.8	30	02-NOV-11
Lead (Pb)		1.92	2.00		mg/kg	3.7	40	02-NOV-11
Lithium (Li)		3.7	4.8		mg/kg	26	30	02-NOV-11
Magnesium (Mg)		949	1100		mg/kg	14	30	02-NOV-11
Manganese (Mn)		31.1	32.8		mg/kg	5.3	30	02-NOV-11
Molybdenum (Mo)		<0.50	<0.50	RPD-NA	mg/kg	N/A	40	02-NOV-11
Nickel (Ni)		4.36	5.44		mg/kg	22	30	02-NOV-11
Phosphorus (P)		354	394		mg/kg	11	30	02-NOV-11
Potassium (K)		440	590		mg/kg	29	40	02-NOV-11
Selenium (Se)		<0.20	<0.20	RPD-NA	mg/kg	N/A	30	02-NOV-11
Silver (Ag)		<0.10	<0.10	RPD-NA	mg/kg	N/A	40	02-NOV-11
Sodium (Na)		<100	<100	RPD-NA	mg/kg	N/A	40	02-NOV-11
Strontium (Sr)		7.36	8.17		mg/kg	10	40	02-NOV-11
Thallium (Tl)		<0.050	<0.050	RPD-NA	mg/kg	N/A	30	02-NOV-11
Tin (Sn)		<2.0	<2.0	RPD-NA	mg/kg	N/A	40	02-NOV-11
Titanium (Ti)		251	276		mg/kg	9.5	40	02-NOV-11
Uranium (U)		0.466	0.503		mg/kg	7.6	30	02-NOV-11
Vanadium (V)		13.2	14.6		mg/kg	10	30	02-NOV-11
Zinc (Zn)		12.6	13.8		mg/kg	9.0	30	02-NOV-11
WG1380265-1 MB								
Aluminum (Al)			<50		mg/kg		50	02-NOV-11
Antimony (Sb)			<0.10		mg/kg		0.1	02-NOV-11
Arsenic (As)			<0.050		mg/kg		0.05	02-NOV-11

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Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-CCMS-VA	**Soil**							
Batch R2280603								
WG1380265-1 MB								
Barium (Ba)			<0.50		mg/kg		0.5	02-NOV-11
Beryllium (Be)			<0.20		mg/kg		0.2	02-NOV-11
Bismuth (Bi)			<0.20		mg/kg		0.2	02-NOV-11
Cadmium (Cd)			<0.050		mg/kg		0.05	02-NOV-11
Calcium (Ca)			<50		mg/kg		50	02-NOV-11
Chromium (Cr)			<0.50		mg/kg		0.5	02-NOV-11
Cobalt (Co)			<0.10		mg/kg		0.1	02-NOV-11
Copper (Cu)			<0.50		mg/kg		0.5	02-NOV-11
Iron (Fe)			<50		mg/kg		50	02-NOV-11
Lead (Pb)			<0.50		mg/kg		0.5	02-NOV-11
Lithium (Li)			<1.0		mg/kg		1	02-NOV-11
Magnesium (Mg)			<20		mg/kg		20	02-NOV-11
Manganese (Mn)			<1.0		mg/kg		1	02-NOV-11
Molybdenum (Mo)			<0.50		mg/kg		0.5	02-NOV-11
Nickel (Ni)			<0.50		mg/kg		0.5	02-NOV-11
Phosphorus (P)			<50		mg/kg		50	02-NOV-11
Potassium (K)			<100		mg/kg		100	02-NOV-11
Selenium (Se)			<0.20		mg/kg		0.2	02-NOV-11
Silver (Ag)			<0.10		mg/kg		0.1	02-NOV-11
Sodium (Na)			<100		mg/kg		100	02-NOV-11
Strontium (Sr)			<0.50		mg/kg		0.5	02-NOV-11
Thallium (Tl)			<0.050		mg/kg		0.05	02-NOV-11
Tin (Sn)			<2.0		mg/kg		2	02-NOV-11
Titanium (Ti)			<1.0		mg/kg		1	02-NOV-11
Uranium (U)			<0.050		mg/kg		0.05	02-NOV-11
Vanadium (V)			<0.20		mg/kg		0.2	02-NOV-11
Zinc (Zn)			<1.0		mg/kg		1	02-NOV-11
WG1380265-2 MB								
Aluminum (Al)			<50		mg/kg		50	02-NOV-11
Antimony (Sb)			<0.10		mg/kg		0.1	02-NOV-11
Arsenic (As)			<0.050		mg/kg		0.05	02-NOV-11
Barium (Ba)			<0.50		mg/kg		0.5	02-NOV-11
Beryllium (Be)			<0.20		mg/kg		0.2	02-NOV-11
Bismuth (Bi)			<0.20		mg/kg		0.2	02-NOV-11

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-CCMS-VA	**Soil**							
Batch R2280603								
WG1380265-2 MB								
Cadmium (Cd)			<0.050		mg/kg		0.05	02-NOV-11
Calcium (Ca)			<50		mg/kg		50	02-NOV-11
Chromium (Cr)			<0.50		mg/kg		0.5	02-NOV-11
Cobalt (Co)			<0.10		mg/kg		0.1	02-NOV-11
Copper (Cu)			<0.50		mg/kg		0.5	02-NOV-11
Iron (Fe)			<50		mg/kg		50	02-NOV-11
Lead (Pb)			<0.50		mg/kg		0.5	02-NOV-11
Lithium (Li)			<1.0		mg/kg		1	02-NOV-11
Magnesium (Mg)			<20		mg/kg		20	02-NOV-11
Manganese (Mn)			<1.0		mg/kg		1	02-NOV-11
Molybdenum (Mo)			<0.50		mg/kg		0.5	02-NOV-11
Nickel (Ni)			<0.50		mg/kg		0.5	02-NOV-11
Phosphorus (P)			<50		mg/kg		50	02-NOV-11
Potassium (K)			<100		mg/kg		100	02-NOV-11
Selenium (Se)			<0.20		mg/kg		0.2	02-NOV-11
Silver (Ag)			<0.10		mg/kg		0.1	02-NOV-11
Sodium (Na)			<100		mg/kg		100	02-NOV-11
Strontium (Sr)			<0.50		mg/kg		0.5	02-NOV-11
Thallium (Tl)			<0.050		mg/kg		0.05	02-NOV-11
Tin (Sn)			<2.0		mg/kg		2	02-NOV-11
Titanium (Ti)			<1.0		mg/kg		1	02-NOV-11
Uranium (U)			<0.050		mg/kg		0.05	02-NOV-11
Vanadium (V)			<0.20		mg/kg		0.2	02-NOV-11
Zinc (Zn)			<1.0		mg/kg		1	02-NOV-11
Batch R2281257								
WG1380456-3 CRM		**VA-CANMET-TILL1**						
Aluminum (Al)			87.9		%		70-130	03-NOV-11
Antimony (Sb)			102.6		%		70-130	03-NOV-11
Arsenic (As)			104.2		%		70-130	03-NOV-11
Barium (Ba)			96.1		%		70-130	03-NOV-11
Calcium (Ca)			96.0		%		70-130	03-NOV-11
Chromium (Cr)			100.8		%		70-130	03-NOV-11
Cobalt (Co)			96.9		%		70-130	03-NOV-11
Copper (Cu)			94.5		%		70-130	03-NOV-11

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-CCMS-VA	**Soil**							
Batch R2281257								
WG1380456-3 CRM		**VA-CANMET-TILL1**						
Iron (Fe)			94.0		%		70-130	03-NOV-11
Lead (Pb)			89.8		%		70-130	03-NOV-11
Lithium (Li)			80.2		%		70-130	03-NOV-11
Magnesium (Mg)			96.9		%		70-130	03-NOV-11
Manganese (Mn)			95.1		%		70-130	03-NOV-11
Nickel (Ni)			97.9		%		70-130	03-NOV-11
Phosphorus (P)			103.4		%		70-130	03-NOV-11
Potassium (K)			94.4		%		70-130	03-NOV-11
Selenium (Se)			0.33		mg/kg		0.22-0.42	03-NOV-11
Sodium (Na)			97.4		%		70-130	03-NOV-11
Strontium (Sr)			93.8		%		70-130	03-NOV-11
Thallium (Tl)			0.116		mg/kg		0.025-0.225	03-NOV-11
Titanium (Ti)			110.4		%		70-130	03-NOV-11
Vanadium (V)			101.6		%		70-130	03-NOV-11
Zinc (Zn)			98.2		%		70-130	03-NOV-11
WG1380456-4 CRM		**VA-NRC-PACS2**						
Aluminum (Al)			91.9		%		70-130	03-NOV-11
Antimony (Sb)			88.1		%		70-130	03-NOV-11
Arsenic (As)			109.5		%		70-130	03-NOV-11
Barium (Ba)			92.0		%		70-130	03-NOV-11
Beryllium (Be)			0.36		mg/kg		0.19-0.59	03-NOV-11
Bismuth (Bi)			0.34		mg/kg		0.15-0.55	03-NOV-11
Cadmium (Cd)			128.2		%		70-130	03-NOV-11
Calcium (Ca)			99.8		%		70-130	03-NOV-11
Chromium (Cr)			104.2		%		70-130	03-NOV-11
Cobalt (Co)			98.9		%		70-130	03-NOV-11
Copper (Cu)			98.1		%		70-130	03-NOV-11
Iron (Fe)			100.2		%		70-130	03-NOV-11
Lead (Pb)			101.2		%		70-130	03-NOV-11
Lithium (Li)			83.0		%		70-130	03-NOV-11
Magnesium (Mg)			99.3		%		70-130	03-NOV-11
Manganese (Mn)			101.4		%		70-130	03-NOV-11
Molybdenum (Mo)			109.4		%		70-130	03-NOV-11
Nickel (Ni)			101.2		%		70-130	03-NOV-11

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-CCMS-VA	**Soil**							
Batch R2281257								
WG1380456-4 CRM		**VA-NRC-PACS2**						
Phosphorus (P)			106.9		%		70-130	03-NOV-11
Potassium (K)			92.9		%		70-130	03-NOV-11
Selenium (Se)			105.6		%		70-130	03-NOV-11
Silver (Ag)			98.9		%		70-130	03-NOV-11
Sodium (Na)			96.9		%		70-130	03-NOV-11
Strontium (Sr)			99.8		%		70-130	03-NOV-11
Thallium (Tl)			100.1		%		70-130	03-NOV-11
Tin (Sn)			107.7		%		70-130	03-NOV-11
Titanium (Ti)			114.1		%		70-130	03-NOV-11
Uranium (U)			100.8		%		70-130	03-NOV-11
Vanadium (V)			106.8		%		70-130	03-NOV-11
Zinc (Zn)			104.6		%		70-130	03-NOV-11
WG1380456-1 MB								
Aluminum (Al)			<50		mg/kg		50	03-NOV-11
Antimony (Sb)			<0.10		mg/kg		0.1	03-NOV-11
Arsenic (As)			<0.050		mg/kg		0.05	03-NOV-11
Barium (Ba)			<0.50		mg/kg		0.5	03-NOV-11
Beryllium (Be)			<0.20		mg/kg		0.2	03-NOV-11
Bismuth (Bi)			<0.20		mg/kg		0.2	03-NOV-11
Cadmium (Cd)			<0.050		mg/kg		0.05	03-NOV-11
Calcium (Ca)			<50		mg/kg		50	03-NOV-11
Chromium (Cr)			<0.50		mg/kg		0.5	03-NOV-11
Cobalt (Co)			<0.10		mg/kg		0.1	03-NOV-11
Copper (Cu)			<0.50		mg/kg		0.5	03-NOV-11
Iron (Fe)			<50		mg/kg		50	03-NOV-11
Lead (Pb)			<0.50		mg/kg		0.5	03-NOV-11
Lithium (Li)			<1.0		mg/kg		1	03-NOV-11
Magnesium (Mg)			<20		mg/kg		20	03-NOV-11
Manganese (Mn)			<1.0		mg/kg		1	03-NOV-11
Molybdenum (Mo)			<0.50		mg/kg		0.5	03-NOV-11
Nickel (Ni)			<0.50		mg/kg		0.5	03-NOV-11
Phosphorus (P)			<50		mg/kg		50	03-NOV-11
Potassium (K)			<100		mg/kg		100	03-NOV-11
Selenium (Se)			<0.20		mg/kg		0.2	03-NOV-11

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-CCMS-VA	**Soil**							
Batch R2281257								
WG1380456-1 MB								
Silver (Ag)			<0.10		mg/kg		0.1	03-NOV-11
Sodium (Na)			<100		mg/kg		100	03-NOV-11
Strontium (Sr)			<0.50		mg/kg		0.5	03-NOV-11
Thallium (Tl)			<0.050		mg/kg		0.05	03-NOV-11
Tin (Sn)			<2.0		mg/kg		2	03-NOV-11
Titanium (Ti)			<1.0		mg/kg		1	03-NOV-11
Uranium (U)			<0.050		mg/kg		0.05	03-NOV-11
Vanadium (V)			<0.20		mg/kg		0.2	03-NOV-11
Zinc (Zn)			<1.0		mg/kg		1	03-NOV-11
MOISTURE-VA	**Soil**							
Batch R2266126								
WG1364973-4 DUP		**L1067095-49**						
Moisture		15.9	15.9		%	0.19	20	08-OCT-11
WG1364973-2 LCS								
Moisture			100		%		90-110	08-OCT-11
WG1364973-1 MB								
Moisture			<0.25		%		0.25	08-OCT-11
Batch R2266127								
WG1365053-2 LCS								
Moisture			100		%		90-110	08-OCT-11
WG1365053-1 MB								
Moisture			<0.25		%		0.25	08-OCT-11
Batch R2267743								
WG1366731-2 LCS								
Moisture			99.6		%		90-110	13-OCT-11
WG1366731-1 MB								
Moisture			<0.25		%		0.25	13-OCT-11
Batch R2279554								
WG1380281-3 DUP		**L1067095-6**						
Moisture		34.1	33.6		%	1.6	20	02-NOV-11
WG1380281-2 LCS								
Moisture			99.8		%		90-110	02-NOV-11
WG1380281-1 MB								
Moisture			<0.25		%		0.25	02-NOV-11
PAH-TMB-H/A-MS-VA	**Soil**							

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Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PAH-TMB-H/A-MS-VA	**Soil**							
Batch R2267194								
WG1364979-4 IRM		**ALS PAH1 RM**						
Acenaphthene			86.1		%		60-130	12-OCT-11
Acenaphthylene			91.9		%		60-130	12-OCT-11
Anthracene			92.6		%		60-130	12-OCT-11
Benz(a)anthracene			100.7		%		60-130	12-OCT-11
Benzo(a)pyrene			86.8		%		60-130	12-OCT-11
Benzo(b)fluoranthene			101.3		%		60-130	12-OCT-11
Benzo(g,h,i)perylene			83.2		%		60-130	12-OCT-11
Benzo(k)fluoranthene			95.9		%		60-130	12-OCT-11
Chrysene			95.7		%		60-130	12-OCT-11
Dibenz(a,h)anthracene			112.0		%		60-130	12-OCT-11
Fluoranthene			91.2		%		60-130	12-OCT-11
Fluorene			80.0		%		60-130	12-OCT-11
Indeno(1,2,3-c,d)pyrene			90.2		%		60-130	12-OCT-11
2-Methylnaphthalene			83.1		%		60-130	12-OCT-11
Naphthalene			77.9		%		50-130	12-OCT-11
Phenanthrene			96.3		%		60-130	12-OCT-11
Pyrene			92.7		%		60-130	12-OCT-11
WG1365059-4 IRM		**ALS PAH1 RM**						
Acenaphthene			78.6		%		60-130	12-OCT-11
Acenaphthylene			91.7		%		60-130	12-OCT-11
Anthracene			91.5		%		60-130	12-OCT-11
Benz(a)anthracene			98.9		%		60-130	12-OCT-11
Benzo(a)pyrene			88.6		%		60-130	12-OCT-11
Benzo(b)fluoranthene			100.7		%		60-130	12-OCT-11
Benzo(g,h,i)perylene			86.6		%		60-130	12-OCT-11
Benzo(k)fluoranthene			97.3		%		60-130	12-OCT-11
Chrysene			91.3		%		60-130	12-OCT-11
Dibenz(a,h)anthracene			114.6		%		60-130	12-OCT-11
Fluoranthene			90.2		%		60-130	12-OCT-11
Fluorene			77.0		%		60-130	12-OCT-11
Indeno(1,2,3-c,d)pyrene			94.1		%		60-130	12-OCT-11
2-Methylnaphthalene			77.6		%		60-130	12-OCT-11
Naphthalene			73.4		%		50-130	12-OCT-11
Phenanthrene			94.2		%		60-130	12-OCT-11

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PAH-TMB-H/A-MS-VA	**Soil**							
Batch R2267194								
WG1365059-4	**IRM**	**ALS PAH1 RM**						
Pyrene			91.7		%		60-130	12-OCT-11
WG1364979-1	**MB**							
Acenaphthene			<0.0050		mg/kg		0.005	12-OCT-11
Acenaphthylene			<0.0050		mg/kg		0.005	12-OCT-11
Anthracene			<0.0040		mg/kg		0.004	12-OCT-11
Benz(a)anthracene			<0.010		mg/kg		0.01	12-OCT-11
Benzo(a)pyrene			<0.010		mg/kg		0.01	12-OCT-11
Benzo(b)fluoranthene			<0.010		mg/kg		0.01	12-OCT-11
Benzo(g,h,i)perylene			<0.010		mg/kg		0.01	12-OCT-11
Benzo(k)fluoranthene			<0.010		mg/kg		0.01	12-OCT-11
Chrysene			<0.010		mg/kg		0.01	12-OCT-11
Dibenz(a,h)anthracene			<0.0050		mg/kg		0.005	12-OCT-11
Fluoranthene			<0.010		mg/kg		0.01	12-OCT-11
Fluorene			<0.010		mg/kg		0.01	12-OCT-11
Indeno(1,2,3-c,d)pyrene			<0.010		mg/kg		0.01	12-OCT-11
2-Methylnaphthalene			<0.010		mg/kg		0.01	12-OCT-11
Naphthalene			<0.010		mg/kg		0.01	12-OCT-11
Phenanthrene			<0.010		mg/kg		0.01	12-OCT-11
Pyrene			<0.010		mg/kg		0.01	12-OCT-11
Surrogate: Naphthalene d8			91.1		%		50-150	12-OCT-11
Surrogate: Acenaphthene d10			91.7		%		50-150	12-OCT-11
Surrogate: Phenanthrene d10			87.8		%		50-150	12-OCT-11
Surrogate: Chrysene d12			95.9		%		50-150	12-OCT-11
WG1365059-1	**MB**							
Acenaphthene			<0.0050		mg/kg		0.005	12-OCT-11
Acenaphthylene			<0.0050		mg/kg		0.005	12-OCT-11
Anthracene			<0.0040		mg/kg		0.004	12-OCT-11
Benz(a)anthracene			<0.010		mg/kg		0.01	12-OCT-11
Benzo(a)pyrene			<0.010		mg/kg		0.01	12-OCT-11
Benzo(b)fluoranthene			<0.010		mg/kg		0.01	12-OCT-11
Benzo(g,h,i)perylene			<0.010		mg/kg		0.01	12-OCT-11
Benzo(k)fluoranthene			<0.010		mg/kg		0.01	12-OCT-11
Chrysene			<0.010		mg/kg		0.01	12-OCT-11
Dibenz(a,h)anthracene			<0.0050		mg/kg		0.005	12-OCT-11
Fluoranthene			<0.010		mg/kg		0.01	12-OCT-11

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Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PAH-TMB-H/A-MS-VA	**Soil**							
Batch R2267194								
WG1365059-1 MB								
Fluorene			<0.010		mg/kg		0.01	12-OCT-11
Indeno(1,2,3-c,d)pyrene			<0.010		mg/kg		0.01	12-OCT-11
2-Methylnaphthalene			<0.010		mg/kg		0.01	12-OCT-11
Naphthalene			<0.010		mg/kg		0.01	12-OCT-11
Phenanthrene			<0.010		mg/kg		0.01	12-OCT-11
Pyrene			<0.010		mg/kg		0.01	12-OCT-11
Surrogate: Naphthalene d8			105.9		%		50-150	12-OCT-11
Surrogate: Acenaphthene d10			106.1		%		50-150	12-OCT-11
Surrogate: Phenanthrene d10			100.6		%		50-150	12-OCT-11
Surrogate: Chrysene d12			97.6		%		50-150	12-OCT-11
Batch R2268120								
WG1367067-4 IRM		**ALS PAH1 RM**						
Acenaphthene			79.4		%		60-130	13-OCT-11
Acenaphthylene			81.7		%		60-130	13-OCT-11
Anthracene			85.6		%		60-130	13-OCT-11
Benz(a)anthracene			90.6		%		60-130	13-OCT-11
Benzo(a)pyrene			85.0		%		60-130	13-OCT-11
Benzo(b)fluoranthene			95.6		%		60-130	13-OCT-11
Benzo(g,h,i)perylene			93.4		%		60-130	13-OCT-11
Benzo(k)fluoranthene			86.5		%		60-130	13-OCT-11
Chrysene			90.6		%		60-130	13-OCT-11
Dibenz(a,h)anthracene			110.7		%		60-130	13-OCT-11
Fluoranthene			85.5		%		60-130	13-OCT-11
Fluorene			78.5		%		60-130	13-OCT-11
Indeno(1,2,3-c,d)pyrene			89.3		%		60-130	13-OCT-11
2-Methylnaphthalene			79.2		%		60-130	13-OCT-11
Naphthalene			77.6		%		50-130	13-OCT-11
Phenanthrene			90.0		%		60-130	13-OCT-11
Pyrene			87.4		%		60-130	13-OCT-11
WG1367067-1 MB								
Acenaphthene			<0.0050		mg/kg		0.005	13-OCT-11
Acenaphthylene			<0.0050		mg/kg		0.005	13-OCT-11
Anthracene			<0.0040		mg/kg		0.004	13-OCT-11
Benz(a)anthracene			<0.010		mg/kg		0.01	13-OCT-11
Benzo(a)pyrene			<0.010		mg/kg		0.01	13-OCT-11

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Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PAH-TMB-H/A-MS-VA	**Soil**							
Batch R2268120								
WG1367067-1 MB								
Benzo(b)fluoranthene			<0.010		mg/kg		0.01	13-OCT-11
Benzo(g,h,i)perylene			<0.010		mg/kg		0.01	13-OCT-11
Benzo(k)fluoranthene			<0.010		mg/kg		0.01	13-OCT-11
Chrysene			<0.010		mg/kg		0.01	13-OCT-11
Dibenz(a,h)anthracene			<0.0050		mg/kg		0.005	13-OCT-11
Fluoranthene			<0.010		mg/kg		0.01	13-OCT-11
Fluorene			<0.010		mg/kg		0.01	13-OCT-11
Indeno(1,2,3-c,d)pyrene			<0.010		mg/kg		0.01	13-OCT-11
2-Methylnaphthalene			<0.010		mg/kg		0.01	13-OCT-11
Naphthalene			<0.010		mg/kg		0.01	13-OCT-11
Phenanthrene			<0.010		mg/kg		0.01	13-OCT-11
Pyrene			<0.010		mg/kg		0.01	13-OCT-11
Surrogate: Naphthalene d8			88.2		%		50-150	13-OCT-11
Surrogate: Acenaphthene d10			85.5		%		50-150	13-OCT-11
Surrogate: Phenanthrene d10			80.9		%		50-150	13-OCT-11
Surrogate: Chrysene d12			73.3		%		50-150	13-OCT-11
Batch R2281460								
WG1381774-4 IRM		**ALS PAH1 RM**						
Acenaphthene			77.6		%		60-130	04-NOV-11
Acenaphthylene			94.3		%		60-130	04-NOV-11
Anthracene			103.4		%		60-130	04-NOV-11
Benz(a)anthracene			95.6		%		60-130	04-NOV-11
Benzo(a)pyrene			85.8		%		60-130	04-NOV-11
Benzo(b)fluoranthene			87.7		%		60-130	04-NOV-11
Benzo(g,h,i)perylene			99.7		%		60-130	04-NOV-11
Benzo(k)fluoranthene			91.7		%		60-130	04-NOV-11
Chrysene			92.7		%		60-130	04-NOV-11
Dibenz(a,h)anthracene			93.5		%		60-130	04-NOV-11
Fluoranthene			86.7		%		60-130	04-NOV-11
Fluorene			77.7		%		60-130	04-NOV-11
Indeno(1,2,3-c,d)pyrene			107.3		%		60-130	04-NOV-11
2-Methylnaphthalene			83.8		%		60-130	04-NOV-11
Naphthalene			74.3		%		50-130	04-NOV-11
Phenanthrene			93.1		%		60-130	04-NOV-11

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Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PAH-TMB-H/A-MS-VA	**Soil**							
Batch R2281460								
WG1381774-4 IRM		**ALS PAH1 RM**						
Pyrene			89.2		%		60-130	04-NOV-11
WG1381774-1 MB								
Acenaphthene			<0.0050		mg/kg		0.005	04-NOV-11
Acenaphthylene			<0.0050		mg/kg		0.005	04-NOV-11
Anthracene			<0.0040		mg/kg		0.004	04-NOV-11
Benz(a)anthracene			<0.010		mg/kg		0.01	04-NOV-11
Benzo(a)pyrene			<0.010		mg/kg		0.01	04-NOV-11
Benzo(b)fluoranthene			<0.010		mg/kg		0.01	04-NOV-11
Benzo(g,h,i)perylene			<0.010		mg/kg		0.01	04-NOV-11
Benzo(k)fluoranthene			<0.010		mg/kg		0.01	04-NOV-11
Chrysene			<0.010		mg/kg		0.01	04-NOV-11
Dibenz(a,h)anthracene			<0.0050		mg/kg		0.005	04-NOV-11
Fluoranthene			<0.010		mg/kg		0.01	04-NOV-11
Fluorene			<0.010		mg/kg		0.01	04-NOV-11
Indeno(1,2,3-c,d)pyrene			<0.010		mg/kg		0.01	04-NOV-11
2-Methylnaphthalene			<0.010		mg/kg		0.01	04-NOV-11
Naphthalene			<0.010		mg/kg		0.01	04-NOV-11
Phenanthrene			<0.010		mg/kg		0.01	04-NOV-11
Pyrene			<0.010		mg/kg		0.01	04-NOV-11
Surrogate: Naphthalene d8			74.1		%		50-150	04-NOV-11
Surrogate: Acenaphthene d10			85.9		%		50-150	04-NOV-11
Surrogate: Phenanthrene d10			84.1		%		50-150	04-NOV-11
Surrogate: Chrysene d12			79.7		%		50-150	04-NOV-11
PH-1:2-VA	**Soil**							
Batch R2269682								
WG1367060-3 DUP		**L1067095-67**						
pH (1:2 soil:water)		4.22	4.32		pH	2.3	25	17-OCT-11
Batch R2279978								
WG1380265-3 DUP		**L1067095-6**						
pH (1:2 soil:water)		4.30	4.36		pH	1.4	25	03-NOV-11
B-DRY-MS-VA	**Tissue**							

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Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
B-DRY-MS-VA	**Tissue**							
Batch R2279350								
WG1376869-4 CRM		**VA-NIST-1547**						
Boron (B)-Total			92.3		%		70-130	28-OCT-11
WG1376869-5 CRM		**VA-NIST-1515**						
Boron (B)-Total			86.5		%		70-130	28-OCT-11
WG1376869-3 DUP		**L1067095-18**						
Boron (B)-Total		<10	<10	RPD-NA	mg/kg	N/A	25	28-OCT-11
WG1376869-1 MB								
Boron (B)-Total			<10		mg/kg		10	28-OCT-11
WG1376869-2 MB								
Boron (B)-Total			<10		mg/kg		10	28-OCT-11
Batch R2280971								
WG1379809-4 CRM		**VA-NIST-1547**						
Boron (B)-Total			100.8		%		70-130	03-NOV-11
WG1379809-5 CRM		**VA-NIST-1515**						
Boron (B)-Total			94.8		%		70-130	03-NOV-11
WG1379809-3 DUP		**L1067095-43**						
Boron (B)-Total		<10	<10	RPD-NA	mg/kg	N/A	25	03-NOV-11
WG1379809-1 MB								
Boron (B)-Total			<10		mg/kg		10	03-NOV-11
WG1379809-2 MB								
Boron (B)-Total			<10		mg/kg		10	03-NOV-11
Batch R2281645								
WG1380880-4 CRM		**VA-NIST-1547**						
Boron (B)-Total			98.1		%		70-130	03-NOV-11
WG1380880-5 CRM		**VA-NIST-1515**						
Boron (B)-Total			108.7		%		70-130	03-NOV-11
WG1380880-3 DUP		**L1067095-12**						
Boron (B)-Total		14	13		mg/kg	9.4	25	03-NOV-11
WG1380880-1 MB								
Boron (B)-Total			<10		mg/kg		10	03-NOV-11
WG1380880-2 MB								
Boron (B)-Total			<10		mg/kg		10	03-NOV-11
Batch R2286136								
WG1384091-1 MB								
Boron (B)-Total			<10		mg/kg		10	14-NOV-11
WG1384091-2 MB								
Boron (B)-Total			<10		mg/kg		10	14-NOV-11
WG1384091-3 MB								

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
B-DRY-MS-VA	**Tissue**							
Batch R2286136								
WG1384091-3 MB								
Boron (B)-Total			<10		mg/kg		10	14-NOV-11
HG-DRY-CVAFS-VA	**Tissue**							
Batch R2278662								
WG1376869-4 CRM		**VA-NIST-1547**						
Mercury (Hg)-Total			93.5		%		70-130	31-OCT-11
WG1376869-5 CRM		**VA-NIST-1515**						
Mercury (Hg)-Total			82.0		%		70-130	31-OCT-11
WG1376869-3 DUP		**L1067095-18**						
Mercury (Hg)-Total		<0.0050	<0.0050	RPD-NA	mg/kg	N/A	30	31-OCT-11
WG1376869-1 MB								
Mercury (Hg)-Total			<0.0050		mg/kg		0.005	31-OCT-11
WG1376869-2 MB								
Mercury (Hg)-Total			<0.0050		mg/kg		0.005	31-OCT-11
Batch R2281615								
WG1379809-4 CRM		**VA-NIST-1547**						
Mercury (Hg)-Total			96.3		%		70-130	04-NOV-11
WG1379809-5 CRM		**VA-NIST-1515**						
Mercury (Hg)-Total			93.3		%		70-130	04-NOV-11
WG1380880-4 CRM		**VA-NIST-1547**						
Mercury (Hg)-Total			100.1		%		70-130	04-NOV-11
WG1380880-5 CRM		**VA-NIST-1515**						
Mercury (Hg)-Total			95.3		%		70-130	04-NOV-11
WG1379809-3 DUP		**L1067095-43**						
Mercury (Hg)-Total		0.0122	0.0119		mg/kg	2.7	30	04-NOV-11
WG1380880-3 DUP		**L1067095-12**						
Mercury (Hg)-Total		0.0493	0.0478		mg/kg	3.0	30	04-NOV-11
WG1379809-1 MB								
Mercury (Hg)-Total			<0.0050		mg/kg		0.005	04-NOV-11
WG1379809-2 MB								
Mercury (Hg)-Total			<0.0050		mg/kg		0.005	04-NOV-11
WG1380880-1 MB								
Mercury (Hg)-Total			<0.0050		mg/kg		0.005	04-NOV-11
WG1380880-2 MB								
Mercury (Hg)-Total			<0.0050		mg/kg		0.005	04-NOV-11

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Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
HG-DRY-CVAFS-VA	**Tissue**							
Batch R2286087								
WG1384091-4 CRM		**VA-NRC-TORT2**						
Mercury (Hg)-Total			101.9		%		70-130	14-NOV-11
WG1384091-5 CRM		**VA-NRC-DOLT4**						
Mercury (Hg)-Total			95.7		%		70-130	14-NOV-11
WG1384091-1 MB								
Mercury (Hg)-Total			<0.0050		mg/kg		0.005	14-NOV-11
WG1384091-2 MB								
Mercury (Hg)-Total			<0.0050		mg/kg		0.005	14-NOV-11
WG1384091-3 MB								
Mercury (Hg)-Total			<0.0050		mg/kg		0.005	14-NOV-11
MET-DRY-ICP-VA	**Tissue**							
Batch R2279373								
WG1376869-1 MB								
Iron (Fe)-Total			<1.0		mg/kg		1	31-OCT-11
Phosphorus (P)-Total			<20		mg/kg		20	31-OCT-11
Potassium (K)-Total			<100		mg/kg		100	31-OCT-11
Sodium (Na)-Total			<100		mg/kg		100	31-OCT-11
Titanium (Ti)-Total			<0.50		mg/kg		0.5	31-OCT-11
WG1376869-2 MB								
Iron (Fe)-Total			<1.0		mg/kg		1	31-OCT-11
Phosphorus (P)-Total			<20		mg/kg		20	31-OCT-11
Potassium (K)-Total			<100		mg/kg		100	31-OCT-11
Sodium (Na)-Total			<100		mg/kg		100	31-OCT-11
Titanium (Ti)-Total			<0.50		mg/kg		0.5	31-OCT-11
Batch R2280539								
WG1376869-4 CRM		**VA-NIST-1547**						
Iron (Fe)-Total			85.2		%		70-130	02-NOV-11
Phosphorus (P)-Total			100.4		%		70-130	02-NOV-11
Potassium (K)-Total			104.1		%		70-130	02-NOV-11
WG1376869-5 CRM		**VA-NIST-1515**						
Iron (Fe)-Total			75.1		%		70-130	02-NOV-11
Phosphorus (P)-Total			95.3		%		70-130	02-NOV-11
Potassium (K)-Total			98.4		%		70-130	02-NOV-11
WG1376869-3 DUP		**L1067095-18**						
Iron (Fe)-Total		24.8	26.4		mg/kg	6.4	30	02-NOV-11
Phosphorus (P)-Total		778	742		mg/kg	4.7	30	02-NOV-11
Potassium (K)-Total		4840	4410		mg/kg	9.4	30	02-NOV-11

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Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-DRY-ICP-VA	**Tissue**							
Batch R2280539								
WG1376869-3 DUP		**L1067095-18**						
Sodium (Na)-Total		<100	<100	RPD-NA	mg/kg	N/A	30	02-NOV-11
Titanium (Ti)-Total		0.79	0.84		mg/kg	6.8	30	02-NOV-11
Batch R2281499								
WG1379809-4 CRM		**VA-NIST-1547**						
Iron (Fe)-Total			84.6		%		70-130	03-NOV-11
Phosphorus (P)-Total			97.6		%		70-130	03-NOV-11
Potassium (K)-Total			103.6		%		70-130	03-NOV-11
WG1379809-5 CRM		**VA-NIST-1515**						
Iron (Fe)-Total			79.6		%		70-130	03-NOV-11
Phosphorus (P)-Total			97.2		%		70-130	03-NOV-11
Potassium (K)-Total			100.7		%		70-130	03-NOV-11
WG1379809-3 DUP		**L1067095-43**						
Iron (Fe)-Total		45.8	44.8		mg/kg	2.3	30	03-NOV-11
Phosphorus (P)-Total		2150	2130		mg/kg	0.81	30	03-NOV-11
Potassium (K)-Total		3780	3690		mg/kg	2.2	30	03-NOV-11
Sodium (Na)-Total		<100	<100	RPD-NA	mg/kg	N/A	30	03-NOV-11
Titanium (Ti)-Total		1.09	0.83		mg/kg	26	30	03-NOV-11
WG1379809-1 MB								
Iron (Fe)-Total			<1.0		mg/kg		1	03-NOV-11
Phosphorus (P)-Total			<20		mg/kg		20	03-NOV-11
Potassium (K)-Total			<100		mg/kg		100	03-NOV-11
Sodium (Na)-Total			<100		mg/kg		100	03-NOV-11
Titanium (Ti)-Total			<0.50		mg/kg		0.5	03-NOV-11
WG1379809-2 MB								
Iron (Fe)-Total			<1.0		mg/kg		1	03-NOV-11
Phosphorus (P)-Total			<20		mg/kg		20	03-NOV-11
Potassium (K)-Total			<100		mg/kg		100	03-NOV-11
Sodium (Na)-Total			<100		mg/kg		100	03-NOV-11
Titanium (Ti)-Total			<0.50		mg/kg		0.5	03-NOV-11
Batch R2281624								
WG1380880-4 CRM		**VA-NIST-1547**						
Iron (Fe)-Total			90.5		%		70-130	03-NOV-11
Phosphorus (P)-Total			103.5		%		70-130	03-NOV-11
Potassium (K)-Total			100.5		%		70-130	03-NOV-11
WG1380880-5 CRM		**VA-NIST-1515**						

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-DRY-ICP-VA	**Tissue**							
Batch R2281624								
WG1380880-5 CRM		**VA-NIST-1515**						
Iron (Fe)-Total			82.4		%		70-130	03-NOV-11
Phosphorus (P)-Total			101.2		%		70-130	03-NOV-11
Potassium (K)-Total			103.7		%		70-130	03-NOV-11
WG1380880-3 DUP		**L1067095-12**						
Iron (Fe)-Total		303	295		mg/kg	2.4	30	03-NOV-11
Phosphorus (P)-Total		657	650		mg/kg	0.99	30	03-NOV-11
Potassium (K)-Total		1340	1350		mg/kg	0.49	30	03-NOV-11
Sodium (Na)-Total		100	100		mg/kg	1.2	30	03-NOV-11
Titanium (Ti)-Total		14.6	13.9		mg/kg	5.1	30	03-NOV-11
WG1380880-1 MB								
Iron (Fe)-Total			<1.0		mg/kg		1	03-NOV-11
Phosphorus (P)-Total			<20		mg/kg		20	03-NOV-11
Potassium (K)-Total			<100		mg/kg		100	03-NOV-11
Sodium (Na)-Total			<100		mg/kg		100	03-NOV-11
Titanium (Ti)-Total			<0.50		mg/kg		0.5	03-NOV-11
WG1380880-2 MB								
Iron (Fe)-Total			<1.0		mg/kg		1	03-NOV-11
Phosphorus (P)-Total			<20		mg/kg		20	03-NOV-11
Potassium (K)-Total			<100		mg/kg		100	03-NOV-11
Sodium (Na)-Total			<100		mg/kg		100	03-NOV-11
Titanium (Ti)-Total			<0.50		mg/kg		0.5	03-NOV-11
Batch R2285892								
WG1384091-4 CRM		**VA-NRC-TORT2**						
Iron (Fe)-Total			116		mg/kg		70-130	14-NOV-11
WG1384091-5 CRM		**VA-NRC-DOLT4**						
Iron (Fe)-Total			107.7		%		70-130	14-NOV-11
WG1384091-1 MB								
Iron (Fe)-Total			<10		mg/kg		10	14-NOV-11
Phosphorus (P)-Total			<200		mg/kg		200	14-NOV-11
Potassium (K)-Total			<1000		mg/kg		1000	14-NOV-11
Sodium (Na)-Total			<1000		mg/kg		1000	14-NOV-11
Titanium (Ti)-Total			<5.0		mg/kg		5	14-NOV-11
WG1384091-2 MB								
Iron (Fe)-Total			<10		mg/kg		10	14-NOV-11
Phosphorus (P)-Total			<200		mg/kg		200	14-NOV-11
Potassium (K)-Total			<1000		mg/kg		1000	14-NOV-11

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-DRY-ICP-VA	**Tissue**							
Batch R2285892								
WG1384091-2 MB								
Sodium (Na)-Total			<1000		mg/kg		1000	14-NOV-11
Titanium (Ti)-Total			<5.0		mg/kg		5	14-NOV-11
WG1384091-3 MB								
Iron (Fe)-Total			<10		mg/kg		10	14-NOV-11
Phosphorus (P)-Total			<200		mg/kg		200	14-NOV-11
Potassium (K)-Total			<1000		mg/kg		1000	14-NOV-11
Sodium (Na)-Total			<1000		mg/kg		1000	14-NOV-11
Titanium (Ti)-Total			<5.0		mg/kg		5	14-NOV-11
MET-DRY-MS-VA	**Tissue**							
Batch R2279350								
WG1376869-4 CRM		**VA-NIST-1547**						
Aluminum (Al)-Total			99.6		%		70-130	28-OCT-11
Antimony (Sb)-Total			0.020		mg/kg		0-0.12	28-OCT-11
Arsenic (As)-Total			0.103		mg/kg		0-0.16	28-OCT-11
Barium (Ba)-Total			102.0		%		70-130	28-OCT-11
Cadmium (Cd)-Total			0.025		mg/kg		0-0.086	28-OCT-11
Calcium (Ca)-Total			98.0		%		70-130	28-OCT-11
Chromium (Cr)-Total			0.75		mg/kg		0-2	28-OCT-11
Cobalt (Co)-Total			0.06		mg/kg		0-0.16	28-OCT-11
Copper (Cu)-Total			97.8		%		70-130	28-OCT-11
Lead (Pb)-Total			96.9		%		70-130	28-OCT-11
Magnesium (Mg)-Total			94.3		%		70-130	28-OCT-11
Manganese (Mn)-Total			104		mg/kg		70-130	28-OCT-11
Molybdenum (Mo)-Total			0.058		mg/kg		0-0.16	28-OCT-11
Nickel (Ni)-Total			0.52		mg/kg		0-1.69	28-OCT-11
Strontium (Sr)-Total			110.6		%		70-130	28-OCT-11
Uranium (U)-Total			0.008		mg/kg		0-0.035	28-OCT-11
Vanadium (V)-Total			0.30		mg/kg		0-1.37	28-OCT-11
Zinc (Zn)-Total			101.7		%		70-130	28-OCT-11
WG1376869-5 CRM		**VA-NIST-1515**						
Aluminum (Al)-Total			76.2		%		70-130	28-OCT-11
Arsenic (As)-Total			0.049		mg/kg		0-0.138	28-OCT-11
Barium (Ba)-Total			93.9		%		70-130	28-OCT-11
Calcium (Ca)-Total			89.5		%		70-130	28-OCT-11
Chromium (Cr)-Total			0.23		mg/kg		0-1.3	28-OCT-11

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-DRY-MS-VA	**Tissue**							
Batch R2279350								
WG1376869-5 CRM		**VA-NIST-1515**						
Cobalt (Co)-Total			0.08		mg/kg		0-0.29	28-OCT-11
Copper (Cu)-Total			88.5		%		70-130	28-OCT-11
Lead (Pb)-Total			79.0		%		70-130	28-OCT-11
Magnesium (Mg)-Total			88.9		%		70-130	28-OCT-11
Manganese (Mn)-Total			96.1		%		70-130	28-OCT-11
Molybdenum (Mo)-Total			0.079		mg/kg		0-0.194	28-OCT-11
Nickel (Ni)-Total			0.86		mg/kg		0-1.91	28-OCT-11
Strontium (Sr)-Total			95.2		%		70-130	28-OCT-11
Uranium (U)-Total			0.004		mg/kg		0-0.026	28-OCT-11
Vanadium (V)-Total			0.14		mg/kg		0-1.26	28-OCT-11
Zinc (Zn)-Total			88.5		%		70-130	28-OCT-11
WG1376869-3 DUP		**L1067095-18**						
Aluminum (Al)-Total		43	49		mg/kg	13	30	28-OCT-11
Antimony (Sb)-Total		<0.050	<0.050	RPD-NA	mg/kg	N/A	30	28-OCT-11
Arsenic (As)-Total		<0.050	<0.050	RPD-NA	mg/kg	N/A	30	28-OCT-11
Barium (Ba)-Total		13.0	18.0	DUP-H	mg/kg	32	30	28-OCT-11
Beryllium (Be)-Total		<0.30	<0.30	RPD-NA	mg/kg	N/A	30	28-OCT-11
Bismuth (Bi)-Total		<0.30	<0.30	RPD-NA	mg/kg	N/A	30	28-OCT-11
Cadmium (Cd)-Total		0.103	0.108		mg/kg	4.7	30	28-OCT-11
Calcium (Ca)-Total		857	935		mg/kg	8.7	50	28-OCT-11
Chromium (Cr)-Total		0.95	1.06		mg/kg	11	30	28-OCT-11
Cobalt (Co)-Total		0.16	0.20		mg/kg	21	30	28-OCT-11
Copper (Cu)-Total		3.41	3.91		mg/kg	14	30	28-OCT-11
Lead (Pb)-Total		<0.10	0.34	DUP-H	mg/kg	N/A	30	28-OCT-11
Lithium (Li)-Total		<0.50	<0.50	RPD-NA	mg/kg	N/A	30	28-OCT-11
Magnesium (Mg)-Total		414	433		mg/kg	4.5	30	28-OCT-11
Manganese (Mn)-Total		104	107		mg/kg	3.0	30	28-OCT-11
Molybdenum (Mo)-Total		0.167	0.183		mg/kg	9.0	30	28-OCT-11
Nickel (Ni)-Total		1.19	1.33		mg/kg	11	30	28-OCT-11
Selenium (Se)-Total		<1.0	<1.0	RPD-NA	mg/kg	N/A	30	28-OCT-11
Strontium (Sr)-Total		2.88	3.51		mg/kg	20	50	28-OCT-11
Thallium (Tl)-Total		<0.030	<0.030	RPD-NA	mg/kg	N/A	30	28-OCT-11
Tin (Sn)-Total		0.38	0.48		mg/kg	25	30	28-OCT-11
Uranium (U)-Total		<0.010	<0.010	RPD-NA	mg/kg	N/A	30	28-OCT-11

Environmental

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-DRY-MS-VA	**Tissue**							
Batch R2279350								
WG1376869-3 DUP		**L1067095-18**						
Vanadium (V)-Total		<0.50	<0.50	RPD-NA	mg/kg	N/A	30	28-OCT-11
Zinc (Zn)-Total		6.76	10.5	DUP-H	mg/kg	43	30	28-OCT-11
WG1376869-1 MB								
Aluminum (Al)-Total			<10		mg/kg		10	28-OCT-11
Antimony (Sb)-Total			<0.050		mg/kg		0.05	28-OCT-11
Arsenic (As)-Total			<0.050		mg/kg		0.05	28-OCT-11
Barium (Ba)-Total			<0.050		mg/kg		0.05	28-OCT-11
Beryllium (Be)-Total			<0.30		mg/kg		0.3	28-OCT-11
Bismuth (Bi)-Total			<0.30		mg/kg		0.3	28-OCT-11
Cadmium (Cd)-Total			<0.030		mg/kg		0.03	28-OCT-11
Calcium (Ca)-Total			<10		mg/kg		10	28-OCT-11
Chromium (Cr)-Total			<0.50		mg/kg		0.5	28-OCT-11
Cobalt (Co)-Total			<0.10		mg/kg		0.1	28-OCT-11
Copper (Cu)-Total			<0.050		mg/kg		0.05	28-OCT-11
Lead (Pb)-Total			<0.10		mg/kg		0.1	28-OCT-11
Lithium (Li)-Total			<0.50		mg/kg		0.5	28-OCT-11
Magnesium (Mg)-Total			<3.0		mg/kg		3	28-OCT-11
Manganese (Mn)-Total			<0.050		mg/kg		0.05	28-OCT-11
Molybdenum (Mo)-Total			<0.050		mg/kg		0.05	28-OCT-11
Nickel (Ni)-Total			<0.50		mg/kg		0.5	28-OCT-11
Selenium (Se)-Total			<1.0		mg/kg		1	28-OCT-11
Strontium (Sr)-Total			<0.050		mg/kg		0.05	28-OCT-11
Thallium (Tl)-Total			<0.030		mg/kg		0.03	28-OCT-11
Tin (Sn)-Total			<0.20		mg/kg		0.2	28-OCT-11
Uranium (U)-Total			<0.010		mg/kg		0.01	28-OCT-11
Vanadium (V)-Total			<0.50		mg/kg		0.5	28-OCT-11
Zinc (Zn)-Total			<0.50		mg/kg		0.5	28-OCT-11
WG1376869-2 MB								
Aluminum (Al)-Total			<10		mg/kg		10	28-OCT-11
Antimony (Sb)-Total			<0.050		mg/kg		0.05	28-OCT-11
Arsenic (As)-Total			<0.050		mg/kg		0.05	28-OCT-11
Barium (Ba)-Total			<0.050		mg/kg		0.05	28-OCT-11
Beryllium (Be)-Total			<0.30		mg/kg		0.3	28-OCT-11
Bismuth (Bi)-Total			<0.30		mg/kg		0.3	28-OCT-11
Cadmium (Cd)-Total			<0.030		mg/kg		0.03	28-OCT-11

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-DRY-MS-VA	**Tissue**							
Batch R2279350								
WG1376869-2 MB								
Calcium (Ca)-Total			<10		mg/kg		10	28-OCT-11
Chromium (Cr)-Total			<0.50		mg/kg		0.5	28-OCT-11
Cobalt (Co)-Total			<0.10		mg/kg		0.1	28-OCT-11
Copper (Cu)-Total			<0.050		mg/kg		0.05	28-OCT-11
Lead (Pb)-Total			<0.10		mg/kg		0.1	28-OCT-11
Lithium (Li)-Total			<0.50		mg/kg		0.5	28-OCT-11
Magnesium (Mg)-Total			<3.0		mg/kg		3	28-OCT-11
Manganese (Mn)-Total			<0.050		mg/kg		0.05	28-OCT-11
Molybdenum (Mo)-Total			<0.050		mg/kg		0.05	28-OCT-11
Nickel (Ni)-Total			<0.50		mg/kg		0.5	28-OCT-11
Selenium (Se)-Total			<1.0		mg/kg		1	28-OCT-11
Strontium (Sr)-Total			<0.050		mg/kg		0.05	28-OCT-11
Thallium (Tl)-Total			<0.030		mg/kg		0.03	28-OCT-11
Tin (Sn)-Total			<0.20		mg/kg		0.2	28-OCT-11
Uranium (U)-Total			<0.010		mg/kg		0.01	28-OCT-11
Vanadium (V)-Total			<0.50		mg/kg		0.5	28-OCT-11
Zinc (Zn)-Total			<0.50		mg/kg		0.5	28-OCT-11
Batch R2280971								
WG1379809-4 CRM		**VA-NIST-1547**						
Aluminum (Al)-Total			114.1		%		70-130	03-NOV-11
Antimony (Sb)-Total			0.029		mg/kg		0-0.12	03-NOV-11
Arsenic (As)-Total			0.096		mg/kg		0-0.16	03-NOV-11
Barium (Ba)-Total			105.3		%		70-130	03-NOV-11
Cadmium (Cd)-Total			0.031		mg/kg		0-0.086	03-NOV-11
Calcium (Ca)-Total			110.9		%		70-130	03-NOV-11
Chromium (Cr)-Total			0.96		mg/kg		0-2	03-NOV-11
Cobalt (Co)-Total			0.06		mg/kg		0-0.16	03-NOV-11
Copper (Cu)-Total			106.8		%		70-130	03-NOV-11
Lead (Pb)-Total			108.0		%		70-130	03-NOV-11
Magnesium (Mg)-Total			103.5		%		70-130	03-NOV-11
Manganese (Mn)-Total			108		mg/kg		70-130	03-NOV-11
Molybdenum (Mo)-Total			0.064		mg/kg		0-0.16	03-NOV-11
Nickel (Ni)-Total			0.49		mg/kg		0-1.69	03-NOV-11
Strontium (Sr)-Total			115.5		%		70-130	03-NOV-11

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-DRY-MS-VA	**Tissue**							
Batch R2280971								
WG1379809-4 CRM		**VA-NIST-1547**						
Uranium (U)-Total			0.011		mg/kg		0-0.035	03-NOV-11
Vanadium (V)-Total			0.38		mg/kg		0-1.37	03-NOV-11
Zinc (Zn)-Total			114.1		%		70-130	03-NOV-11
WG1379809-5 CRM		**VA-NIST-1515**						
Aluminum (Al)-Total			97.9		%		70-130	03-NOV-11
Arsenic (As)-Total			0.048		mg/kg		0-0.138	03-NOV-11
Barium (Ba)-Total			92.1		%		70-130	03-NOV-11
Calcium (Ca)-Total			94.9		%		70-130	03-NOV-11
Chromium (Cr)-Total			0.27		mg/kg		0-1.3	03-NOV-11
Cobalt (Co)-Total			0.08		mg/kg		0-0.29	03-NOV-11
Copper (Cu)-Total			93.3		%		70-130	03-NOV-11
Lead (Pb)-Total			97.2		%		70-130	03-NOV-11
Magnesium (Mg)-Total			91.9		%		70-130	03-NOV-11
Manganese (Mn)-Total			94.9		%		70-130	03-NOV-11
Molybdenum (Mo)-Total			0.082		mg/kg		0-0.194	03-NOV-11
Nickel (Ni)-Total			0.82		mg/kg		0-1.91	03-NOV-11
Strontium (Sr)-Total			95.6		%		70-130	03-NOV-11
Uranium (U)-Total			0.007		mg/kg		0-0.026	03-NOV-11
Vanadium (V)-Total			0.23		mg/kg		0-1.26	03-NOV-11
Zinc (Zn)-Total			98.5		%		70-130	03-NOV-11
WG1379809-3 DUP		**L1067095-43**						
Aluminum (Al)-Total		20	20		mg/kg	0.14	30	03-NOV-11
Antimony (Sb)-Total		<0.050	<0.050	RPD-NA	mg/kg	N/A	30	03-NOV-11
Arsenic (As)-Total		<0.050	<0.050	RPD-NA	mg/kg	N/A	30	03-NOV-11
Barium (Ba)-Total		59.9	61.9		mg/kg	3.2	30	03-NOV-11
Beryllium (Be)-Total		<0.30	<0.30	RPD-NA	mg/kg	N/A	30	03-NOV-11
Bismuth (Bi)-Total		<0.30	<0.30	RPD-NA	mg/kg	N/A	30	03-NOV-11
Cadmium (Cd)-Total		0.062	0.061		mg/kg	1.8	30	03-NOV-11
Calcium (Ca)-Total		5020	5110		mg/kg	1.8	50	03-NOV-11
Chromium (Cr)-Total		<0.50	<0.50	RPD-NA	mg/kg	N/A	30	03-NOV-11
Cobalt (Co)-Total		0.55	0.57		mg/kg	5.1	30	03-NOV-11
Copper (Cu)-Total		3.81	3.94		mg/kg	3.4	30	03-NOV-11
Lead (Pb)-Total		<0.10	<0.10	RPD-NA	mg/kg	N/A	30	03-NOV-11
Lithium (Li)-Total		0.64	0.74		mg/kg	15	30	03-NOV-11
Magnesium (Mg)-Total		2780	2830		mg/kg	1.6	30	03-NOV-11

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-DRY-MS-VA	**Tissue**							
Batch R2280971								
WG1379809-3 DUP		**L1067095-43**						
Manganese (Mn)-Total		328	332		mg/kg	1.4	30	03-NOV-11
Molybdenum (Mo)-Total		<0.050	<0.050	RPD-NA	mg/kg	N/A	30	03-NOV-11
Nickel (Ni)-Total		2.46	2.49		mg/kg	0.93	30	03-NOV-11
Selenium (Se)-Total		<1.0	<1.0	RPD-NA	mg/kg	N/A	30	03-NOV-11
Strontium (Sr)-Total		20.9	21.5		mg/kg	2.8	50	03-NOV-11
Thallium (Tl)-Total		<0.030	<0.030	RPD-NA	mg/kg	N/A	30	03-NOV-11
Tin (Sn)-Total		<0.20	<0.20	RPD-NA	mg/kg	N/A	30	03-NOV-11
Uranium (U)-Total		<0.010	<0.010	RPD-NA	mg/kg	N/A	30	03-NOV-11
Vanadium (V)-Total		<0.50	<0.50	RPD-NA	mg/kg	N/A	30	03-NOV-11
Zinc (Zn)-Total		121	125		mg/kg	3.3	30	03-NOV-11
WG1379809-1 MB								
Aluminum (Al)-Total			<10		mg/kg		10	03-NOV-11
Antimony (Sb)-Total			<0.050		mg/kg		0.05	03-NOV-11
Arsenic (As)-Total			<0.050		mg/kg		0.05	03-NOV-11
Barium (Ba)-Total			<0.050		mg/kg		0.05	03-NOV-11
Beryllium (Be)-Total			<0.30		mg/kg		0.3	03-NOV-11
Bismuth (Bi)-Total			<0.30		mg/kg		0.3	03-NOV-11
Cadmium (Cd)-Total			<0.030		mg/kg		0.03	03-NOV-11
Calcium (Ca)-Total			<10		mg/kg		10	03-NOV-11
Chromium (Cr)-Total			<0.50		mg/kg		0.5	03-NOV-11
Cobalt (Co)-Total			<0.10		mg/kg		0.1	03-NOV-11
Copper (Cu)-Total			<0.050		mg/kg		0.05	03-NOV-11
Lead (Pb)-Total			<0.10		mg/kg		0.1	03-NOV-11
Lithium (Li)-Total			<0.50		mg/kg		0.5	03-NOV-11
Magnesium (Mg)-Total			<3.0		mg/kg		3	03-NOV-11
Manganese (Mn)-Total			<0.050		mg/kg		0.05	03-NOV-11
Molybdenum (Mo)-Total			<0.050		mg/kg		0.05	03-NOV-11
Nickel (Ni)-Total			<0.50		mg/kg		0.5	03-NOV-11
Selenium (Se)-Total			<1.0		mg/kg		1	03-NOV-11
Strontium (Sr)-Total			<0.050		mg/kg		0.05	03-NOV-11
Thallium (Tl)-Total			<0.030		mg/kg		0.03	03-NOV-11
Tin (Sn)-Total			<0.20		mg/kg		0.2	03-NOV-11
Uranium (U)-Total			<0.010		mg/kg		0.01	03-NOV-11
Vanadium (V)-Total			<0.50		mg/kg		0.5	03-NOV-11

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-DRY-MS-VA	**Tissue**							
Batch R2280971								
WG1379809-1 MB								
Zinc (Zn)-Total			<0.50		mg/kg		0.5	03-NOV-11
WG1379809-2 MB								
Aluminum (Al)-Total			<10		mg/kg		10	03-NOV-11
Antimony (Sb)-Total			<0.050		mg/kg		0.05	03-NOV-11
Arsenic (As)-Total			<0.050		mg/kg		0.05	03-NOV-11
Barium (Ba)-Total			<0.050		mg/kg		0.05	03-NOV-11
Beryllium (Be)-Total			<0.30		mg/kg		0.3	03-NOV-11
Bismuth (Bi)-Total			<0.30		mg/kg		0.3	03-NOV-11
Cadmium (Cd)-Total			<0.030		mg/kg		0.03	03-NOV-11
Calcium (Ca)-Total			<10		mg/kg		10	03-NOV-11
Chromium (Cr)-Total			<0.50		mg/kg		0.5	03-NOV-11
Cobalt (Co)-Total			<0.10		mg/kg		0.1	03-NOV-11
Copper (Cu)-Total			<0.050		mg/kg		0.05	03-NOV-11
Lead (Pb)-Total			<0.10		mg/kg		0.1	03-NOV-11
Lithium (Li)-Total			<0.50		mg/kg		0.5	03-NOV-11
Magnesium (Mg)-Total			<3.0		mg/kg		3	03-NOV-11
Manganese (Mn)-Total			<0.050		mg/kg		0.05	03-NOV-11
Molybdenum (Mo)-Total			<0.050		mg/kg		0.05	03-NOV-11
Nickel (Ni)-Total			<0.50		mg/kg		0.5	03-NOV-11
Selenium (Se)-Total			<1.0		mg/kg		1	03-NOV-11
Strontium (Sr)-Total			<0.050		mg/kg		0.05	03-NOV-11
Thallium (Tl)-Total			<0.030		mg/kg		0.03	03-NOV-11
Tin (Sn)-Total			<0.20		mg/kg		0.2	03-NOV-11
Uranium (U)-Total			<0.010		mg/kg		0.01	03-NOV-11
Vanadium (V)-Total			<0.50		mg/kg		0.5	03-NOV-11
Zinc (Zn)-Total			<0.50		mg/kg		0.5	03-NOV-11
Batch R2281645								
WG1380880-4 CRM		**VA-NIST-1547**						
Aluminum (Al)-Total			103.7		%		70-130	03-NOV-11
Antimony (Sb)-Total			0.017		mg/kg		0-0.12	03-NOV-11
Arsenic (As)-Total			0.095		mg/kg		0-0.16	03-NOV-11
Barium (Ba)-Total			95.8		%		70-130	03-NOV-11
Cadmium (Cd)-Total			0.026		mg/kg		0-0.086	03-NOV-11
Calcium (Ca)-Total			100.4		%		70-130	03-NOV-11
Chromium (Cr)-Total			0.80		mg/kg		0-2	03-NOV-11

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-DRY-MS-VA	**Tissue**							
Batch R2281645								
WG1380880-4 CRM		**VA-NIST-1547**						
Cobalt (Co)-Total			0.06		mg/kg		0-0.16	03-NOV-11
Copper (Cu)-Total			95.1		%		70-130	03-NOV-11
Lead (Pb)-Total			97.3		%		70-130	03-NOV-11
Magnesium (Mg)-Total			96.8		%		70-130	03-NOV-11
Manganese (Mn)-Total			99.7		mg/kg		70-130	03-NOV-11
Molybdenum (Mo)-Total			0.052		mg/kg		0-0.16	03-NOV-11
Nickel (Ni)-Total			0.47		mg/kg		0-1.69	03-NOV-11
Strontium (Sr)-Total			105.1		%		70-130	03-NOV-11
Uranium (U)-Total			0.012		mg/kg		0-0.035	03-NOV-11
Vanadium (V)-Total			0.32		mg/kg		0-1.37	03-NOV-11
Zinc (Zn)-Total			105.7		%		70-130	03-NOV-11
WG1380880-5 CRM		**VA-NIST-1515**						
Aluminum (Al)-Total			92.2		%		70-130	03-NOV-11
Arsenic (As)-Total			0.073		mg/kg		0-0.138	03-NOV-11
Barium (Ba)-Total			97.9		%		70-130	03-NOV-11
Calcium (Ca)-Total			101.3		%		70-130	03-NOV-11
Chromium (Cr)-Total			0.25		mg/kg		0-1.3	03-NOV-11
Cobalt (Co)-Total			0.09		mg/kg		0-0.29	03-NOV-11
Copper (Cu)-Total			98.2		%		70-130	03-NOV-11
Lead (Pb)-Total			89.2		%		70-130	03-NOV-11
Magnesium (Mg)-Total			98.5		%		70-130	03-NOV-11
Manganese (Mn)-Total			102.4		%		70-130	03-NOV-11
Molybdenum (Mo)-Total			0.088		mg/kg		0-0.194	03-NOV-11
Nickel (Ni)-Total			0.92		mg/kg		0-1.91	03-NOV-11
Strontium (Sr)-Total			101.5		%		70-130	03-NOV-11
Uranium (U)-Total			0.005		mg/kg		0-0.026	03-NOV-11
Vanadium (V)-Total			0.17		mg/kg		0-1.26	03-NOV-11
Zinc (Zn)-Total			103.7		%		70-130	03-NOV-11
WG1380880-3 DUP		**L1067095-12**						
Aluminum (Al)-Total		339	337		mg/kg	0.52	30	03-NOV-11
Antimony (Sb)-Total		<0.050	<0.050	RPD-NA	mg/kg	N/A	30	03-NOV-11
Arsenic (As)-Total		0.172	0.171		mg/kg	0.60	30	03-NOV-11
Barium (Ba)-Total		37.8	37.5		mg/kg	0.57	30	03-NOV-11
Beryllium (Be)-Total		<0.30	<0.30	RPD-NA	mg/kg	N/A	30	03-NOV-11
Bismuth (Bi)-Total		<0.30	<0.30	RPD-NA	mg/kg	N/A	30	03-NOV-11

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-DRY-MS-VA	**Tissue**							
Batch R2281645								
WG1380880-3 DUP		**L1067095-12**						
Cadmium (Cd)-Total		0.125	0.117		mg/kg	6.9	30	03-NOV-11
Calcium (Ca)-Total		2120	2080		mg/kg	1.8	50	03-NOV-11
Chromium (Cr)-Total		1.37	1.34		mg/kg	2.3	30	03-NOV-11
Cobalt (Co)-Total		0.42	0.42		mg/kg	0.52	30	03-NOV-11
Copper (Cu)-Total		2.75	2.64		mg/kg	4.3	30	03-NOV-11
Lead (Pb)-Total		0.62	0.61		mg/kg	1.3	30	03-NOV-11
Lithium (Li)-Total		<0.50	<0.50	RPD-NA	mg/kg	N/A	30	03-NOV-11
Magnesium (Mg)-Total		466	465		mg/kg	0.26	30	03-NOV-11
Manganese (Mn)-Total		67.3	67.8		mg/kg	0.69	30	03-NOV-11
Molybdenum (Mo)-Total		<0.050	<0.050	RPD-NA	mg/kg	N/A	30	03-NOV-11
Nickel (Ni)-Total		2.09	2.10		mg/kg	0.30	30	03-NOV-11
Selenium (Se)-Total		<1.0	<1.0	RPD-NA	mg/kg	N/A	30	03-NOV-11
Strontium (Sr)-Total		12.1	11.8		mg/kg	2.4	50	03-NOV-11
Thallium (Tl)-Total		<0.030	<0.030	RPD-NA	mg/kg	N/A	30	03-NOV-11
Tin (Sn)-Total		<0.20	<0.20	RPD-NA	mg/kg	N/A	30	03-NOV-11
Uranium (U)-Total		0.028	0.028		mg/kg	0.094	30	03-NOV-11
Vanadium (V)-Total		0.64	0.62		mg/kg	4.0	30	03-NOV-11
Zinc (Zn)-Total		27.6	27.6		mg/kg	0.10	30	03-NOV-11
WG1380880-1 MB								
Aluminum (Al)-Total			<10		mg/kg		10	03-NOV-11
Antimony (Sb)-Total			<0.050		mg/kg		0.05	03-NOV-11
Arsenic (As)-Total			<0.050		mg/kg		0.05	03-NOV-11
Barium (Ba)-Total			<0.050		mg/kg		0.05	03-NOV-11
Beryllium (Be)-Total			<0.30		mg/kg		0.3	03-NOV-11
Bismuth (Bi)-Total			<0.30		mg/kg		0.3	03-NOV-11
Cadmium (Cd)-Total			<0.030		mg/kg		0.03	03-NOV-11
Calcium (Ca)-Total			<10		mg/kg		10	03-NOV-11
Chromium (Cr)-Total			<0.50		mg/kg		0.5	03-NOV-11
Cobalt (Co)-Total			<0.10		mg/kg		0.1	03-NOV-11
Copper (Cu)-Total			<0.050		mg/kg		0.05	03-NOV-11
Lead (Pb)-Total			<0.10		mg/kg		0.1	03-NOV-11
Lithium (Li)-Total			<0.50		mg/kg		0.5	03-NOV-11
Magnesium (Mg)-Total			<3.0		mg/kg		3	03-NOV-11
Manganese (Mn)-Total			<0.050		mg/kg		0.05	03-NOV-11

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-DRY-MS-VA	**Tissue**							
Batch R2281645								
WG1380880-1 MB								
Molybdenum (Mo)-Total			<0.050		mg/kg		0.05	03-NOV-11
Nickel (Ni)-Total			<0.50		mg/kg		0.5	03-NOV-11
Selenium (Se)-Total			<1.0		mg/kg		1	03-NOV-11
Strontium (Sr)-Total			<0.050		mg/kg		0.05	03-NOV-11
Thallium (Tl)-Total			<0.030		mg/kg		0.03	03-NOV-11
Tin (Sn)-Total			<0.20		mg/kg		0.2	03-NOV-11
Uranium (U)-Total			<0.010		mg/kg		0.01	03-NOV-11
Vanadium (V)-Total			<0.50		mg/kg		0.5	03-NOV-11
Zinc (Zn)-Total			<0.50		mg/kg		0.5	03-NOV-11
WG1380880-2 MB								
Aluminum (Al)-Total			<10		mg/kg		10	03-NOV-11
Antimony (Sb)-Total			<0.050		mg/kg		0.05	03-NOV-11
Arsenic (As)-Total			<0.050		mg/kg		0.05	03-NOV-11
Barium (Ba)-Total			<0.050		mg/kg		0.05	03-NOV-11
Beryllium (Be)-Total			<0.30		mg/kg		0.3	03-NOV-11
Bismuth (Bi)-Total			<0.30		mg/kg		0.3	03-NOV-11
Cadmium (Cd)-Total			<0.030		mg/kg		0.03	03-NOV-11
Calcium (Ca)-Total			<10		mg/kg		10	03-NOV-11
Chromium (Cr)-Total			<0.50		mg/kg		0.5	03-NOV-11
Cobalt (Co)-Total			<0.10		mg/kg		0.1	03-NOV-11
Copper (Cu)-Total			<0.050		mg/kg		0.05	03-NOV-11
Lead (Pb)-Total			<0.10		mg/kg		0.1	03-NOV-11
Lithium (Li)-Total			<0.50		mg/kg		0.5	03-NOV-11
Magnesium (Mg)-Total			<3.0		mg/kg		3	03-NOV-11
Manganese (Mn)-Total			<0.050		mg/kg		0.05	03-NOV-11
Molybdenum (Mo)-Total			<0.050		mg/kg		0.05	03-NOV-11
Nickel (Ni)-Total			<0.50		mg/kg		0.5	03-NOV-11
Selenium (Se)-Total			<1.0		mg/kg		1	03-NOV-11
Strontium (Sr)-Total			<0.050		mg/kg		0.05	03-NOV-11
Thallium (Tl)-Total			<0.030		mg/kg		0.03	03-NOV-11
Tin (Sn)-Total			<0.20		mg/kg		0.2	03-NOV-11
Uranium (U)-Total			<0.010		mg/kg		0.01	03-NOV-11
Vanadium (V)-Total			<0.50		mg/kg		0.5	03-NOV-11
Zinc (Zn)-Total			<0.50		mg/kg		0.5	03-NOV-11

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-DRY-MS-VA	**Tissue**							
Batch R2286136								
WG1384091-4 CRM		**VA-NRC-TORT2**						
Arsenic (As)-Total			109.2		%		70-130	14-NOV-11
Cadmium (Cd)-Total			107.8		%		70-130	14-NOV-11
Chromium (Cr)-Total			0.58		mg/kg		0-1.77	14-NOV-11
Cobalt (Co)-Total			106.9		%		70-130	14-NOV-11
Copper (Cu)-Total			99.6		mg/kg		70-130	14-NOV-11
Lead (Pb)-Total			0.28		mg/kg		0.15-0.55	14-NOV-11
Manganese (Mn)-Total			99.4		%		70-130	14-NOV-11
Molybdenum (Mo)-Total			110.7		%		70-130	14-NOV-11
Nickel (Ni)-Total			89.9		%		70-130	14-NOV-11
Selenium (Se)-Total			115.8		%		70-130	14-NOV-11
Strontium (Sr)-Total			111.3		%		70-130	14-NOV-11
Vanadium (V)-Total			1.86		mg/kg		0.64-2.64	14-NOV-11
Zinc (Zn)-Total			108.8		%		70-130	14-NOV-11
WG1384091-5 CRM		**VA-NRC-DOLT4**						
Arsenic (As)-Total			106.2		%		70-130	14-NOV-11
Cadmium (Cd)-Total			103.8		%		70-130	14-NOV-11
Copper (Cu)-Total			106.4		%		70-130	14-NOV-11
Lead (Pb)-Total			0.13		mg/kg		0.06-0.26	14-NOV-11
Nickel (Ni)-Total			0.73		mg/kg		0.47-1.47	14-NOV-11
Selenium (Se)-Total			118.5		%		70-130	14-NOV-11
Zinc (Zn)-Total			114.6		%		70-130	14-NOV-11
WG1384091-1 MB								
Aluminum (Al)-Total			<10		mg/kg		10	14-NOV-11
Antimony (Sb)-Total			<0.050		mg/kg		0.05	14-NOV-11
Arsenic (As)-Total			<0.050		mg/kg		0.05	14-NOV-11
Barium (Ba)-Total			<0.050		mg/kg		0.05	14-NOV-11
Beryllium (Be)-Total			<0.30		mg/kg		0.3	14-NOV-11
Bismuth (Bi)-Total			<0.30		mg/kg		0.3	14-NOV-11
Cadmium (Cd)-Total			<0.030		mg/kg		0.03	14-NOV-11
Calcium (Ca)-Total			<10		mg/kg		10	14-NOV-11
Chromium (Cr)-Total			<0.50		mg/kg		0.5	14-NOV-11
Cobalt (Co)-Total			<0.10		mg/kg		0.1	14-NOV-11
Copper (Cu)-Total			<0.050		mg/kg		0.05	14-NOV-11
Lead (Pb)-Total			<0.10		mg/kg		0.1	14-NOV-11
Lithium (Li)-Total			<0.50		mg/kg		0.5	14-NOV-11

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-DRY-MS-VA	**Tissue**							
Batch R2286136								
WG1384091-1 MB								
Magnesium (Mg)-Total			<3.0		mg/kg		3	14-NOV-11
Manganese (Mn)-Total			<0.050		mg/kg		0.05	14-NOV-11
Molybdenum (Mo)-Total			<0.050		mg/kg		0.05	14-NOV-11
Nickel (Ni)-Total			<0.50		mg/kg		0.5	14-NOV-11
Selenium (Se)-Total			<1.0		mg/kg		1	14-NOV-11
Strontium (Sr)-Total			<0.050		mg/kg		0.05	14-NOV-11
Thallium (Tl)-Total			<0.030		mg/kg		0.03	14-NOV-11
Tin (Sn)-Total			<0.20		mg/kg		0.2	14-NOV-11
Uranium (U)-Total			<0.010		mg/kg		0.01	14-NOV-11
Vanadium (V)-Total			<0.50		mg/kg		0.5	14-NOV-11
Zinc (Zn)-Total			<0.50		mg/kg		0.5	14-NOV-11
WG1384091-2 MB								
Aluminum (Al)-Total			<10		mg/kg		10	14-NOV-11
Antimony (Sb)-Total			<0.050		mg/kg		0.05	14-NOV-11
Arsenic (As)-Total			<0.050		mg/kg		0.05	14-NOV-11
Barium (Ba)-Total			<0.050		mg/kg		0.05	14-NOV-11
Beryllium (Be)-Total			<0.30		mg/kg		0.3	14-NOV-11
Bismuth (Bi)-Total			<0.30		mg/kg		0.3	14-NOV-11
Cadmium (Cd)-Total			<0.030		mg/kg		0.03	14-NOV-11
Calcium (Ca)-Total			<10		mg/kg		10	14-NOV-11
Chromium (Cr)-Total			<0.50		mg/kg		0.5	14-NOV-11
Cobalt (Co)-Total			<0.10		mg/kg		0.1	14-NOV-11
Copper (Cu)-Total			<0.050		mg/kg		0.05	14-NOV-11
Lead (Pb)-Total			<0.10		mg/kg		0.1	14-NOV-11
Lithium (Li)-Total			<0.50		mg/kg		0.5	14-NOV-11
Magnesium (Mg)-Total			<3.0		mg/kg		3	14-NOV-11
Manganese (Mn)-Total			<0.050		mg/kg		0.05	14-NOV-11
Molybdenum (Mo)-Total			<0.050		mg/kg		0.05	14-NOV-11
Nickel (Ni)-Total			<0.50		mg/kg		0.5	14-NOV-11
Selenium (Se)-Total			<1.0		mg/kg		1	14-NOV-11
Strontium (Sr)-Total			<0.050		mg/kg		0.05	14-NOV-11
Thallium (Tl)-Total			<0.030		mg/kg		0.03	14-NOV-11
Tin (Sn)-Total			<0.20		mg/kg		0.2	14-NOV-11
Uranium (U)-Total			<0.010		mg/kg		0.01	14-NOV-11

Environmental

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-DRY-MS-VA	**Tissue**							
Batch R2286136								
WG1384091-2 MB								
Vanadium (V)-Total			<0.50		mg/kg		0.5	14-NOV-11
Zinc (Zn)-Total			<0.50		mg/kg		0.5	14-NOV-11
WG1384091-3 MB								
Aluminum (Al)-Total			<10		mg/kg		10	14-NOV-11
Antimony (Sb)-Total			<0.050		mg/kg		0.05	14-NOV-11
Arsenic (As)-Total			<0.050		mg/kg		0.05	14-NOV-11
Barium (Ba)-Total			<0.050		mg/kg		0.05	14-NOV-11
Beryllium (Be)-Total			<0.30		mg/kg		0.3	14-NOV-11
Bismuth (Bi)-Total			<0.30		mg/kg		0.3	14-NOV-11
Cadmium (Cd)-Total			<0.030		mg/kg		0.03	14-NOV-11
Calcium (Ca)-Total			<10		mg/kg		10	14-NOV-11
Chromium (Cr)-Total			<0.50		mg/kg		0.5	14-NOV-11
Cobalt (Co)-Total			<0.10		mg/kg		0.1	14-NOV-11
Copper (Cu)-Total			<0.050		mg/kg		0.05	14-NOV-11
Lead (Pb)-Total			<0.10		mg/kg		0.1	14-NOV-11
Lithium (Li)-Total			<0.50		mg/kg		0.5	14-NOV-11
Magnesium (Mg)-Total			<3.0		mg/kg		3	14-NOV-11
Manganese (Mn)-Total			<0.050		mg/kg		0.05	14-NOV-11
Molybdenum (Mo)-Total			<0.050		mg/kg		0.05	14-NOV-11
Nickel (Ni)-Total			<0.50		mg/kg		0.5	14-NOV-11
Selenium (Se)-Total			<1.0		mg/kg		1	14-NOV-11
Strontium (Sr)-Total			<0.050		mg/kg		0.05	14-NOV-11
Thallium (Tl)-Total			<0.030		mg/kg		0.03	14-NOV-11
Tin (Sn)-Total			<0.20		mg/kg		0.2	14-NOV-11
Uranium (U)-Total			<0.010		mg/kg		0.01	14-NOV-11
Vanadium (V)-Total			<0.50		mg/kg		0.5	14-NOV-11
Zinc (Zn)-Total			<0.50		mg/kg		0.5	14-NOV-11
MOISTURE-TISS-VA	**Tissue**							
Batch R2276151								
WG1375755-1 DUP		**L1067095-19**						
% Moisture		53.9	57.0		%	5.7	20	25-OCT-11
WG1375755-2 DUP		**L1067095-28**						
% Moisture		61.1	62.1		%	1.6	20	25-OCT-11

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MOISTURE-TISS-VA	**Tissue**							
Batch R2276938								
WG1376828-1 DUP		**L1067095-4**						
% Moisture		23.4	19.9		%	16	20	27-OCT-11
WG1376828-2 DUP		**L1067095-29**						
% Moisture		23.9	23.0		%	3.5	20	27-OCT-11
Batch R2277202								
WG1377739-1 DUP		**L1067095-40**						
% Moisture		83.5	84.3		%	1.0	20	28-OCT-11
PAH-T-DRY-SOX-MS-VA	**Tissue**							
Batch R2283990								
WG1377416-3 DUP		**L1067095-80**						
Acenaphthene		<0.050	<0.050	RPD-NA	mg/kg	N/A	50	09-NOV-11
Acenaphthylene		<0.050	<0.050	RPD-NA	mg/kg	N/A	50	09-NOV-11
Anthracene		<0.050	<0.050	RPD-NA	mg/kg	N/A	50	09-NOV-11
Benz(a)anthracene		<0.050	<0.050	RPD-NA	mg/kg	N/A	50	09-NOV-11
Benzo(a)pyrene		<2.0	<1.0	RPD-NA	mg/kg	N/A	50	09-NOV-11
Benzo(b)fluoranthene		<0.050	<0.080	RPD-NA	mg/kg	N/A	50	09-NOV-11
Benzo(g,h,i)perylene		<0.050	<0.080	RPD-NA	mg/kg	N/A	50	09-NOV-11
Benzo(k)fluoranthene		<0.050	<0.050	RPD-NA	mg/kg	N/A	50	09-NOV-11
Chrysene		<0.050	<0.050	RPD-NA	mg/kg	N/A	50	09-NOV-11
Dibenz(a,h)anthracene		<0.050	<0.050	RPD-NA	mg/kg	N/A	50	09-NOV-11
Fluoranthene		<0.050	<0.050	RPD-NA	mg/kg	N/A	50	09-NOV-11
Fluorene		<0.20	<0.20	RPD-NA	mg/kg	N/A	50	09-NOV-11
Indeno(1,2,3-c,d)pyrene		<0.050	<0.050	RPD-NA	mg/kg	N/A	50	09-NOV-11
Naphthalene		<0.050	<0.050	RPD-NA	mg/kg	N/A	50	09-NOV-11
Phenanthrene		<0.050	<0.050	RPD-NA	mg/kg	N/A	50	09-NOV-11
Pyrene		<0.050	<0.050	RPD-NA	mg/kg	N/A	50	09-NOV-11
WG1377416-1 MB								
Acenaphthene			<0.050		mg/kg		0.05	09-NOV-11
Acenaphthylene			<0.050		mg/kg		0.05	09-NOV-11
Anthracene			<0.050		mg/kg		0.05	09-NOV-11
Benz(a)anthracene			<0.050		mg/kg		0.05	09-NOV-11
Benzo(a)pyrene			<0.050		mg/kg		0.05	09-NOV-11
Benzo(b)fluoranthene			<0.050		mg/kg		0.05	09-NOV-11
Benzo(g,h,i)perylene			<0.050		mg/kg		0.05	09-NOV-11
Benzo(k)fluoranthene			<0.050		mg/kg		0.05	09-NOV-11

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PAH-T-DRY-SOX-MS-VA	**Tissue**							
Batch R2283990								
WG1377416-1 MB								
Chrysene			<0.050		mg/kg		0.05	09-NOV-11
Dibenz(a,h)anthracene			<0.050		mg/kg		0.05	09-NOV-11
Fluoranthene			<0.050		mg/kg		0.05	09-NOV-11
Fluorene			<0.050		mg/kg		0.05	09-NOV-11
Indeno(1,2,3-c,d)pyrene			<0.050		mg/kg		0.05	09-NOV-11
Naphthalene			<0.050		mg/kg		0.05	09-NOV-11
Phenanthrene			<0.050		mg/kg		0.05	09-NOV-11
Pyrene			<0.050		mg/kg		0.05	09-NOV-11
Batch R2286093								
WG1381969-3 DUP		**L1067095-75**						
Acenaphthene		<0.050	<0.050	RPD-NA	mg/kg	N/A	50	14-NOV-11
Acenaphthylene		<0.050	<0.050	RPD-NA	mg/kg	N/A	50	14-NOV-11
Anthracene		<0.050	<0.050	RPD-NA	mg/kg	N/A	50	14-NOV-11
Benz(a)anthracene		<0.050	<0.050	RPD-NA	mg/kg	N/A	50	14-NOV-11
Benzo(a)pyrene		<2.0	<3.0	RPD-NA	mg/kg	N/A	50	14-NOV-11
Benzo(b)fluoranthene		<0.050	<0.050	RPD-NA	mg/kg	N/A	50	14-NOV-11
Benzo(g,h,i)perylene		<0.050	<0.060	RPD-NA	mg/kg	N/A	50	14-NOV-11
Benzo(k)fluoranthene		<0.050	<0.050	RPD-NA	mg/kg	N/A	50	14-NOV-11
Chrysene		<0.050	<0.050	RPD-NA	mg/kg	N/A	50	14-NOV-11
Dibenz(a,h)anthracene		<0.050	<0.070	RPD-NA	mg/kg	N/A	50	14-NOV-11
Fluoranthene		<0.050	<0.050	RPD-NA	mg/kg	N/A	50	14-NOV-11
Fluorene		<0.20	<0.20	RPD-NA	mg/kg	N/A	50	14-NOV-11
Indeno(1,2,3-c,d)pyrene		<0.050	<0.050	RPD-NA	mg/kg	N/A	50	14-NOV-11
Naphthalene		<0.050	<0.050	RPD-NA	mg/kg	N/A	50	14-NOV-11
Phenanthrene		<0.050	<0.050	RPD-NA	mg/kg	N/A	50	14-NOV-11
Pyrene		<0.050	<0.050	RPD-NA	mg/kg	N/A	50	14-NOV-11
WG1384639-3 DUP		**L1067095-58**						
Acenaphthene		<0.070	<0.070	RPD-NA	mg/kg	N/A	50	15-NOV-11
Acenaphthylene		<0.080	<0.10	RPD-NA	mg/kg	N/A	50	15-NOV-11
Anthracene		<0.050	<0.070	RPD-NA	mg/kg	N/A	50	15-NOV-11
Benz(a)anthracene		<0.050	<0.060	RPD-NA	mg/kg	N/A	50	15-NOV-11
Benzo(a)pyrene		<4.0	<4.0	RPD-NA	mg/kg	N/A	50	15-NOV-11
Benzo(b)fluoranthene		<0.050	<0.050	RPD-NA	mg/kg	N/A	50	15-NOV-11
Benzo(g,h,i)perylene		<0.070	<0.20	RPD-NA	mg/kg	N/A	50	15-NOV-11
Benzo(k)fluoranthene		<0.050	<0.050	RPD-NA	mg/kg	N/A	50	15-NOV-11

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PAH-T-DRY-SOX-MS-VA	**Tissue**							
Batch R2286093								
WG1384639-3 DUP		**L1067095-58**						
Chrysene		<0.050	<0.080	RPD-NA	mg/kg	N/A	50	15-NOV-11
Dibenz(a,h)anthracene		<0.70	<0.60	RPD-NA	mg/kg	N/A	50	15-NOV-11
Fluoranthene		<0.050	<0.050	RPD-NA	mg/kg	N/A	50	15-NOV-11
Fluorene		<0.40	<0.60	RPD-NA	mg/kg	N/A	50	15-NOV-11
Indeno(1,2,3-c,d)pyrene		<0.050	<0.20	RPD-NA	mg/kg	N/A	50	15-NOV-11
Naphthalene		<0.10	<0.20	RPD-NA	mg/kg	N/A	50	15-NOV-11
Phenanthrene		<0.080	<0.20	RPD-NA	mg/kg	N/A	50	15-NOV-11
Pyrene		<0.050	<0.050	RPD-NA	mg/kg	N/A	50	15-NOV-11
WG1381969-1 MB								
Acenaphthene			<0.050		mg/kg		0.05	14-NOV-11
Acenaphthylene			<0.050		mg/kg		0.05	14-NOV-11
Anthracene			<0.050		mg/kg		0.05	14-NOV-11
Benz(a)anthracene			<0.050		mg/kg		0.05	14-NOV-11
Benzo(a)pyrene			<0.050		mg/kg		0.05	14-NOV-11
Benzo(b)fluoranthene			<0.050		mg/kg		0.05	14-NOV-11
Benzo(g,h,i)perylene			<0.050		mg/kg		0.05	14-NOV-11
Benzo(k)fluoranthene			<0.050		mg/kg		0.05	14-NOV-11
Chrysene			<0.050		mg/kg		0.05	14-NOV-11
Dibenz(a,h)anthracene			<0.050		mg/kg		0.05	14-NOV-11
Fluoranthene			<0.050		mg/kg		0.05	14-NOV-11
Fluorene			<0.050		mg/kg		0.05	14-NOV-11
Indeno(1,2,3-c,d)pyrene			<0.050		mg/kg		0.05	14-NOV-11
Naphthalene			<0.050		mg/kg		0.05	14-NOV-11
Phenanthrene			<0.050		mg/kg		0.05	14-NOV-11
Pyrene			<0.050		mg/kg		0.05	14-NOV-11
WG1384639-1 MB								
Acenaphthene			<0.050		mg/kg		0.05	13-NOV-11
Acenaphthylene			<0.050		mg/kg		0.05	13-NOV-11
Anthracene			<0.050		mg/kg		0.05	13-NOV-11
Benz(a)anthracene			<0.050		mg/kg		0.05	13-NOV-11
Benzo(a)pyrene			<0.050		mg/kg		0.05	13-NOV-11
Benzo(b)fluoranthene			<0.050		mg/kg		0.05	13-NOV-11
Benzo(g,h,i)perylene			<0.050		mg/kg		0.05	13-NOV-11
Benzo(k)fluoranthene			<0.050		mg/kg		0.05	13-NOV-11
Chrysene			<0.050		mg/kg		0.05	13-NOV-11

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PAH-T-DRY-SOX-MS-VA	**Tissue**							
Batch R2286093								
WG1384639-1 MB								
Dibenz(a,h)anthracene			<0.050		mg/kg		0.05	13-NOV-11
Fluoranthene			<0.050		mg/kg		0.05	13-NOV-11
Fluorene			<0.050		mg/kg		0.05	13-NOV-11
Indeno(1,2,3-c,d)pyrene			<0.050		mg/kg		0.05	13-NOV-11
Naphthalene			<0.050		mg/kg		0.05	13-NOV-11
Phenanthrene			<0.050		mg/kg		0.05	13-NOV-11
Pyrene			<0.050		mg/kg		0.05	13-NOV-11

Quality Control Report

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
DUP-H	Duplicate results outside ALS DQO, due to sample heterogeneity.
DUP-H,J	Duplicate results outside ALS DQO, due to sample heterogeneity. Duplicate results and limits are expressed in terms of absolute difference.
J	Duplicate results and limits are expressed in terms of absolute difference.
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Hold Time Exceedances:

ALS Product Description	Sample ID	Sampling Date	Date Processed	Rec. HT	Actual HT	Units	Qualifier
Physical Tests							
Moisture content							
	1	14-SEP-11	08-OCT-11 11:32	14	24	days	EHTR
	5	14-SEP-11	08-OCT-11 11:32	14	24	days	EHTR
	6	14-SEP-11	02-NOV-11 05:01	14	49	days	EHTR
	13	14-SEP-11	08-OCT-11 11:32	14	24	days	EHTR
	17	14-SEP-11	08-OCT-11 11:32	14	24	days	EHTR
	21	15-SEP-11	08-OCT-11 11:32	14	23	days	EHTR
	26	15-SEP-11	08-OCT-11 11:32	14	23	days	EHTR
	31	15-SEP-11	08-OCT-11 11:32	14	23	days	EHTR
	35	15-SEP-11	02-NOV-11 05:01	14	48	days	EHTR
	37	15-SEP-11	08-OCT-11 11:32	14	23	days	EHTR
	38	15-SEP-11	08-OCT-11 11:32	14	23	days	EHTR
	45	15-SEP-11	08-OCT-11 11:32	14	23	days	EHTR
	46	15-SEP-11	08-OCT-11 11:32	14	23	days	EHTR
	49	15-SEP-11	08-OCT-11 11:32	14	23	days	EHTR
	50	15-SEP-11	08-OCT-11 11:32	14	23	days	EHTR
	52	16-SEP-11	08-OCT-11 11:32	14	22	days	EHTR
	53	16-SEP-11	08-OCT-11 11:32	14	22	days	EHTR
	54	16-SEP-11	08-OCT-11 11:32	14	22	days	EHTR
	55	17-SEP-11	08-OCT-11 11:46	14	21	days	EHTR
	59	17-SEP-11	08-OCT-11 11:32	14	21	days	EHTR
	61	17-SEP-11	08-OCT-11 11:32	14	21	days	EHTR
	66	17-SEP-11	08-OCT-11 11:32	14	21	days	EHTR
	67	17-SEP-11	08-OCT-11 11:32	14	21	days	EHTR
	68	17-SEP-11	08-OCT-11 11:32	14	21	days	EHTR
	70	17-SEP-11	08-OCT-11 11:32	14	21	days	EHTR
	71	17-SEP-11	08-OCT-11 11:32	14	21	days	EHTR
	72	17-SEP-11	08-OCT-11 11:32	14	21	days	EHTR
	73	17-SEP-11	13-OCT-11 06:17	14	26	days	EHTR
Metals							
Mercury in Soil by CVAFS							
	6	14-SEP-11	01-NOV-11 08:44	28	48	days	EHT
	35	15-SEP-11	02-NOV-11 18:06	28	48	days	EHT
Polycyclic Aromatic Hydrocarbons							
PAH - Rotary Extraction (Hexane/Acetone)							
	1	14-SEP-11	08-OCT-11 12:35	14	24	days	EHTR
	5	14-SEP-11	08-OCT-11 12:35	14	24	days	EHTR
	6	14-SEP-11	01-NOV-11 21:30	14	48	days	EHTR
	13	14-SEP-11	08-OCT-11 12:35	14	24	days	EHTR
	17	14-SEP-11	08-OCT-11 12:35	14	24	days	EHTR
	21	15-SEP-11	08-OCT-11 12:35	14	23	days	EHTR
	26	15-SEP-11	08-OCT-11 12:35	14	23	days	EHTR
	31	15-SEP-11	08-OCT-11 12:35	14	23	days	EHTR
	35	15-SEP-11	01-NOV-11 21:30	14	47	days	EHTR
	37	15-SEP-11	08-OCT-11 12:35	14	23	days	EHTR
	38	15-SEP-11	08-OCT-11 12:35	14	23	days	EHTR
	45	15-SEP-11	08-OCT-11 12:35	14	23	days	EHTR
	46	15-SEP-11	08-OCT-11 12:35	14	23	days	EHTR
	49	15-SEP-11	08-OCT-11 12:35	14	23	days	EHTR
	50	15-SEP-11	08-OCT-11 12:35	14	23	days	EHTR
	52	16-SEP-11	08-OCT-11 12:35	14	22	days	EHTR
	53	16-SEP-11	08-OCT-11 12:35	14	22	days	EHTR
	54	16-SEP-11	08-OCT-11 12:35	14	22	days	EHTR
	55	17-SEP-11	08-OCT-11 15:42	14	21	days	EHTR
	59	17-SEP-11	08-OCT-11 12:35	14	21	days	EHTR
	61	17-SEP-11	08-OCT-11 12:35	14	21	days	EHTR
	66	17-SEP-11	08-OCT-11 12:35	14	21	days	EHTR

Hold Time Exceedances:

ALS Product Description	Sample ID	Sampling Date	Date Processed	Rec. HT	Actual HT	Units	Qualifier
Polycyclic Aromatic Hydrocarbons							
PAH - Rotary Extraction (Hexane/Acetone)							
	67	17-SEP-11	08-OCT-11 12:35	14	21	days	EHTR
	68	17-SEP-11	08-OCT-11 12:35	14	21	days	EHTR
	70	17-SEP-11	08-OCT-11 12:35	14	21	days	EHTR
	71	17-SEP-11	08-OCT-11 12:35	14	21	days	EHTR
	72	17-SEP-11	08-OCT-11 12:35	14	21	days	EHTR
	73	17-SEP-11	12-OCT-11 23:24	14	25	days	EHTR

Legend & Qualifier Definitions:

EHTR-FM: Exceeded ALS recommended hold time prior to sample receipt. Field Measurement recommended.
EHTR: Exceeded ALS recommended hold time prior to sample receipt.
EHTL: Exceeded ALS recommended hold time prior to analysis. Sample was received less than 24 hours prior to expiry.
EHT: Exceeded ALS recommended hold time prior to analysis.
Rec. HT: ALS recommended hold time (see units).

Notes*:
Where actual sampling date is not provided to ALS, the date (& time) of receipt is used for calculation purposes.
Where actual sampling time is not provided to ALS, the earlier of 12 noon on the sampling date or the time (& date) of receipt is used for calculation purposes. Samples for L1067095 were received on 04-OCT-11 12:42.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

ALS Environmental

Chain of Custody / Analytical Request Form

Canada Toll Free: 1 800 668 9878

www.alsglobal.com

COC # ____________

Report To	
Company:	Golder Associates Ltd.
Contact:	Audrey Wagenaar
Address:	#500 - 4260 Still Creek Drive, Burnaby, BC, V5C 6C6
Phone:	604-297-2036 Fax: 604-298-5253
Invoice To	Same as Report ? ☑ Yes ☐ No
Hardcopy of Invoice with Report?	☑ Yes ☐ No
Company:	
Contact:	
Address:	
Phone:	

L1067095-COFC

Report Format / Distribution	
☑ Standard ☐ Other	
☑ PDF ☑ Excel ☐ Digital ☐ Fax	
Email 1:	audrey_wagenaar@golder.com
Email 2:	lilly_cesh@golder.com
Email 3:	damian_panayi@golder.com
Client / Project Information	
Job #:	11-1365-0001-2120
PO / AFE:	
LSD:	Gahcho Kue Project
Quote #:	
ALS Contact:	Sampler:

Service Requested (Rush for routine analysis subject to availability)

- ◉ Regular (Standard Turnaround Times - Business Days)
- ○ Priority (2-4 Business Days) - 50% Surcharge - Contact ALS to Confirm TAT
- ○ Emergency (1-2 Bus. Days) - 100% Surcharge - Contact ALS to Confirm TAT
- ○ Same Day or Weekend Emergency - Contact ALS to Confirm TAT

Analysis Request

Please indicate below Filtered, Preserved or both (F, P, F/P)

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	% moisture	Low detection Total metal-CC	PAH	Number of Containers
	2011-GK-S-01	14-Sep-11		SOIL	X	X	X	2
	2011-GK-B-01	14-Sep-11		Tissue	X	X	X	1
	2011-GK-LV-01	14-Sep-11		Tissue	X	X	X	1
	2011-GK-L-01	14-Sep-11		Tissue	X	X	X	1
	2011-GK-S-02	14-Sep-11		Soil	X	X	X	2
	2011-GK-S-02-D	14-Sep-11		~~Tissue~~ Soil	X	X	X	2
	2011-GK-B-02	14-Sep-11		Tissue	X	X	X	1
	2011-GK-B-02-D	14-Sep-11		Tissue	X	X	X	2
	2011-GK-LV-02	14-Sep-11		Tissue	X	X	X	1
	2011-GK-LV-02-D	14-Sep-11		Tissue	X	X	X	1
	2011-GK-L-02	14-Sep-11		Tissue	X	X	X	1
	2011-GK-L-02-D	14-Sep-11		Tissue	X	X	X	1

Special Instructions / Regulations with water or land use (CCME-Freshwater Aquatic Life/BC CSR - Commercial/AB Tier 1 - Natural, etc) / Hazardous Details

Please include boron in total metals analysis

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.

By the use of this form the user acknowledges and agrees with the Terms and Conditions as provided on a separate Excel tab.

Also provided on another Excel tab are the ALS location addresses, phone numbers and sample container / preservation / holding time table for common analyses.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by:	Date (dd-mmm-yy)	Time (hh-mm)	Received by:	Date:	Time:	Temperature:	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF
Anne Croteau	3-Oct-11		[signature]	3-Oct-11	1645	6 °C				

RD OCT 07 11:20

GENF 18.01 Front

ALS

Chain of Custody / Analytical Request Form

Canada Toll Free: 1 800 668 9878

www.alsglobal.com

COC #:

Report To

Company:	Golder Associates Ltd.
Contact:	Audrey Wagenaar
Address:	#500 - 4260 Still Creek Drive, Burnaby, BC, V5C 6C6
Phone:	604-297-2036 Fax: 604-298-5253

Invoice To Same as Report? ☑ Yes ☐ No

Hardcopy of Invoice with Report? ☑ Yes ☐ No

Company:

Contact:

Address:

Phone:

L1067095-COFC

Report Format / Distribution

☑ Standard ☐ Other

☑ PDF ☑ Excel ☐ Digital ☐ Fax

Email 1: audrey_wagenaar@golder.com

Email 2: lilly_cesh@golder.com

Email 3: damian_panayi@golder.com

Client / Project Information

Job #: 11-1365-0001-2120

PO / AFE:

LSD: Gahcho Kue Project

Quote #:

ALS Contact: Sampler:

Service Requested (Rush for routine analysis subject to availability)

◉ Regular (Standard Turnaround Times - Business Days)

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○ Emergency (1-2 Bus. Days) - 100% Surcharge - Contact ALS to Confirm TAT

○ Same Day or Weekend Emergency - Contact ALS to Confirm TAT

Analysis Request

Please indicate below Filtered, Preserved or both (F, P, F/P)

Lab Work Order # (lab use only) / Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	% moisture	Low detection Total metal-CC	PAH	Number of Containers
	2011-GK-S-03	14-Sep-11		SOIL	X	X	X	2
	2011-GK-B-03	14-Sep-11		Tissue	X	X	X	2
	2011-GK-LV-03	14-Sep-11		Tissue	X	X	X	1
	2011-GK-L-03	14-Sep-11		Tissue	X	X	X	1
	2011-GK-S-04	14-Sep-11		SOIL	X	X	X	2
	2011-GK-B-04	14-Sep-11		Tissue	X	X	X	1
	2011-GK-LV-04	14-Sep-11		Tissue	X	X	X	1
	2011-GK-L-04	14-Sep-11		Tissue	X	X	X	1
	2011-GK-S-05	15-Sep-11		SOIL	X	X	X	2
	2011-GK-B-05	15-Sep-11		Tissue	X	X	X	1
	2011-GK-LV-05	15-Sep-11		Tissue	X	X	X	1
	2011-GK-L-05	15-Sep-11		Tissue	X	X	X	1

Special Instructions / Regulations with water or land use (CCME-Freshwater Aquatic Life/BC CSR - Commercial/AB Tier 1 - Natural, etc) / Hazardous Details

Please include boron in total metals analysis

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Released by:	Date (dd-mmm-yy)	Time (hh-mm)	Received by:	Date:	Time:	Temperature:	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF
Anne Croteau	3-Oct-11		KD	OCT 07	11:20	6 °C				

AL

Chain of Custody / Analytical Request Form

Canada Toll Free: 1 800 668 9878

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COC # ____________

Report

Company:	Golder Associates Ltd.
Contact:	Audrey Wagenaar
Address:	#500 - 4260 Still Creek Drive
	Burnaby, BC, V5C 6C6
Phone:	604-297-2036 Fax: 604-298-5253
Invoice To	Same as Report ? ☑ Yes ☐ No
Hardcopy of Invoice with Report?	☑ Yes ☐ No
Company:	
Contact:	
Address:	
Phone:	

L1067095-COFC

Report Format / Distribution

☑ Standard ☐ Other

☑ PDF ☑ Excel ☐ Digital ☐ Fax

Email 1: audrey_wagenaar@golder.com

Email 2: lilly_cesh@golder.com

Email 3: damian_panayi@golder.com

Client / Project Information

Job #: 11-1365-0001-2120

PO / AFE:

LSD: Gahcho Kue Project

Quote #:

ALS Contact: Sampler:

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○ Emergency (1-2 Bus. Days) - 100% Surcharge - Contact ALS to Confirm TAT

○ Same Day or Weekend Emergency - Contact ALS to Confirm TAT

Analysis Request

Please indicate below Filtered, Preserved or both (F, P, F/P)

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	% moisture	Low detection Total metal-CC	PAH	Number of Containers
	2011-GK-G-05	15-Sep-11		Tissue	X	X	X	1
	2011-GK-S-06	15-Sep-11		Soil	X	X	X	2
	2011-GK-B-06	15-Sep-11		Tissue	X	X	X	1
	2011-GK-LV-06	15-Sep-11		Tissue	X	X	X	1
	2011-GK-L-06	15-Sep-11		Tissue	X	X	X	1
	2011-GK-G-06	15-Sep-11		Tissue	X	X	X	1
	2011-GK-S-07	15-Sep-11		Soil	X	X	X	2
	2011-GK-B-07	15-Sep-11		Tissue	X	X	X	1
	2011-GK-LV-07	15-Sep-11		Tissue	X	X	X	1
	2011-GK-L-07	15-Sep-11		Tissue	X	X	X	1
	2011-GK-S-08	15-Sep-11		Tissue	X	X	X	2
	2011-GK-G-08	15-Sep-11		Tissue	X	X	X	1

Special Instructions / Regulations with water or land use (CCME-Freshwater Aquatic Life/BC CSR - Commercial/AB Tier 1 - Natural, etc) / Hazardous Details

Please include boron in total metals analysis

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SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by:	Date (dd-mmm-yy)	Time (hh-mm)	Received by:	Date:	Time:	Temperature:	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF
Anne Croteau	3-Oct-11		RD	Oct 07	11:20	6 °C				

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COC #

Report To

Company: Golder Associates Ltd.

Contact: Audrey Wagenaar

Address: #500 - 4260 Still Creek Drive, Burnaby, BC, V5C 6C6

Phone: 604-297-2036 Fax: 604-298-5253

Invoice To Same as Report ? ☑ Yes ☐ No

Hardcopy of Invoice with Report? ☑ Yes ☐ No

Company:

Contact:

Address:

Phone:

L1067095-COFC

Report Format / Distribution

☑ Standard ☐ Other

☑ PDF ☑ Excel ☐ Digital ☐ Fax

Email 1: audrey_wagenaar@golder.com

Email 2: lilly_cesh@golder.com

Email 3: damian_panayi@golder.com

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Job #: 11-1365-0001-2120

PO / AFE:

LSD: Gahcho Kue Project

Quote #:

ALS Contact:

Sampler:

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○ Emergency (1-2 Bus. Days) - 100% Surcharge - Contact ALS to Confirm TAT

○ Same Day or Weekend Emergency - Contact ALS to Confirm TAT

Analysis Request

Please indicate below Filtered, Preserved or both (F, P, F/P)

Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	% moisture	Low detection Total metal-CC	PAH	Number of Containers
2011-GK-S-09	15-Sep-11		Soil	X	X	X	2
2011-GK-S-09-D	15-Sep-11		Soil	X	X	X	2
2011-GK-B-09	15-Sep-11		Tissue	X	X	X	1
2011-GK-B-09-D	15-Sep-11		Tissue	X	X	X	1
2011-GK-L-09	15-Sep-11		Tissue	X	X	X	1
2011-GK-L-09-D	15-Sep-11		Tissue	X	X	X	1
2011-GK-LV-09	15-Sep-11		Tissue	X	X	X	1
2011-GK-LV-09-D	15-Sep-11		Tissue	X	X	X	1
2011-GK-S-10	15-Sep-11		Soil	X	X	X	2
2011-GK-S-10-D	15-Sep-11		Soil	X	X	X	2
2011-GK-G-10	15-Sep-11		Tissue	X	X	X	1
2011-GK-G-10-D	15-Sep-11		Tissue	X	X	X	1

Special Instructions / Regulations with water or land use (CCME-Freshwater Aquatic Life/BC CSR - Commercial/AB Tier 1 - Natural, etc) / Hazardous Details

Please include boron in total metals analysis

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Also provided on another Excel tab are the ALS location addresses, phone numbers and sample container / preservation / holding time table for common analyses.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by: Anne Croteau	Date (dd-mmm-yy) 3-Oct-11	Time (hh-mm)	Received by: RD	Date: Oct 07	Time: 11:20	Temperature: 6 °C	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF

ALS

Chain of Custody / Analytical Request Form
Canada Toll Free: 1 800 668 9878
www.alsglobal.com

COC # ______

Report To
Company: Golder Associates Ltd.
Contact: Audrey Wagenaar
Address: #500 - 4260 Still Creek Drive
Burnaby, BC, V5C 6C6
Phone: 604-297-2036 Fax: 604-298-5253

Invoice To Same as Report ? ☑ Yes ☐ No
Hardcopy of Invoice with Report? ☑ Yes ☐ No
Company:
Contact:
Address:
Phone:

L1067095-COFC

Report Format / Distribution
☑ Standard ☐ Other
☑ PDF ☑ Excel ☐ Digital ☐ Fax
Email 1: audrey_wagenaar@golder.com
Email 2: lilly_cesh@golder.com
Email 3: damian_panayi@golder.com

Client / Project Information
Job #: 11-1365-0001-2120
PO / AFE:
LSD: Gahcho Kue Project

Quote #:

ALS Contact:
Sampler:

Service Requested (Rush for routine analysis subject to availability)
◉ Regular (Standard Turnaround Times - Business Days)
○ Priority (2-4 Business Days) - 50% Surcharge - Contact ALS to Confirm TAT
○ Emergency (1-2 Bus. Days) - 100% Surcharge - Contact ALS to Confirm TAT
○ Same Day or Weekend Emergency - Contact ALS to Confirm TAT

Analysis Request
Please indicate below Filtered, Preserved or both (F, P, F/P)

Lab Work Order # (lab use only) / Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	% moisture	Low detection Total metal-CC	PAH									Number of Containers
	2011-GK-S-11	15-Sep-11		Soil	X	X	X									2
	2011-GK-S-12	15-Sep-11		Soil	X	X	X									2
	2011-GK-G-12	15-Sep-11		Tissue	X	X	X									1
	2011-GK-S-13	16-Sep-11		Soil	X	X	X									2
	2011-GK-S-14	16-Sep-11		Soil	X	X	X									2
	2011-GK-S-16	16-Sep-11		Soil	X	X	X									2
	2011-GK-S-17	17-Sep-11		Soil	X	X	X									2
	2011-GK-B-17	17-Sep-11		Tissue	X	X	X									1
	2011-GK-L-17	17-Sep-11		Tissue	X	X	X									1
	2011-GK-LV-17	17-Sep-11		Tissue	X	X	X									1
	2011-GK-S-18	17-Sep-11		Soil	X	X	X									2
	2011-GK-G-18	17-Sep-11		Tissue	X	X	X									1

Special Instructions / Regulations with water or land use (CCME-Freshwater Aquatic Life/BC CSR - Commercial/AB Tier 1 - Natural, etc) / Hazardous Details

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SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by: Anne Croteau	Date (dd-mmm-yy) 3-Oct-11	Time (hh-mm)	Received by: [signature]	Date: Oct 07	Time: 1120	Temperature: 6 °C	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF

Chain of Custody / Analytical Request Form
Canada Toll Free: 1 800 668 9878
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COC # ______

Report To	
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Address:	#500 - 4260 Still Creek Drive, Burnaby, BC, V5C 6C6
Phone:	604-297-2036 Fax: 604-298-5253
Invoice To Same as Report ?	☑ Yes ☐ No
Hardcopy of Invoice with Report?	☑ Yes ☐ No
Company:	
Contact:	
Address:	
Phone:	

L1067095-COFC

Report Format / Distribution	
☑ Standard ☐ Other	
☑ PDF ☑ Excel ☐ Digital ☐ Fax	
Email 1:	audrey_wagenaar@golder.com
Email 2:	lilly_cesh@golder.com
Email 3:	damian_panayi@golder.com
Client / Project Information	
Job #:	11-1365-0001-2120
PO / AFE:	
LSD:	Gahcho Kue Project
Quote #:	
ALS Contact:	Sampler:

Service Requested (Rush for routine analysis subject to availability)
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- ○ Emergency (1-2 Bus. Days) - 100% Surcharge - Contact ALS to Confirm TAT
- ○ Same Day or Weekend Emergency - Contact ALS to Confirm TAT

Analysis Request
Please indicate below Filtered, Preserved or both (F, P, F/P)

Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	% moisture	Low detection Total metal-CC	PAH	Number of Containers
2011-GK-S-19	17-Sep-11		Soil	X	X	X	2
2011-GK-LV-19	17-Sep-11		Tissue	X	X	X	1
2011-GK-L-19	17-Sep-11		Tissue	X	X	X	1
2011-GK-G-19	17-Sep-11		Tissue	X	X	X	1
2011-GK-B-19	17-Sep-11		Tissue	X	X	X	1
2011-GK-S-20	17-Sep-11		Soil	X	X	X	2
2011-GK-S-20-D	17-Sep-11		Soil	X	X	X	2
2011-GK-S-21	17-Sep-11		Soil	X	X	X	2
2011-GK-G-21	17-Sep-11		Tissue	X	X	X	1
2011-GK-S-22	17-Sep-11		Soil	X	X	X	2
2011-GK-S-23	17-Sep-11		Soil	X	X	X	2

Special Instructions / Regulations with water or land use (CCME-Freshwater Aquatic Life/BC CSR - Commercial/AB Tier 1 - Natural, etc) / Hazardous Details

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SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by: Anne Croteau	Date (dd-mmm-yy) 3-Oct-11	Time (hh-mm)	Received by: RD	Date: Oct 07	Time: 1120	Temperature: 6 °C	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF

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Report To	
Company:	Golder Associates Ltd.
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Phone:	604-297-2036 Fax: 604-298-5253
Invoice To	Same as Report ? ☑ Yes ☐ No
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Company:	
Contact:	
Address:	
Phone:	

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Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	% moisture	Low detection Total metal-CC	PAH	Number of Containers
	2011-GK-S-24	17-Sep-11		Soil	X	X	X	2
	2011-GK-S-24-D	17-Sep-11		Soil	X	X	X	2
	2011-GK-G-24	17-Sep-11		Tissue	X	X	X	1
	2011-GK-G-24-D	17-Sep-11		Tissue	X	X	X	1
	ANTS-GK	16-Sep-11		Tissue	X	X	X	1
	ANTS-GK-BAIT (jam)	16-Sep-11		Tissue	X	X	X	1
	ANTS-GK	15-Sep-11		Tissue	X	X	X	1

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Released by:	Date (dd-mmm-yy)	Time (hh-mm)	Received by:	Date:	Time:	Temperature:	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF
Anne Croteau	3-Oct-11		RS	04 07	11:20	6 °C				

APPENDIX VIII

WILDLIFE EXPOSURE DOSE ESTIMATES

Table VIII-1 Estimated Daily Intake (EDI) of COCs from Various Food Items for Mammalian Receptors Based on 100% Soil and Sediment Bioaccessibility - Baseline and Project Phases

COC	Caribou					Grizzly Bear					
	Grass	Leaves	Lichen	Soil	Water	Berries	Caribou	Invertebrates	Medium Herbivore (mammal)	Soil	Water
Baseline Phase											
arsenic	0.00062	0.000378	0.005055	0.001478	7.62E-06	0.002734	1.93E-05	0.00023809	1.84E-05	0.000835	7.45E-06
cadmium	0.001287	0.001907	0.001088	0.000197	1.19E-06	0.003459	3.15E-06	0.0019172	0.000227	0.000111	1.16E-06
chromium	0.026438	0.029827	0.093084	0.027579	9.99E-06	0.02253	0.001246	0.0071562	0.004527	0.015591	9.77E-06
copper	0.052065	0.048184	0.040814	0.01098	8.00E-05	0.083039	0.001947	0.0047951	0.018912	0.006207	7.82E-05
iron	1.9378	2.7542	7.3729	9.0659	0.003685	4.2791	0.54098	1.6913	0.000872	5.1252	0.003604
manganese	1.5103	2.6952	1.5905	0.068072	0.000356	5.02	0.003002	0.00077928	0.002367	0.038483	0.000348
nickel	0.032393	0.055425	0.067343	0.067928	2.90E-05	0.058841	0.001713	0.001152	0.009606	0.038401	2.84E-05
selenium	0.00454	0.001514	0.00908	0.000381	2.00E-06	0.002735	0.000298	0.00043266	0.001011	0.000215	1.95E-06
uranium	0.001097	0.000681	0.001559	0.000898	9.87E-07	0.00123	1.08E-06	4.80E-05	2.25E-09	0.000508	9.65E-07
zinc	0.38907	0.94355	0.50772	0.021548	0.00015	0.58827	0.23831	0.13796	0.16963	0.012182	0.000147
Project Phase											
arsenic	0.000734	0.00049	0.005449	0.0015	4.64E-05	0.002936	2.10E-05	0.0002416	1.87E-05	0.000848	4.53E-05
cadmium	0.005115	0.008232	0.0178	0.000798	1.47E-06	0.010095	2.25E-05	0.0077807	0.000922	0.000451	1.44E-06
chromium	0.037446	0.038538	0.11924	0.02946	2.36E-05	0.038006	0.001582	0.0076444	0.004836	0.016654	2.31E-05
copper	0.056645	0.051538	0.046694	0.011341	9.20E-05	0.090329	0.002129	0.0049527	0.019534	0.006411	9.00E-05
iron	3.7728	4.5624	11.207	9.4672	0.005526	7.4665	0.74269	1.7662	0.001312	5.3521	0.005404
manganese	1.6498	2.9365	1.7765	0.073918	0.000851	5.3094	0.003296	0.00084621	0.00257	0.041788	0.000833
nickel	0.052857	0.07701	0.10357	0.070678	7.63E-05	0.091923	0.002336	0.0011987	0.009995	0.039956	7.46E-05
selenium	0.005006	0.001961	0.009975	0.000393	3.52E-06	0.003541	0.000333	0.00044608	0.001043	0.000222	3.44E-06
uranium	0.001195	0.000776	0.001831	0.000919	2.32E-05	0.001403	1.21E-06	4.91E-05	2.49E-09	0.000519	2.27E-05
zinc	0.41	0.99779	0.54726	0.022507	0.000216	0.61664	0.25313	0.1441	0.17718	0.012724	0.000212

Notes:

All units in mg/kg/day (milligrams per kilograms per day).
COC = Chemical of Concern.

Table VIII-1 Estimated Daily Intake (EDI) of COCs from Various Food Items for Mammalian Receptors Based on 100% Soil and Sediment Bioaccessibility - Baseline and Project Phases (continued)

COC	Shrew				Medium Carnivore					
	Grass	Invertebrates	Soil	Water	Berries	Caribou	Shrew	Small Herbivore (mammal)	Soil	Water
Baseline Phase										
arsenic	0.001964	0.04792	0.037258	2.20E-05	0.00035	2.38E-05	0.000166	0.0001663	0.002347	1.10E-05
cadmium	0.004072	0.38587	0.004957	3.42E-06	0.000443	3.88E-06	0.002052	0.0020515	0.000312	1.72E-06
chromium	0.083682	1.4403	0.69535	2.88E-05	0.002885	0.001534	0.04087	0.04087	0.043794	1.45E-05
copper	0.1648	0.96511	0.27684	0.000231	0.010635	0.002397	0.17076	0.17076	0.017436	0.000116
iron	6.1336	340.41	228.58	0.010634	0.54801	0.66605	0.000453	0.0010427	14.397	0.00533
manganese	4.7804	0.15684	1.7163	0.001027	0.64291	0.003696	0.021368	0.021368	0.1081	0.000515
nickel	0.10253	0.23187	1.7127	8.38E-05	0.007536	0.00211	0.086728	0.086728	0.10787	4.20E-05
selenium	0.014371	0.08708	0.0096	5.77E-06	0.00035	0.000367	0.009132	0.0091319	0.000605	2.89E-06
uranium	0.003473	0.0096596	0.022651	2.85E-06	0.000158	1.34E-06	2.82E-10	2.58E-09	0.001427	1.43E-06
zinc	1.2315	27.767	0.54331	0.000433	0.075339	0.29341	1.5316	1.5316	0.034218	0.000217
Project Phase										
arsenic	0.002324	0.048626	0.037808	0.000134	0.000376	2.59E-05	0.000169	0.0001688	0.002381	6.71E-05
cadmium	0.01619	1.566	0.020117	4.25E-06	0.001293	2.77E-05	0.008326	0.0083258	0.001267	2.13E-06
chromium	0.11853	1.5386	0.74278	6.81E-05	0.004867	0.001948	0.043658	0.043658	0.046782	3.41E-05
copper	0.1793	0.99682	0.28594	0.000265	0.011568	0.002621	0.17637	0.17637	0.018009	0.000133
iron	11.942	355.48	238.7	0.015945	0.95622	0.9144	0.000478	0.0015368	15.034	0.007992
manganese	5.222	0.17032	1.8637	0.002457	0.67996	0.004058	0.023204	0.023204	0.11738	0.001231
nickel	0.16731	0.24126	1.782	0.00022	0.011772	0.002876	0.09024	0.09024	0.11224	0.00011
selenium	0.015846	0.089783	0.009898	1.02E-05	0.000454	0.00041	0.009415	0.0094153	0.000623	5.09E-06
uranium	0.003781	0.0098767	0.02316	6.71E-05	0.00018	1.50E-06	2.91E-10	2.85E-09	0.001459	3.36E-05
zinc	1.2978	29.002	0.56747	0.000625	0.078972	0.31165	1.5997	1.5997	0.03574	0.000313

Notes:

All units in mg/kg/day (milligrams per kilograms per day).
COC = Chemical of Concern.

Table VIII-1 Estimated Daily Intake (EDI) of COCs from Various Food Items for Mammalian Receptors Based on 100% Soil and Sediment Bioaccessibility - Baseline and Project Phases (continued)

COC	Medium Herbivore					Musk Ox				
	Berries	Grass	Leaves	Soil	Water	Grass	Leaves	Lichen	Soil	Water
Baseline Phase										
arsenic	0.00488	0.002001	0.00122	0.002102	1.25E-05	0.000745	0.000454	0.003035	0.000783	7.19E-06
cadmium	0.006175	0.004149	0.006151	0.00028	1.95E-06	0.001545	0.00229	0.000653	0.000104	1.12E-06
chromium	0.040214	0.085257	0.096188	0.039237	1.64E-05	0.031755	0.035816	0.055886	0.014611	9.42E-06
copper	0.14822	0.1679	0.15538	0.015622	0.000131	0.062537	0.057857	0.024504	0.005817	7.54E-05
iron	7.6377	6.2491	8.8819	12.898	0.006053	2.3275	3.3072	4.4265	4.8031	0.003475
manganese	8.9602	4.8704	8.6916	0.096848	0.000585	1.814	3.2363	0.9549	0.036064	0.000336
nickel	0.10503	0.10446	0.17874	0.096643	4.77E-05	0.038908	0.066553	0.040431	0.035988	2.74E-05
selenium	0.004881	0.014641	0.004881	0.000542	3.28E-06	0.005453	0.001817	0.005452	0.000202	1.88E-06
uranium	0.002196	0.003538	0.002196	0.001278	1.62E-06	0.001318	0.000818	0.000936	0.000476	9.31E-07
zinc	1.05	1.2547	3.0428	0.030658	0.000246	0.46732	1.133	0.30482	0.011416	0.000141
Project Phase										
arsenic	0.00524	0.002368	0.001582	0.002133	7.62E-05	0.000882	0.000589	0.003271	0.000794	4.37E-05
cadmium	0.018019	0.016494	0.026546	0.001135	2.42E-06	0.006144	0.009885	0.010687	0.000423	1.39E-06
chromium	0.067836	0.12076	0.12428	0.041913	3.88E-05	0.044977	0.046275	0.07159	0.015608	2.23E-05
copper	0.16123	0.18267	0.1662	0.016135	0.000151	0.068038	0.061884	0.028034	0.006008	8.68E-05
iron	13.327	12.167	14.713	13.469	0.009077	4.5316	5.4783	6.7283	5.0157	0.005211
manganese	9.4767	5.3203	9.4698	0.10517	0.001398	1.9816	3.5261	1.0666	0.039162	0.000803
nickel	0.16407	0.17046	0.24834	0.10056	0.000125	0.063488	0.092471	0.062183	0.037445	7.20E-05
selenium	0.006321	0.016145	0.006324	0.000559	5.78E-06	0.006013	0.002355	0.005989	0.000208	3.32E-06
uranium	0.002503	0.003852	0.002504	0.001307	3.82E-05	0.001435	0.000932	0.001099	0.000487	2.19E-05
zinc	1.1006	1.3222	3.2177	0.032021	0.000355	0.49246	1.1981	0.32856	0.011924	0.000204

Notes:

All units in mg/kg/day (milligrams per kilograms per day).
COC = Chemical of Concern.

Table VIII-1 Estimated Daily Intake (EDI) of COCs from Various Food Items for Mammalian Receptors Based on 100% Soil and Sediment Bioaccessibility - Baseline and Project Phases (continued)

COC	Small Carnivore					Small Herbivore				
	Fish	Medium Herbivore (mammal)	Small Herbivore (mammal)	Soil	Water	Berries	Grass	Leaves	Soil	Water
Baseline Phase										
arsenic	0.01404	0.0003496	0.0003496	0.005326	1.75E-05	0.007675	0.003147	0.001919	0.003968	1.61E-05
cadmium	0.001243	0.0043117	0.0043117	0.000709	2.72E-06	0.00971	0.006525	0.009673	0.000528	2.51E-06
chromium	0.003444	0.085898	0.085898	0.099407	2.29E-05	0.063243	0.13409	0.15127	0.074049	2.12E-05
copper	0.29638	0.35888	0.35888	0.039577	0.000183	0.23309	0.26407	0.24437	0.029481	0.000169
iron	2.4424	0.01654	0.0021915	32.678	0.008447	12.011	9.8282	13.969	24.342	0.007806
manganese	0.04562	0.04491	0.04491	0.24536	0.000816	14.091	7.6599	13.669	0.18277	0.000754
nickel	0.029773	0.18228	0.18228	0.24485	6.66E-05	0.16517	0.16429	0.2811	0.18239	6.15E-05
selenium	0.026494	0.019193	0.019193	0.001372	4.58E-06	0.007676	0.023027	0.007676	0.001022	4.23E-06
uranium	0.001177	4.27E-08	5.42E-09	0.003238	2.26E-06	0.003454	0.005565	0.003454	0.002412	2.09E-06
zinc	0.25103	3.219	3.219	0.077671	0.000344	1.6513	1.9733	4.7854	0.057858	0.000318
Project Phase										
arsenic	0.085428	0.0003547	0.0003547	0.005405	0.000106	0.00824	0.003724	0.002487	0.004026	9.82E-05
cadmium	0.001541	0.017499	0.017499	0.002876	3.37E-06	0.028337	0.025941	0.041749	0.002142	3.12E-06
chromium	0.008133	0.091758	0.091758	0.10619	5.41E-05	0.10668	0.18992	0.19545	0.0791	5.00E-05
copper	0.34107	0.37067	0.37067	0.040878	0.000211	0.25355	0.28729	0.26138	0.03045	0.000195
iron	3.6624	0.024891	0.00323	34.125	0.012666	20.959	19.135	23.139	25.42	0.011706
manganese	0.10909	0.048768	0.048768	0.26644	0.001951	14.904	8.3674	14.893	0.19847	0.001803
nickel	0.078242	0.18966	0.18966	0.25476	0.000175	0.25803	0.26808	0.39057	0.18977	0.000162
selenium	0.046647	0.019788	0.019788	0.001415	8.07E-06	0.009941	0.025391	0.009945	0.001054	7.45E-06
uranium	0.027735	4.73E-08	5.99E-09	0.003311	5.33E-05	0.003937	0.006058	0.003938	0.002466	4.92E-05
zinc	0.36243	3.3622	3.3622	0.081126	0.000496	1.7309	2.0794	5.0605	0.060431	0.000458

Notes:

All units in mg/kg/day (milligrams per kilograms per day).
COC = Chemical of Concern.

Table VIII-1 Estimated Daily Intake (EDI) of COCs from Various Food Items for Mammalian Receptors Based on 100% Soil and Sediment Bioaccessibility - Baseline and Project Phases (continued)

COC	Small Omnivore						Wolf			
	Berries	Grass	Invertebrates	Leaves	Soil	Water	Caribou	Musk Ox	Soil	Water
Baseline Phase										
arsenic	0.004678	0.002558	0.021273	0.00117	0.004479	1.91E-05	2.92E-05	3.50E-05	0.001113	8.75E-06
cadmium	0.005919	0.005303	0.1713	0.005896	0.000596	2.98E-06	4.77E-06	8.81E-06	0.000148	1.36E-06
chromium	0.038549	0.10897	0.63942	0.092208	0.083584	2.51E-05	0.001885	0.002648	0.020763	1.15E-05
copper	0.14208	0.2146	0.42845	0.14895	0.033278	0.000201	0.002946	0.005257	0.008266	9.18E-05
iron	7.3214	7.9873	151.12	8.5144	27.477	0.009257	0.81868	1.0367	6.8254	0.004233
manganese	8.5892	6.2251	0.069629	8.3319	0.20631	0.000894	0.004543	0.008425	0.051249	0.000409
nickel	0.10068	0.13352	0.10294	0.17134	0.20587	7.30E-05	0.002593	0.003805	0.05114	3.34E-05
selenium	0.004679	0.018714	0.038658	0.004679	0.001154	5.02E-06	0.000451	0.000676	0.000287	2.30E-06
uranium	0.002105	0.004522	0.0042883	0.002105	0.002723	2.48E-06	1.64E-06	2.47E-06	0.000676	1.13E-06
zinc	1.0065	1.6037	12.327	2.9169	0.065308	0.000377	0.36065	0.66821	0.016223	0.000172
Project Phase										
arsenic	0.005023	0.003026	0.021587	0.001516	0.004545	0.000116	3.18E-05	3.89E-05	0.001129	5.33E-05
cadmium	0.017273	0.021082	0.69521	0.025448	0.002418	3.70E-06	3.40E-05	5.20E-05	0.000601	1.69E-06
chromium	0.065027	0.15434	0.68303	0.11913	0.089286	5.93E-05	0.002394	0.003422	0.022179	2.71E-05
copper	0.15455	0.23348	0.44253	0.15932	0.034371	0.000231	0.003221	0.005719	0.008538	0.000106
iron	12.775	15.551	157.81	14.104	28.693	0.013881	1.1239	1.5172	7.1275	0.006348
manganese	9.0843	6.8002	0.075609	9.0779	0.22403	0.002139	0.004988	0.009224	0.05565	0.000978
nickel	0.15728	0.21787	0.1071	0.23807	0.21421	0.000192	0.003535	0.005348	0.053211	8.77E-05
selenium	0.006059	0.020635	0.039858	0.006062	0.00119	8.84E-06	0.000504	0.000762	0.000296	4.04E-06
uranium	0.0024	0.004924	0.0043846	0.0024	0.002784	5.84E-05	1.84E-06	2.77E-06	0.000692	2.67E-05
zinc	1.0551	1.69	12.875	3.0845	0.068213	0.000544	0.38306	0.70816	0.016945	0.000249

Notes:

All units in mg/kg/day (milligrams per kilograms per day).
COC = Chemical of Concern.

Table VIII-2 Estimated Daily Intake (EDI) of COCs from Various Food Items for Mammalian Receptors Based on 10% Soil and Sediment Bioaccessibility - Baseline and Project Phases

COC	Caribou					Grizzly Bear					
	Grass	Leaves	Lichen	Soil	Water	Berries	Caribou	Invertebrates	Medium Herbivore (mammal)	Soil	Water
Baseline Phase											
arsenic	0.00062	0.000378	0.005055	0.000148	7.62E-06	0.002734	1.93E-05	0.00023809	1.84E-05	8.35E-05	7.45E-06
cadmium	0.001287	0.001907	0.001088	1.97E-05	1.19E-06	0.003459	3.15E-06	0.0019172	0.000227	1.11E-05	1.16E-06
chromium	0.026438	0.029827	0.093084	0.002758	9.99E-06	0.02253	0.001246	0.0071562	0.004527	0.001559	9.77E-06
copper	0.052065	0.048184	0.040814	0.001098	8.00E-05	0.083039	0.001947	0.0047951	0.018912	0.000621	7.82E-05
iron	1.9378	2.7542	7.3729	0.90659	0.003685	4.2791	0.54098	1.6913	0.000872	0.51252	0.003604
manganese	1.5103	2.6952	1.5905	0.006807	0.000356	5.02	0.003002	0.00077928	0.002367	0.003848	0.000348
nickel	0.032393	0.055425	0.067343	0.006793	2.90E-05	0.058841	0.001713	0.001152	0.009606	0.00384	2.84E-05
selenium	0.00454	0.001514	0.00908	3.81E-05	2.00E-06	0.002735	0.000298	0.00043266	0.001011	2.15E-05	1.95E-06
uranium	0.001097	0.000681	0.001559	8.98E-05	9.87E-07	0.00123	1.08E-06	4.80E-05	2.25E-09	5.08E-05	9.65E-07
zinc	0.38907	0.94355	0.50772	0.002155	0.00015	0.58827	0.23831	0.13796	0.16963	0.001218	0.000147
Project Phase											
arsenic	0.000734	0.00049	0.005449	0.00015	4.64E-05	0.002936	2.10E-05	0.0002416	1.87E-05	8.48E-05	4.53E-05
cadmium	0.005115	0.008232	0.0178	7.98E-05	1.47E-06	0.010095	2.25E-05	0.0077807	0.000922	4.51E-05	1.44E-06
chromium	0.037446	0.038538	0.11924	0.002946	2.36E-05	0.038006	0.001582	0.0076444	0.004836	0.001665	2.31E-05
copper	0.056645	0.051538	0.046694	0.001134	9.20E-05	0.090329	0.002129	0.0049527	0.019534	0.000641	9.00E-05
iron	3.7728	4.5624	11.207	0.94672	0.005526	7.4665	0.74269	1.7662	0.001312	0.53521	0.005404
manganese	1.6498	2.9365	1.7765	0.007392	0.000851	5.3094	0.003296	0.00084621	0.00257	0.004179	0.000833
nickel	0.052857	0.07701	0.10357	0.007068	7.63E-05	0.091923	0.002336	0.0011987	0.009995	0.003996	7.46E-05
selenium	0.005006	0.001961	0.009975	3.93E-05	3.52E-06	0.003541	0.000333	0.00044608	0.001043	2.22E-05	3.44E-06
uranium	0.001195	0.000776	0.001831	9.19E-05	2.32E-05	0.001403	1.21E-06	4.91E-05	2.49E-09	5.19E-05	2.27E-05
zinc	0.41	0.99779	0.54726	0.002251	0.000216	0.61664	0.25313	0.1441	0.17718	0.001272	0.000212

Notes:

All units in mg/kg/day (milligrams per kilograms per day).
COC = Chemical of Concern.

Table VIII-2 Estimated Daily Intake (EDI) of COCs from Various Food Items for Mammalian Receptors Based on 10% Soil and Sediment Bioaccessibility - Baseline and Project Phases (continued)

COC	Shrew				Medium Carnivore					
	Grass	**Invertebrates**	**Soil**	**Water**	**Berries**	**Caribou**	**Shrew**	**Small Herbivore (mammal)**	**Soil**	**Water**
Baseline Phase										
arsenic	0.001964	0.04792	0.0037258	2.20E-05	0.00035	2.38E-05	0.000166	0.0001663	0.0002347	1.10E-05
cadmium	0.004072	0.38587	0.00049568	3.42E-06	0.000443	3.88E-06	0.002052	0.0020515	3.122E-05	1.72E-06
chromium	0.083682	1.4403	0.069535	2.88E-05	0.002885	0.001534	0.04087	0.04087	0.0043794	1.45E-05
copper	0.1648	0.96511	0.027684	0.000231	0.010635	0.002397	0.17076	0.17076	0.0017436	0.000116
iron	6.1336	340.41	22.858	0.010634	0.54801	0.66605	0.000453	0.0010427	1.4397	0.00533
manganese	4.7804	0.15684	0.17163	0.001027	0.64291	0.003696	0.021368	0.021368	0.01081	0.000515
nickel	0.10253	0.23187	0.17127	8.38E-05	0.007536	0.00211	0.086728	0.086728	0.010787	4.20E-05
selenium	0.014371	0.08708	0.00096001	5.77E-06	0.00035	0.000367	0.009132	0.0091319	6.046E-05	2.89E-06
uranium	0.003473	0.0096596	0.0022651	2.85E-06	0.000158	1.34E-06	2.82E-10	2.58E-09	1.43E-04	1.43E-06
zinc	1.2315	27.767	0.054331	0.000433	0.075339	0.29341	1.5316	1.5316	0.0034218	0.000217
Project Phase									0	
arsenic	0.002324	0.048626	0.0037808	0.000134	0.000376	2.59E-05	0.000169	0.0001688	0.0002381	6.71E-05
cadmium	0.01619	1.566	0.0020117	4.25E-06	0.001293	2.77E-05	0.008326	0.0083258	0.0001267	2.13E-06
chromium	0.11853	1.5386	0.074278	6.81E-05	0.004867	0.001948	0.043658	0.043658	0.0046782	3.41E-05
copper	0.1793	0.99682	0.028594	0.000265	0.011568	0.002621	0.17637	0.17637	0.0018009	0.000133
iron	11.942	355.48	23.87	0.015945	0.95622	0.9144	0.000478	0.0015368	1.5034	0.007992
manganese	5.222	0.17032	0.18637	0.002457	0.67996	0.004058	0.023204	0.023204	0.011738	0.001231
nickel	0.16731	0.24126	0.1782	0.00022	0.011772	0.002876	0.09024	0.09024	0.011224	0.00011
selenium	0.015846	0.089783	0.00098981	1.02E-05	0.000454	0.00041	0.009415	0.0094153	6.234E-05	5.09E-06
uranium	0.003781	0.0098767	0.002316	6.71E-05	0.00018	1.50E-06	2.91E-10	2.85E-09	1.46E-04	3.36E-05
zinc	1.2978	29.002	0.056747	0.000625	0.078972	0.31165	1.5997	1.5997	0.003574	0.000313

Notes:

All units in mg/kg/day (milligrams per kilograms per day).
COC = Chemical of Concern.

Table VIII-2 Estimated Daily Intake (EDI) of COCs from Various Food Items for Mammalian Receptors Based on 10% Soil and Sediment Bioaccessibility - Baseline and Project Phases (continued)

COC	Medium Herbivore					Musk Ox				
	Berries	Grass	Leaves	Soil	Water	Grass	Leaves	Lichen	Soil	Water
Baseline Phase										
arsenic	0.00488	0.002001	0.00122	0.00021	1.25E-05	0.000745	0.000454	0.003035	7.83E-05	7.19E-06
cadmium	0.006175	0.004149	0.006151	2.8E-05	1.95E-06	0.001545	0.00229	0.000653	1.04E-05	1.12E-06
chromium	0.040214	0.085257	0.096188	0.003924	1.64E-05	0.031755	0.035816	0.055886	0.001461	9.42E-06
copper	0.14822	0.1679	0.15538	0.001562	0.000131	0.062537	0.057857	0.024504	0.000582	7.54E-05
iron	7.6377	6.2491	8.8819	1.2898	0.006053	2.3275	3.3072	4.4265	0.48031	0.003475
manganese	8.9602	4.8704	8.6916	0.009685	0.000585	1.814	3.2363	0.9549	0.003606	0.000336
nickel	0.10503	0.10446	0.17874	0.009664	4.77E-05	0.038908	0.066553	0.040431	0.003599	2.74E-05
selenium	0.004881	0.014641	0.004881	5.42E-05	3.28E-06	0.005453	0.001817	0.005452	2.02E-05	1.88E-06
uranium	0.002196	0.003538	0.002196	0.000128	1.62E-06	0.001318	0.000818	0.000936	4.76E-05	9.31E-07
zinc	1.05	1.2547	3.0428	0.003066	0.000246	0.46732	1.133	0.30482	0.001142	0.000141
Project Phase										
arsenic	0.00524	0.002368	0.001582	0.000213	7.62E-05	0.000882	0.000589	0.003271	7.94E-05	4.37E-05
cadmium	0.018019	0.016494	0.026546	0.000114	2.42E-06	0.006144	0.009885	0.010687	4.23E-05	1.39E-06
chromium	0.067836	0.12076	0.12428	0.004191	3.88E-05	0.044977	0.046275	0.07159	0.001561	2.23E-05
copper	0.16123	0.18267	0.1662	0.001614	0.000151	0.068038	0.061884	0.028034	0.000601	8.68E-05
iron	13.327	12.167	14.713	1.3469	0.009077	4.5316	5.4783	6.7283	0.50157	0.005211
manganese	9.4767	5.3203	9.4698	0.010517	0.001398	1.9816	3.5261	1.0666	0.003916	0.000803
nickel	0.16407	0.17046	0.24834	0.010056	0.000125	0.063488	0.092471	0.062183	0.003745	7.20E-05
selenium	0.006321	0.016145	0.006324	5.59E-05	5.78E-06	0.006013	0.002355	0.005989	2.08E-05	3.32E-06
uranium	0.002503	0.003852	0.002504	0.000131	3.82E-05	0.001435	0.000932	0.001099	4.87E-05	2.19E-05
zinc	1.1006	1.3222	3.2177	0.003202	0.000355	0.49246	1.1981	0.32856	0.001192	0.000204

Notes:

All units in mg/kg/day (milligrams per kilograms per day).
COC = Chemical of Concern.

Table VIII-2 Estimated Daily Intake (EDI) of COCs from Various Food Items for Mammalian Receptors Based on 10% Soil and Sediment Bioaccessibility - Baseline and Project Phases (continued)

COC	Small Carnivore					Small Herbivore				
	Fish	Medium Herbivore (mammal)	Small Herbivore (mammal)	Soil	Water	Berries	Grass	Leaves	Soil	Water
Baseline Phase										
arsenic	0.01404	0.0003496	0.0003496	0.0005326	1.75E-05	0.007675	0.003147	0.001919	0.000397	1.61E-05
cadmium	0.001243	0.0043117	0.0043117	7.086E-05	2.72E-06	0.00971	0.006525	0.009673	5.28E-05	2.51E-06
chromium	0.003444	0.085898	0.085898	0.0099407	2.29E-05	0.063243	0.13409	0.15127	0.007405	2.12E-05
copper	0.29638	0.35888	0.35888	0.0039577	0.000183	0.23309	0.26407	0.24437	0.002948	0.000169
iron	2.4424	0.01654	0.0021915	3.2678	0.008447	12.011	9.8282	13.969	2.4342	0.007806
manganese	0.04562	0.04491	0.04491	0.024536	0.000816	14.091	7.6599	13.669	0.018277	0.000754
nickel	0.029773	0.18228	0.18228	0.024485	6.66E-05	0.16517	0.16429	0.2811	0.018239	6.15E-05
selenium	0.026494	0.019193	0.019193	0.0001372	4.58E-06	0.007676	0.023027	0.007676	0.000102	4.23E-06
uranium	0.001177	4.27E-08	5.42E-09	3.24E-04	2.26E-06	0.003454	0.005565	0.003454	0.000241	2.09E-06
zinc	0.25103	3.219	3.219	0.0077671	0.000344	1.6513	1.9733	4.7854	0.005786	0.000318
Project Phase										
arsenic	0.085428	0.0003547	0.0003547	0.0005405	0.000106	0.00824	0.003724	0.002487	0.000403	9.82E-05
cadmium	0.001541	0.017499	0.017499	0.0002876	3.37E-06	0.028337	0.025941	0.041749	0.000214	3.12E-06
chromium	0.008133	0.091758	0.091758	0.010619	5.41E-05	0.10668	0.18992	0.19545	0.00791	5.00E-05
copper	0.34107	0.37067	0.37067	0.0040878	0.000211	0.25355	0.28729	0.26138	0.003045	0.000195
iron	3.6624	0.024891	0.00323	3.4125	0.012666	20.959	19.135	23.139	2.542	0.011706
manganese	0.10909	0.048768	0.048768	0.026644	0.001951	14.904	8.3674	14.893	0.019847	0.001803
nickel	0.078242	0.18966	0.18966	0.025476	0.000175	0.25803	0.26808	0.39057	0.018977	0.000162
selenium	0.046647	0.019788	0.019788	0.0001415	8.07E-06	0.009941	0.025391	0.009945	0.000105	7.45E-06
uranium	0.027735	4.73E-08	5.99E-09	3.31E-04	5.33E-05	0.003937	0.006058	0.003938	0.000247	4.92E-05
zinc	0.36243	3.3622	3.3622	0.0081126	0.000496	1.7309	2.0794	5.0605	0.006043	0.000458

Notes:

All units in mg/kg/day (milligrams per kilograms per day).
COC = Chemical of Concern.

Table VIII-2 Estimated Daily Intake (EDI) of COCs from Various Food Items for Mammalian Receptors Based on 10% Soil and Sediment Bioaccessibility - Baseline and Project Phases (continued)

COC	Small Omnivore						Wolf			
	Berries	Grass	Invertebrates	Leaves	Soil	Water	Caribou	Musk Ox	Soil	Water
Baseline Phase										
arsenic	0.004678	0.002558	0.021273	0.00117	0.000448	1.91E-05	2.92E-05	3.50E-05	1.11E-04	8.75E-06
cadmium	0.005919	0.005303	0.1713	0.005896	5.96E-05	2.98E-06	4.77E-06	8.81E-06	1.48E-05	1.36E-06
chromium	0.038549	0.10897	0.63942	0.092208	0.008358	2.51E-05	0.001885	0.002648	0.002076	1.15E-05
copper	0.14208	0.2146	0.42845	0.14895	0.003328	0.000201	0.002946	0.005257	0.000827	9.18E-05
iron	7.3214	7.9873	151.12	8.5144	2.7477	0.009257	0.81868	1.0367	0.68254	0.004233
manganese	8.5892	6.2251	0.069629	8.3319	0.020631	0.000894	0.004543	0.008425	0.005125	0.000409
nickel	0.10068	0.13352	0.10294	0.17134	0.020587	7.30E-05	0.002593	0.003805	0.005114	3.34E-05
selenium	0.004679	0.018714	0.038658	0.004679	0.000115	5.02E-06	0.000451	0.000676	2.87E-05	2.30E-06
uranium	0.002105	0.004522	0.0042883	0.002105	0.000272	2.48E-06	1.64E-06	2.47E-06	6.76E-05	1.13E-06
zinc	1.0065	1.6037	12.327	2.9169	0.006531	0.000377	0.36065	0.66821	0.001622	0.000172
Project Phase										
arsenic	0.005023	0.003026	0.021587	0.001516	0.000454	0.000116	3.18E-05	3.89E-05	1.13E-04	5.33E-05
cadmium	0.017273	0.021082	0.69521	0.025448	0.000242	3.70E-06	3.40E-05	5.20E-05	6.01E-05	1.69E-06
chromium	0.065027	0.15434	0.68303	0.11913	0.008929	5.93E-05	0.002394	0.003422	0.002218	2.71E-05
copper	0.15455	0.23348	0.44253	0.15932	0.003437	0.000231	0.003221	0.005719	0.000854	0.000106
iron	12.775	15.551	157.81	14.104	2.8693	0.013881	1.1239	1.5172	0.71275	0.006348
manganese	9.0843	6.8002	0.075609	9.0779	0.022403	0.002139	0.004988	0.009224	0.005565	0.000978
nickel	0.15728	0.21787	0.1071	0.23807	0.021421	0.000192	0.003535	0.005348	0.005321	8.77E-05
selenium	0.006059	0.020635	0.039858	0.006062	0.000119	8.84E-06	0.000504	0.000762	2.96E-05	4.04E-06
uranium	0.0024	0.004924	0.0043846	0.0024	0.000278	5.84E-05	1.84E-06	2.77E-06	6.92E-05	2.67E-05
zinc	1.0551	1.69	12.875	3.0845	0.006821	0.000544	0.38306	0.70816	0.001695	0.000249

Notes:

All units in mg/kg/day (milligrams per kilograms per day).
COC = Chemical of Concern.

Table VIII-3 Estimated Daily Intake (EDI) of COCs from Various Food Items for Avian Receptors Based on 100% Soil and Sediment Bioaccessibility - Baseline and Project Phases (continued)

COC	Eagle					Hawks, Owls and Falcons					
	Fish	Medium Herbivore	Small Herbivore	Soil	Water	Amphibians	Invertebrates	Shrew	Small Herbivore	Soil	Water
Baseline Phase											
arsenic	0.004483	0.000112	0.000112	0.001215	5.32E-06	0.0021413	0.011024	0.000267	0.000267	0.002901	1.21E-05
cadmium	0.000397	0.001377	0.001377	0.000162	8.29E-07	0.00018953	0.088773	0.003288	0.003288	0.000386	1.89E-06
chromium	0.0011	0.027429	0.027429	0.022673	6.98E-06	0.00052527	0.33136	0.0655	0.0655	0.054144	1.59E-05
copper	0.09464	0.1146	0.1146	0.009027	5.59E-05	0.045201	0.22203	0.27366	0.27366	0.021556	0.000127
iron	0.77992	0.005282	0.0007	7.4533	0.002574	0.37249	78.314	0.000726	0.001671	17.799	0.005863
manganese	0.014567	0.014341	0.014341	0.055964	0.000249	0.0069574	0.036083	0.034246	0.034246	0.13364	0.000566
nickel	0.009507	0.058205	0.058205	0.055845	2.03E-05	0.0045406	0.053344	0.13899	0.13899	0.13336	4.62E-05
selenium	0.00846	0.006129	0.006129	0.000313	1.40E-06	0.0040406	0.020034	0.014635	0.014635	0.000748	3.18E-06
uranium	0.000376	1.36E-08	1.73E-09	0.000739	6.89E-07	0.00017955	0.0022223	4.52E-10	4.14E-09	0.001764	1.57E-06
zinc	0.080159	1.0279	1.0279	0.017715	0.000105	0.038284	6.388	2.4546	2.4546	0.042305	0.000239
Project Phase											
arsenic	0.027278	0.000113	0.000113	0.001233	3.24E-05	0.013028	0.011187	0.00027	0.00027	0.002944	2.34E-06
cadmium	0.000492	0.005588	0.005588	0.000656	1.03E-06	0.00023502	0.36028	0.013343	0.013343	0.001566	3.43E-05
chromium	0.002597	0.0293	0.0293	0.02422	1.65E-05	0.0012403	0.35396	0.069969	0.069969	0.057837	3.59E-05
copper	0.10891	0.11836	0.11836	0.009324	6.43E-05	0.052016	0.22933	0.28265	0.28265	0.022265	3.75E-05
iron	1.1695	0.007948	0.001031	7.7832	0.00386	0.55855	81.781	0.000765	0.002463	18.587	5.10E-05
manganese	0.034834	0.015572	0.015572	0.06077	0.000595	0.016637	0.039182	0.037187	0.037187	0.14512	0.000121
nickel	0.024984	0.060561	0.060561	0.058106	5.33E-05	0.011932	0.055504	0.14462	0.14462	0.13876	0.000344
selenium	0.014895	0.006319	0.006319	0.000323	2.46E-06	0.0071139	0.020655	0.015089	0.015089	0.000771	0.001029
uranium	0.008856	1.51E-08	1.91E-09	0.000755	1.62E-05	0.0042297	0.0022722	4.66E-10	4.57E-09	0.001803	0.002549
zinc	0.11573	1.0736	1.0736	0.018503	0.000151	0.055273	6.6722	2.5638	2.5638	0.044187	0.008792

Notes:

All units in mg/kg/day (milligrams per kilograms per day).
COC = Chemical of Concern.

Table VIII-3 Estimated Daily Intake (EDI) of COCs from Various Food Items for Avian Receptors Based on 100% Soil and Sediment Bioaccessibility - Baseline and Project Phases (continued)

COC	Upland Breeding Birds						
	Large				Medium		
	Carnivore				Carnivore		
	Aquatic Invertebrates	Fish	Soil	Water	Small Herbivore	Soil	Water
Baseline Phase							
arsenic	0.00058237	0.009703	0.001643	7.08E-06	0.000958	0.002607	1.10E-05
cadmium	0.0043001	0.000859	0.000219	1.10E-06	0.011815	0.000347	1.71E-06
chromium	0.031388	0.00238	0.030669	9.29E-06	0.23539	0.048644	1.44E-05
copper	0.3112	0.20482	0.01221	7.43E-05	0.98345	0.019367	0.000115
iron	15.687	1.6879	10.082	0.003425	0.006006	15.991	0.005298
manganese	1.5155	0.031527	0.075699	0.000331	0.12307	0.12007	0.000512
nickel	0.00085139	0.020575	0.075538	2.70E-05	0.4995	0.11981	4.18E-05
selenium	0.0026408	0.01831	0.000423	1.86E-06	0.052594	0.000672	2.87E-06
uranium	0.00027896	0.000814	0.000999	9.17E-07	1.49E-08	0.001585	1.42E-06
zinc	0.71847	0.17348	0.023963	0.000139	8.821	0.038008	0.000216
Project Phase							
arsenic	0.0035434	0.059037	0.001668	4.31E-05	0.000972	0.002645	6.67E-05
cadmium	0.0053321	0.001065	0.000887	1.37E-06	0.047952	0.001407	2.12E-06
chromium	0.074114	0.00562	0.032761	2.19E-05	0.25145	0.051962	3.39E-05
copper	0.35812	0.23571	0.012611	8.55E-05	1.0158	0.020003	0.000132
iron	23.522	2.531	10.528	0.005136	0.008851	16.699	0.007945
manganese	3.624	0.075388	0.0822	0.000791	0.13364	0.13038	0.001224
nickel	0.0022374	0.054071	0.078597	7.09E-05	0.51973	0.12466	0.00011
selenium	0.0046494	0.032236	0.000437	3.27E-06	0.054227	0.000692	5.06E-06
uranium	0.0065714	0.019167	0.001022	2.16E-05	1.64E-08	0.00162	3.34E-05
zinc	1.0373	0.25047	0.025029	0.000201	9.2134	0.039698	0.000311

Notes:

All units in mg/kg/day (milligrams per kilograms per day).
COC = Chemical of Concern.

Table VIII-3 Estimated Daily Intake (EDI) of COCs from Various Food Items for Avian Receptors Based on 100% Soil and Sediment Bioaccessibility - Baseline and Project Phases (continued)

COC	Upland Breeding Birds							
	Medium							
	Herbivore			Omnivore				
	Leaves	Soil	Water	Grasses	Invertebrates	Soil	Terrestrial Invertebrates	Water
Baseline Phase								
arsenic	0.003907	0.002244	9.51E-06	0.001106	0.004118	0.058099	0.011039	1.59E-05
cadmium	0.019695	0.000299	1.48E-06	0.002293	0.030406	0.00773	0.088889	2.48E-06
chromium	0.30801	0.04188	1.25E-05	0.047121	0.22195	1.0843	0.3318	2.09E-05
copper	0.49756	0.016674	9.98E-05	0.092799	2.2005	0.4317	0.22232	0.000167
iron	28.441	13.767	0.004599	3.4539	110.92	356.44	78.417	0.007706
manganese	27.832	0.10337	0.000444	2.6919	10.716	2.6764	0.036131	0.000744
nickel	0.57234	0.10315	3.62E-05	0.057736	0.0060203	2.6707	0.053414	6.07E-05
selenium	0.015629	0.000578	2.49E-06	0.008092	0.018673	0.01497	0.02006	4.18E-06
uranium	0.007032	0.001364	1.23E-06	0.001956	0.0019725	0.035321	0.0022252	2.06E-06
zinc	9.7434	0.032723	0.000187	0.69347	5.0803	0.84721	6.3964	0.000313
Project Phase								
arsenic	0.005065	0.002277	5.79E-05	0.001309	0.025056	0.058956	0.011202	9.69E-05
cadmium	0.085005	0.001212	1.84E-06	0.009116	0.037704	0.031369	0.36075	3.08E-06
chromium	0.39795	0.044737	2.94E-05	0.066742	0.52407	1.1583	0.35443	4.93E-05
copper	0.53219	0.017222	0.000115	0.10096	2.5323	0.44588	0.22963	0.000192
iron	47.113	14.377	0.006896	6.7245	166.33	372.22	81.888	0.011554
manganese	30.324	0.11225	0.001062	2.9405	25.625	2.9062	0.039234	0.00178
nickel	0.79523	0.10733	9.53E-05	0.094211	0.015821	2.7788	0.055577	0.00016
selenium	0.020249	0.000596	4.39E-06	0.008923	0.032876	0.015435	0.020682	7.36E-06
uranium	0.008018	0.001395	2.90E-05	0.002129	0.046467	0.036114	0.0022752	4.86E-05
zinc	10.304	0.034178	0.00027	0.73077	7.3347	0.88489	6.681	0.000453

Notes:

All units in mg/kg/day (milligrams per kilograms per day).
COC = Chemical of Concern.

Table VIII-3 Estimated Daily Intake (EDI) of COCs from Various Food Items for Avian Receptors Based on 100% Soil and Sediment Bioaccessibility - Baseline and Project Phases (continued)

COC	Upland Breeding Birds							
	Small							
	Carnivore			Herbivore				
	Aquatic Invertebrates	Soil	Terrestrial Invertebrates	Berries	Grasses	Soil	Water	Water
Baseline Phase								
arsenic	0.010219	0.073535	0.027401	0.011234	0.018424	0.008066	3.19E-05	3.41E-05
cadmium	0.075453	0.009783	0.22064	0.014213	0.038205	0.001073	4.97E-06	5.31E-06
chromium	0.55076	1.3724	0.8236	0.09257	0.78504	0.15054	4.18E-05	4.47E-05
copper	5.4606	0.54639	0.55186	0.34118	1.546	0.059934	0.000335	0.000357
iron	275.26	451.15	194.65	17.581	57.541	49.486	0.015419	0.016474
manganese	26.593	3.3874	0.089685	20.626	44.846	0.37157	0.00149	0.001592
nickel	0.014939	3.3803	0.13259	0.24176	0.96187	0.37078	0.000122	0.00013
selenium	0.046337	0.018947	0.049793	0.011236	0.13482	0.002078	8.36E-06	8.94E-06
uranium	0.0048949	0.044705	0.0055235	0.005055	0.032579	0.004904	4.13E-06	4.41E-06
zinc	12.607	1.0723	15.878	2.417	11.553	0.11762	0.000627	0.00067
Project Phase								
arsenic	0.062176	0.07462	0.027805	0.012061	0.021801	0.008185	0.000194	0.000207
cadmium	0.093561	0.039704	0.89547	0.041478	0.15188	0.004355	6.16E-06	6.58E-06
chromium	1.3005	1.466	0.87978	0.15615	1.1119	0.16081	9.87E-05	0.000105
copper	6.2839	0.56435	0.56999	0.37113	1.682	0.061903	0.000385	0.000411
iron	412.75	471.11	203.27	30.678	112.03	51.676	0.02312	0.024703
manganese	63.589	3.6784	0.097388	21.815	48.989	0.40348	0.003562	0.003806
nickel	0.03926	3.5171	0.13795	0.37768	1.5695	0.38579	0.000319	0.000341
selenium	0.081582	0.019536	0.051339	0.014551	0.14866	0.002143	1.47E-05	1.57E-05
uranium	0.11531	0.04571	0.0056476	0.005762	0.03547	0.005014	9.73E-05	0.000104
zinc	18.201	1.12	16.584	2.5336	12.175	0.12285	0.000906	0.000968

Notes:

All units in mg/kg/day (milligrams per kilograms per day).
COC = Chemical of Concern.

Table VIII-3 Estimated Daily Intake (EDI) of COCs from Various Food Items for Avian Receptors Based on 100% Soil and Sediment Bioaccessibility - Baseline and Project Phases (continued)

COC	Upland Breeding Birds				
	Small				
	Omnivore				
	Berries	Invertebrates	Leaves	Soil	Water
Baseline Phase					
arsenic	0.02565	0.019739	0.006413	0.009444	3.70E-05
cadmium	0.032451	0.15894	0.032327	0.001257	5.76E-06
chromium	0.21135	0.59328	0.50555	0.17626	4.85E-05
copper	0.77898	0.39754	0.81668	0.070174	0.000388
iron	40.142	140.22	46.682	57.942	0.017899
manganese	47.092	0.064606	45.682	0.43505	0.001729
nickel	0.55198	0.095509	0.93942	0.43413	0.000141
selenium	0.025654	0.035869	0.025654	0.002434	9.71E-06
uranium	0.011542	0.0039789	0.011542	0.005742	4.79E-06
zinc	5.5185	11.438	15.992	0.13772	0.000728
Project Phase					
arsenic	0.027538	0.02003	0.008313	0.009584	0.000225
cadmium	0.094702	0.64506	0.13952	0.005099	7.15E-06
chromium	0.35653	0.63376	0.65319	0.18828	0.000115
copper	0.84736	0.4106	0.87353	0.07248	0.000447
iron	70.043	146.42	77.329	60.506	0.026839
manganese	49.807	0.070154	49.772	0.47242	0.004135
nickel	0.86232	0.099377	1.3053	0.45171	0.000371
selenium	0.033222	0.036982	0.033236	0.002509	1.71E-05
uranium	0.013156	0.0040683	0.01316	0.005871	0.000113
zinc	5.7846	11.946	16.912	0.14384	0.001051

Notes:

All units in mg/kg/day (milligrams per kilograms per day).
COC = Chemical of Concern.

Table VIII-3 Estimated Daily Intake (EDI) of COCs from Various Food Items for Avian Receptors Based on 100% Soil and Sediment Bioaccessibility - Baseline and Project Phases (continued)

COC	Water Breeding Birds									
	Large						Medium			
	Carnivore			Herbivore			Carnivore			
	Fish	Sediment	Water	Grasses	Sediment	Water	Aquatic Invertebrates	Fish	Sediment	Water
Baseline Phase										
arsenic	0.009369	0.021	5.55E-06	0.002995	0.004232	4.63E-06	0.0010462	0.01743	0.065508	1.23E-05
cadmium	0.000829	0.00191	8.64E-07	0.006211	0.000385	7.22E-07	0.0077245	0.001543	0.005958	1.92E-06
chromium	0.002298	0.18046	7.28E-06	0.12762	0.036371	6.08E-06	0.056384	0.004276	0.56294	1.62E-05
copper	0.19778	0.21232	5.82E-05	0.25132	0.042792	4.86E-05	0.55903	0.36794	0.66232	0.000129
iron	1.6299	126.83	0.002684	9.3539	25.562	0.002241	28.18	3.0321	395.64	0.00596
manganese	0.030442	1.3696	0.000259	7.2902	0.27605	0.000216	2.7224	0.056634	4.2726	0.000576
nickel	0.019868	0.17285	2.12E-05	0.15636	0.034837	1.77E-05	0.0015294	0.036961	0.53919	4.70E-05
selenium	0.01768	0.007811	1.46E-06	0.021916	0.001574	1.22E-06	0.0047438	0.032891	0.024365	3.23E-06
uranium	0.000786	0.011094	7.19E-07	0.005296	0.002236	6.00E-07	0.00050112	0.001462	0.034608	1.60E-06
zinc	0.16752	0.36497	0.000109	1.8781	0.073559	9.11E-05	1.2906	0.31164	1.1385	0.000242
Project Phase										
arsenic	0.057006	0.021	3.38E-05	0.003544	0.004232	2.82E-05	0.0063653	0.10605	0.065508	7.50E-05
cadmium	0.001028	0.00191	1.07E-06	0.024689	0.000385	8.95E-07	0.0095784	0.001913	0.005958	2.38E-06
chromium	0.005427	0.18046	1.72E-05	0.18075	0.036371	1.43E-05	0.13314	0.010096	0.56294	3.82E-05
copper	0.2276	0.21232	6.70E-05	0.27343	0.042792	5.59E-05	0.64332	0.42342	0.66232	0.000149
iron	2.444	126.83	0.004024	18.212	25.562	0.00336	42.255	4.5467	395.64	0.008937
manganese	0.072795	1.3696	0.00062	7.9636	0.27605	0.000518	6.51	0.13542	4.2726	0.001377
nickel	0.052211	0.17285	5.56E-05	0.25514	0.034837	4.64E-05	0.0040193	0.097132	0.53919	0.000123
selenium	0.031128	0.007811	2.56E-06	0.024166	0.001574	2.14E-06	0.0083521	0.057909	0.024365	5.69E-06
uranium	0.018507	0.011094	1.69E-05	0.005766	0.002236	1.41E-05	0.011805	0.034431	0.034608	3.76E-05
zinc	0.24185	0.36497	0.000158	1.9791	0.073559	0.000132	1.8634	0.44993	1.1385	0.00035

Notes:

All units in mg/kg/day (milligrams per kilograms per day).
COC = Chemical of Concern.

Table VIII-3 Estimated Daily Intake (EDI) of COCs from Various Food Items for Avian Receptors Based on 100% Soil and Sediment Bioaccessibility - Baseline and Project Phases (continued)

COC	Water Breeding Birds											
	Medium									Small		
	Herbivore				Omnivore					Carnivore		
	Leaves	Sediment	Grasses	Water	Aquatic Invertebrates	Grasses	Sediment	Water	Terrestrial Invertebrates	Aquatic Invertebrates	Sediment	Water
Baseline Phase												
arsenic	0.001481	0.027464	0.002429	7.32E-06	0.0010213	0.005184	0.019185	1.20E-05	0.004654	0.0098462	0.20178	2.24E-05
cadmium	0.007468	0.002498	0.005038	1.14E-06	0.0075408	0.010749	0.001745	1.88E-06	0.037476	0.072701	0.018353	3.49E-06
chromium	0.11678	0.23601	0.10351	9.60E-06	0.055043	0.22087	0.16486	1.58E-05	0.13989	0.53068	1.734	2.94E-05
copper	0.18866	0.27768	0.20385	7.68E-05	0.54573	0.43497	0.19397	0.000126	0.093732	5.2615	2.0401	0.000235
iron	10.784	165.87	7.5872	0.00354	27.509	16.189	115.87	0.005826	33.061	265.22	1218.7	0.010839
manganese	10.553	1.7913	5.9133	0.000342	2.6577	12.617	1.2513	0.000563	0.015233	25.623	13.161	0.001047
nickel	0.21701	0.22606	0.12683	2.79E-05	0.001493	0.27062	0.15791	4.59E-05	0.022519	0.014395	1.6608	8.54E-05
selenium	0.005926	0.010215	0.017776	1.92E-06	0.0046309	0.03793	0.007136	3.16E-06	0.0084573	0.044647	0.075049	5.88E-06
uranium	0.002666	0.014509	0.004296	9.48E-07	0.00048919	0.009166	0.010136	1.56E-06	0.00093815	0.0047164	0.1066	2.90E-06
zinc	3.6943	0.47733	1.5234	0.000144	1.2599	3.2504	0.33344	0.000237	2.6968	12.147	3.5069	0.000441
Project Phase												
arsenic	0.00192	0.027464	0.002875	4.45E-05	0.0062139	0.006134	0.019185	7.33E-05	0.0047226	0.059909	0.20178	0.000136
cadmium	0.032231	0.002498	0.020026	1.41E-06	0.0093506	0.042731	0.001745	2.33E-06	0.15209	0.09015	0.018353	4.33E-06
chromium	0.15089	0.23601	0.14661	2.27E-05	0.12997	0.31283	0.16486	3.73E-05	0.14943	1.2531	1.734	6.94E-05
copper	0.20179	0.27768	0.22179	8.84E-05	0.62802	0.47323	0.19397	0.000145	0.096812	6.0548	2.0401	0.000271
iron	17.863	165.87	14.772	0.005309	41.25	31.52	115.87	0.008736	34.524	397.7	1218.7	0.016254
manganese	11.498	1.7913	6.4595	0.000818	6.3551	13.783	1.2513	0.001346	0.016541	61.27	13.161	0.002504
nickel	0.30152	0.22606	0.20695	7.33E-05	0.0039236	0.44159	0.15791	0.000121	0.023431	0.037828	1.6608	0.000225
selenium	0.007678	0.010215	0.019602	3.38E-06	0.0081534	0.041825	0.007136	5.56E-06	0.0087198	0.078607	0.075049	1.04E-05
uranium	0.00304	0.014509	0.004677	2.23E-05	0.011524	0.009979	0.010136	3.68E-05	0.00095923	0.1111	0.1066	6.84E-05
zinc	3.9067	0.47733	1.6053	0.000208	1.819	3.4253	0.33344	0.000342	2.8167	17.537	3.5069	0.000637

Notes:

All units in mg/kg/day (milligrams per kilograms per day).
COC = Chemical of Concern.

Table VIII-4 Estimated Daily Intake (EDI) of COCs from Various Food Items for Avian Receptors Based on 10% Soil and Sediment Bioaccessibility - Baseline and Project Phases

COC	Eagle					Hawks, Owls and Falcons					
	Fish	Medium Herbivore	Small Herbivore	Soil	Water	Amphibians	Invertebrates	Shrew	Small Herbivore	Soil	Water
Baseline Phase											
arsenic	0.004483	0.000112	0.000112	0.000121	5.32E-06	0.0021413	0.011024	0.000267	0.000267	0.00029	1.21E-05
cadmium	0.000397	0.001377	0.001377	1.62E-05	8.29E-07	0.00018953	0.088773	0.003288	0.003288	3.86E-05	1.89E-06
chromium	0.0011	0.027429	0.027429	0.002267	6.98E-06	0.00052527	0.33136	0.0655	0.0655	0.005414	1.59E-05
copper	0.09464	0.1146	0.1146	0.000903	5.59E-05	0.045201	0.22203	0.27366	0.27366	0.002156	0.000127
iron	0.77992	0.005282	0.0007	0.74533	0.002574	0.37249	78.314	0.000726	0.001671	1.7799	0.005863
manganese	0.014567	0.014341	0.014341	0.005596	0.000249	0.0069574	0.036083	0.034246	0.034246	0.013364	0.000566
nickel	0.009507	0.058205	0.058205	0.005585	2.03E-05	0.0045406	0.053344	0.13899	0.13899	0.013336	4.62E-05
selenium	0.00846	0.006129	0.006129	3.13E-05	1.40E-06	0.0040406	0.020034	0.014635	0.014635	7.48E-05	3.18E-06
uranium	0.000376	1.36E-08	1.73E-09	7.39E-05	6.89E-07	0.00017955	0.0022223	4.52E-10	4.14E-09	1.76E-04	1.57E-06
zinc	0.080159	1.0279	1.0279	0.001772	0.000105	0.038284	6.388	2.4546	2.4546	0.004231	0.000239
Project Phase											
arsenic	0.027278	0.000113	0.000113	0.000123	3.24E-05	0.013028	0.011187	0.00027	0.00027	0.000294	2.34E-06
cadmium	0.000492	0.005588	0.005588	6.56E-05	1.03E-06	0.00023502	0.36028	0.013343	0.013343	0.000157	3.43E-05
chromium	0.002597	0.0293	0.0293	0.002422	1.65E-05	0.0012403	0.35396	0.069969	0.069969	0.005784	3.59E-05
copper	0.10891	0.11836	0.11836	0.000932	6.43E-05	0.052016	0.22933	0.28265	0.28265	0.002227	3.75E-05
iron	1.1695	0.007948	0.001031	0.77832	0.00386	0.55855	81.781	0.000765	0.002463	1.8587	5.10E-05
manganese	0.034834	0.015572	0.015572	0.006077	0.000595	0.016637	0.039182	0.037187	0.037187	0.014512	0.000121
nickel	0.024984	0.060561	0.060561	0.005811	5.33E-05	0.011932	0.055504	0.14462	0.14462	0.013876	0.000344
selenium	0.014895	0.006319	0.006319	3.23E-05	2.46E-06	0.0071139	0.020655	0.015089	0.015089	7.71E-05	0.001029
uranium	0.008856	1.51E-08	1.91E-09	7.55E-05	1.62E-05	0.0042297	0.0022722	4.66E-10	4.57E-09	1.80E-04	0.002549
zinc	0.11573	1.0736	1.0736	0.00185	0.000151	0.055273	6.6722	2.5638	2.5638	0.004419	0.008792

Notes:

All units in mg/kg/day (milligrams per kilograms per day).
COC = Chemical of Concern.

Table VIII-4 Estimated Daily Intake (EDI) of COCs from Various Food Items for Avian Receptors Based on 10% Soil and Sediment Bioaccessibility - Baseline and Project Phases (continued)

COC	Upland Breeding Birds									
	Large				Medium					
	Carnivore				Carnivore			Herbivore		
	Aquatic Invertebrates	Fish	Soil	Water	Small Herbivore	Soil	Water	Leaves	Soil	Water
Baseline Phase										
arsenic	0.00058237	0.009703	0.000164	7.08E-06	0.000958	0.000261	1.10E-05	0.003907	0.000224	9.51E-06
cadmium	0.0043001	0.000859	2.19E-05	1.10E-06	0.011815	3.47E-05	1.71E-06	0.019695	2.99E-05	1.48E-06
chromium	0.031388	0.00238	0.003067	9.29E-06	0.23539	0.004864	1.44E-05	0.30801	0.004188	1.25E-05
copper	0.3112	0.20482	0.001221	7.43E-05	0.98345	0.001937	0.000115	0.49756	0.001667	9.98E-05
iron	15.687	1.6879	1.0082	0.003425	0.006006	1.5991	0.005298	28.441	1.3767	0.004599
manganese	1.5155	0.031527	0.00757	0.000331	0.12307	0.012007	0.000512	27.832	0.010337	0.000444
nickel	0.00085139	0.020575	0.007554	2.70E-05	0.4995	0.011981	4.18E-05	0.57234	0.010315	3.62E-05
selenium	0.0026408	0.01831	4.23E-05	1.86E-06	0.052594	6.72E-05	2.87E-06	0.015629	5.78E-05	2.49E-06
uranium	0.00027896	0.000814	9.99E-05	9.17E-07	1.49E-08	1.58E-04	1.42E-06	0.007032	0.000136	1.23E-06
zinc	0.71847	0.17348	0.002396	0.000139	8.821	0.003801	0.000216	9.7434	0.003272	0.000187
Project Phase										
arsenic	0.0035434	0.059037	0.000167	4.31E-05	0.000972	0.000264	6.67E-05	0.005065	0.000228	5.79E-05
cadmium	0.0053321	0.001065	8.87E-05	1.37E-06	0.047952	0.000141	2.12E-06	0.085005	0.000121	1.84E-06
chromium	0.074114	0.00562	0.003276	2.19E-05	0.25145	0.005196	3.39E-05	0.39795	0.004474	2.94E-05
copper	0.35812	0.23571	0.001261	8.55E-05	1.0158	0.002	0.000132	0.53219	0.001722	0.000115
iron	23.522	2.531	1.0528	0.005136	0.008851	1.6699	0.007945	47.113	1.4377	0.006896
manganese	3.624	0.075388	0.00822	0.000791	0.13364	0.013038	0.001224	30.324	0.011225	0.001062
nickel	0.0022374	0.054071	0.00786	7.09E-05	0.51973	0.012466	0.00011	0.79523	0.010733	9.53E-05
selenium	0.0046494	0.032236	4.37E-05	3.27E-06	0.054227	6.92E-05	5.06E-06	0.020249	5.96E-05	4.39E-06
uranium	0.0065714	0.019167	0.000102	2.16E-05	1.64E-08	1.62E-04	3.34E-05	0.008018	0.000139	2.90E-05
zinc	1.0373	0.25047	0.002503	0.000201	9.2134	0.00397	0.000311	10.304	0.003418	0.00027

Notes:

All units in mg/kg/day (milligrams per kilograms per day).
COC = Chemical of Concern.

Table VIII-4 Estimated Daily Intake (EDI) of COCs from Various Food Items for Avian Receptors Based on 10% Soil and Sediment Bioaccessibility - Baseline and Project Phases (continued)

COC	Upland Breeding Birds							
	Medium					Small		
	Omnivore					Carnivore		
	Grasses	Invertebrates	Soil	Terrestrial Invertebrates	Water	Aquatic Invertebrates	Soil	Terrestrial Invertebrates
Baseline Phase								
arsenic	0.001106	0.004118	0.0058099	0.011039	1.59E-05	0.010219	0.007354	0.027401
cadmium	0.002293	0.030406	0.00077295	0.088889	2.48E-06	0.075453	0.000978	0.22064
chromium	0.047121	0.22195	0.10843	0.3318	2.09E-05	0.55076	0.13724	0.8236
copper	0.092799	2.2005	0.04317	0.22232	0.000167	5.4606	0.054639	0.55186
iron	3.4539	110.92	35.644	78.417	0.007706	275.26	45.115	194.65
manganese	2.6919	10.716	0.26764	0.036131	0.000744	26.593	0.33874	0.089685
nickel	0.057736	0.0060203	0.26707	0.053414	6.07E-05	0.014939	0.33803	0.13259
selenium	0.008092	0.018673	0.001497	0.02006	4.18E-06	0.046337	0.001895	0.049793
uranium	0.001956	0.0019725	0.0035321	0.0022252	2.06E-06	0.0048949	0.004471	0.0055235
zinc	0.69347	5.0803	0.084721	6.3964	0.000313	12.607	0.10723	15.878
Project Phase								
arsenic	0.001309	0.025056	0.0058956	0.011202	9.69E-05	0.062176	0.007462	0.027805
cadmium	0.009116	0.037704	0.0031369	0.36075	3.08E-06	0.093561	0.00397	0.89547
chromium	0.066742	0.52407	0.11583	0.35443	4.93E-05	1.3005	0.1466	0.87978
copper	0.10096	2.5323	0.044588	0.22963	0.000192	6.2839	0.056435	0.56999
iron	6.7245	166.33	37.222	81.888	0.011554	412.75	47.111	203.27
manganese	2.9405	25.625	0.29062	0.039234	0.00178	63.589	0.36784	0.097388
nickel	0.094211	0.015821	0.27788	0.055577	0.00016	0.03926	0.35171	0.13795
selenium	0.008923	0.032876	0.0015435	0.020682	7.36E-06	0.081582	0.001954	0.051339
uranium	0.002129	0.046467	0.0036114	0.0022752	4.86E-05	0.11531	0.004571	0.0056476
zinc	0.73077	7.3347	0.088489	6.681	0.000453	18.201	0.112	16.584

Notes:

All units in mg/kg/day (milligrams per kilograms per day).
COC = Chemical of Concern.

Table VIII-4 Estimated Daily Intake (EDI) of COCs from Various Food Items for Avian Receptors Based on 10% Soil and Sediment Bioaccessibility - Baseline and Project Phases (continued)

COC	Upland Breeding Birds									
	Small									
	Herbivore					Omnivore				
	Berries	Grasses	Soil	Water	Water	Berries	Invertebrates	Leaves	Soil	Water
Baseline Phase										
arsenic	0.011234	0.018424	0.000807	3.19E-05	3.41E-05	0.02565	0.019739	0.006413	0.000944	3.70E-05
cadmium	0.014213	0.038205	0.000107	4.97E-06	5.31E-06	0.032451	0.15894	0.032327	0.000126	5.76E-06
chromium	0.09257	0.78504	0.015054	4.18E-05	4.47E-05	0.21135	0.59328	0.50555	0.017626	4.85E-05
copper	0.34118	1.546	0.005993	0.000335	0.000357	0.77898	0.39754	0.81668	0.007017	0.000388
iron	17.581	57.541	4.9486	0.015419	0.016474	40.142	140.22	46.682	5.7942	0.017899
manganese	20.626	44.846	0.037157	0.00149	0.001592	47.092	0.064606	45.682	0.043505	0.001729
nickel	0.24176	0.96187	0.037078	0.000122	0.00013	0.55198	0.095509	0.93942	0.043413	0.000141
selenium	0.011236	0.13482	0.000208	8.36E-06	8.94E-06	0.025654	0.035869	0.025654	0.000243	9.71E-06
uranium	0.005055	0.032579	0.00049	4.13E-06	4.41E-06	0.011542	0.0039789	0.011542	0.000574	4.79E-06
zinc	2.417	11.553	0.011762	0.000627	0.00067	5.5185	11.438	15.992	0.013772	0.000728
Project Phase										
arsenic	0.012061	0.021801	0.000819	0.000194	0.000207	0.027538	0.02003	0.008313	0.000958	0.000225
cadmium	0.041478	0.15188	0.000436	6.16E-06	6.58E-06	0.094702	0.64506	0.13952	0.00051	7.15E-06
chromium	0.15615	1.1119	0.016081	9.87E-05	0.000105	0.35653	0.63376	0.65319	0.018828	0.000115
copper	0.37113	1.682	0.00619	0.000385	0.000411	0.84736	0.4106	0.87353	0.007248	0.000447
iron	30.678	112.03	5.1676	0.02312	0.024703	70.043	146.42	77.329	6.0506	0.026839
manganese	21.815	48.989	0.040348	0.003562	0.003806	49.807	0.070154	49.772	0.047242	0.004135
nickel	0.37768	1.5695	0.038579	0.000319	0.000341	0.86232	0.099377	1.3053	0.045171	0.000371
selenium	0.014551	0.14866	0.000214	1.47E-05	1.57E-05	0.033222	0.036982	0.033236	0.000251	1.71E-05
uranium	0.005762	0.03547	0.000501	9.73E-05	0.000104	0.013156	0.0040683	0.01316	0.000587	0.000113
zinc	2.5336	12.175	0.012285	0.000906	0.000968	5.7846	11.946	16.912	0.014384	0.001051

Notes:

All units in mg/kg/day (milligrams per kilograms per day).
COC = Chemical of Concern.

Table VIII-4 Estimated Daily Intake (EDI) of COCs from Various Food Items for Avian Receptors Based on 10% Soil and Sediment Bioaccessibility - Baseline and Project Phases (continued)

COC	Water Breeding Birds									
	Large						Medium			
	Carnivore			Herbivore			Carnivore			
	Fish	Sediment	Water	Grasses	Sediment	Water	Aquatic Invertebrates	Fish	Sediment	Water
Baseline Phase										
arsenic	0.009369	0.0021	5.55E-06	0.002995	0.000423	4.63E-06	0.0010462	0.01743	0.006551	1.23E-05
cadmium	0.000829	0.000191	8.64E-07	0.006211	3.85E-05	7.22E-07	0.0077245	0.001543	0.000596	1.92E-06
chromium	0.002298	0.018046	7.28E-06	0.12762	0.003637	6.08E-06	0.056384	0.004276	0.056294	1.62E-05
copper	0.19778	0.021232	5.82E-05	0.25132	0.004279	4.86E-05	0.55903	0.36794	0.066232	0.000129
iron	1.6299	12.683	0.002684	9.3539	2.5562	0.002241	28.18	3.0321	39.564	0.00596
manganese	0.030442	0.13696	0.000259	7.2902	0.027605	0.000216	2.7224	0.056634	0.42726	0.000576
nickel	0.019868	0.017285	2.12E-05	0.15636	0.003484	1.77E-05	0.0015294	0.036961	0.053919	4.70E-05
selenium	0.01768	0.000781	1.46E-06	0.021916	0.000157	1.22E-06	0.0047438	0.032891	0.002437	3.23E-06
uranium	0.000786	0.001109	7.19E-07	0.005296	0.000224	6.00E-07	0.00050112	0.001462	0.003461	1.60E-06
zinc	0.16752	0.036497	0.000109	1.8781	0.007356	9.11E-05	1.2906	0.31164	0.11385	0.000242
Project Phase										
arsenic	0.057006	0.0021	3.38E-05	0.003544	0.000423	2.82E-05	0.0063653	0.10605	0.006551	7.50E-05
cadmium	0.001028	0.000191	1.07E-06	0.024689	3.85E-05	8.95E-07	0.0095784	0.001913	0.000596	2.38E-06
chromium	0.005427	0.018046	1.72E-05	0.18075	0.003637	1.43E-05	0.13314	0.010096	0.056294	3.82E-05
copper	0.2276	0.021232	6.70E-05	0.27343	0.004279	5.59E-05	0.64332	0.42342	0.066232	0.000149
iron	2.444	12.683	0.004024	18.212	2.5562	0.00336	42.255	4.5467	39.564	0.008937
manganese	0.072795	0.13696	0.00062	7.9636	0.027605	0.000518	6.51	0.13542	0.42726	0.001377
nickel	0.052211	0.017285	5.56E-05	0.25514	0.003484	4.64E-05	0.0040193	0.097132	0.053919	0.000123
selenium	0.031128	0.000781	2.56E-06	0.024166	0.000157	2.14E-06	0.0083521	0.057909	0.002437	5.69E-06
uranium	0.018507	0.001109	1.69E-05	0.005766	0.000224	1.41E-05	0.011805	0.034431	0.003461	3.76E-05
zinc	0.24185	0.036497	0.000158	1.9791	0.007356	0.000132	1.8634	0.44993	0.11385	0.00035

Notes:

All units in mg/kg/day (milligrams per kilograms per day).
COC = Chemical of Concern.

Table VIII-4 Estimated Daily Intake (EDI) of COCs from Various Food Items for Avian Receptors Based on 10% Soil and Sediment Bioaccessibility - Baseline and Project Phases (continued)

COC	Water Breeding Birds			
	Medium			
	Herbivore			
	Leaves	Sediment	Grasses	Water
Baseline Phase				
arsenic	0.001481	0.002746	0.002429	7.32E-06
cadmium	0.007468	0.00025	0.005038	1.14E-06
chromium	0.11678	0.023601	0.10351	9.60E-06
copper	0.18866	0.027768	0.20385	7.68E-05
iron	10.784	16.587	7.5872	0.00354
manganese	10.553	0.17913	5.9133	0.000342
nickel	0.21701	0.022606	0.12683	2.79E-05
selenium	0.005926	0.001022	0.017776	1.92E-06
uranium	0.002666	0.001451	0.004296	9.48E-07
zinc	3.6943	0.047733	1.5234	0.000144
Project Phase				
arsenic	0.00192	0.002746	0.002875	4.45E-05
cadmium	0.032231	0.00025	0.020026	1.41E-06
chromium	0.15089	0.023601	0.14661	2.27E-05
copper	0.20179	0.027768	0.22179	8.84E-05
iron	17.863	16.587	14.772	0.005309
manganese	11.498	0.17913	6.4595	0.000818
nickel	0.30152	0.022606	0.20695	7.33E-05
selenium	0.007678	0.001022	0.019602	3.38E-06
uranium	0.00304	0.001451	0.004677	2.23E-05
zinc	3.9067	0.047733	1.6053	0.000208

Notes:

All units in mg/kg/day (milligrams per kilograms per day).
COC = Chemical of Concern.

Table VIII-4 Estimated Daily Intake (EDI) of COCs from Various Food Items for Avian Receptors Based on 10% Soil and Sediment Bioaccessibility - Baseline and Project Phases (continued)

COC	Water Breeding Birds							
	Medium					Small		
	Omnivore					Carnivore		
	Aquatic Invertebrates	Grasses	Sediment	Water	Terrestrial Invertebrates	Aquatic Invertebrates	Sediment	Water
Baseline Phase								
arsenic	0.0010213	0.005184	0.001919	1.20E-05	0.004654	0.0098462	0.020178	2.24E-05
cadmium	0.0075408	0.010749	0.000175	1.88E-06	0.037476	0.072701	0.0018353	3.49E-06
chromium	0.055043	0.22087	0.016486	1.58E-05	0.13989	0.53068	0.1734	2.94E-05
copper	0.54573	0.43497	0.019397	0.000126	0.093732	5.2615	0.20401	0.000235
iron	27.509	16.189	11.587	0.005826	33.061	265.22	121.87	0.010839
manganese	2.6577	12.617	0.12513	0.000563	0.015233	25.623	1.3161	0.001047
nickel	0.001493	0.27062	0.015791	4.59E-05	0.022519	0.014395	0.16608	8.54E-05
selenium	0.0046309	0.03793	0.000714	3.16E-06	0.0084573	0.044647	0.0075049	5.88E-06
uranium	0.00048919	0.009166	0.001014	1.56E-06	0.00093815	0.0047164	0.01066	2.90E-06
zinc	1.2599	3.2504	0.033344	0.000237	2.6968	12.147	0.35069	0.000441
Project Phase								
arsenic	0.0062139	0.006134	0.001919	7.33E-05	0.0047226	0.059909	0.020178	0.000136
cadmium	0.0093506	0.042731	0.000175	2.33E-06	0.15209	0.09015	0.0018353	4.33E-06
chromium	0.12997	0.31283	0.016486	3.73E-05	0.14943	1.2531	0.1734	6.94E-05
copper	0.62802	0.47323	0.019397	0.000145	0.096812	6.0548	0.20401	0.000271
iron	41.25	31.52	11.587	0.008736	34.524	397.7	121.87	0.016254
manganese	6.3551	13.783	0.12513	0.001346	0.016541	61.27	1.3161	0.002504
nickel	0.0039236	0.44159	0.015791	0.000121	0.023431	0.037828	0.16608	0.000225
selenium	0.0081534	0.041825	0.000714	5.56E-06	0.0087198	0.078607	0.0075049	1.04E-05
uranium	0.011524	0.009979	0.001014	3.68E-05	0.00095923	0.1111	0.01066	6.84E-05
zinc	1.819	3.4253	0.033344	0.000342	2.8167	17.537	0.35069	0.000637

Notes:

All units in mg/kg/day (milligrams per kilograms per day).
COC = Chemical of Concern.

APPENDIX IX

WILDLIFE RISK ESTIMATES

Table IX-1 Chronic Exposure Hazard Quotients for Mammalian Receptors Based on 100% Soil and Sediment Bioaccessibility - Baseline and Project Phase

Parameter	Caribou		Grizzly Bear		Shrew		Medium Carnivore		Medium Herbivore	
	Baseline	Project	Baseline	Application	Baseline	Project	Baseline	Project	Baseline	Project
Lower TRVs										
arsenic	0.01	0.01	0.004	0.004	0.08	0.09	0.003	0.003	0.010	0.01
cadmium	0.006	0.04	0.007	0.03	0.51	**2.1**	0.006	0.02	0.02	0.08
chromium	0.07	0.09	0.02	0.03	0.92	1.0	0.05	0.06	0.11	0.15
copper	0.027	0.030	0.02	0.02	0.25	0.26	0.07	0.07	0.09	0.09
iron	**1.1**	**1.5**	0.62	0.83	**28.8**	**30.3**	0.83	0.92	**1.8**	**2.7**
manganese	0.12	0.14	0.10	0.10	0.13	0.14	0.02	0.02	0.44	0.47
nickel	0.13	0.18	0.07	0.09	**1.2**	**1.3**	0.17	0.18	0.29	0.40
selenium	0.11	0.12	0.03	0.04	0.78	0.81	0.14	0.14	0.17	0.21
uranium	0.002	0.003	0.001	0.001	0.01	0.01	0.001	0.001	0.003	0.003
zinc	0.025	0.026	0.02	0.02	0.39	0.41	0.05	0.05	0.07	0.08
Upper TRVs										
arsenic	0.008	0.009	0.002	0.002	0.05	0.05	0.002	0.002	0.006	0.007
cadmium	0.004	0.03	0.006	0.02	0.39	**1.6**	0.005	0.02	0.02	0.06
chromium	0.06	0.080	0.02	0.02	0.79	0.85	0.05	0.05	0.09	0.13
copper	0.026	0.029	0.02	0.02	0.24	0.25	0.06	0.07	0.08	0.09
iron	0.35	0.048	0.21	0.28	**9.6**	**10.1**	0.28	0.31	0.59	0.89
manganese	0.10	0.11	0.08	0.08	0.10	0.11	0.01	0.01	0.35	0.37
nickel	0.082	0.11	0.04	0.05	0.76	0.81	0.11	0.11	0.18	0.25
selenium	0.11	0.12	0.03	0.04	0.77	0.80	0.14	0.14	0.17	0.20
uranium	0.001	0.001	0.0003	0.0003	0.006	0.006	0.0003	0.0003	0.002	0.002
zinc	0.025	0.026	0.02	0.02	0.39	0.41	0.05	0.05	0.07	0.07

Table IX-1 Chronic Exposure Hazard Quotients for Mammalian Receptors Based on 100% Soil and Sediment Bioaccessibility - Baseline and Project Phase (continued)

Parameter	Musk Ox		Small						Wolf	
			Carnivore		Herbivore		Omnivore			
	Baseline	Project	Baseline	Project	Baseline	Project	Baseline	Project	Baseline	Project
Lower TRVs										
arsenic	0.005	0.005	0.02	0.09	0.02	0.02	0.03	0.03	0.001	0.001
cadmium	0.006	0.04	0.01	0.05	0.03	0.13	0.25	0.99	0.0002	0.001
chromium	0.06	0.07	0.11	0.12	0.18	0.24	0.40	0.46	0.01	0.01
copper	0.03	0.03	0.19	0.20	0.14	0.15	0.17	0.18	0.003	0.003
iron	0.74	**1.1**	**1.8**	**1.9**	**3.0**	**4.4**	**10.1**	**11.4**	0.49	0.58
manganese	0.12	0.13	0.007	0.009	0.69	0.74	0.45	0.49	0.001	0.001
nickel	0.11	0.15	0.38	0.42	0.47	0.65	0.42	0.55	0.04	0.04
selenium	0.09	0.10	0.46	0.61	0.28	0.32	0.47	0.52	0.01	0.01
uranium	0.001	0.001	0.001	0.01	0.005	0.005	0.005	0.006	0.0002	0.0002
zinc	0.03	0.03	0.09	0.10	0.11	0.12	0.24	0.25	0.01	0.02
Upper TRVs										
arsenic	0.003	0.003	0.01	0.06	0.01	0.01	0.02	0.02	0.001	0.001
cadmium	0.005	0.03	0.01	0.04	0.03	0.10	0.19	0.76	0.0002	0.001
chromium	0.05	0.06	0.10	0.11	0.15	0.20	0.34	0.39	0.009	0.01
copper	0.03	0.03	0.18	0.19	0.13	0.14	0.17	0.18	0.003	0.003
iron	0.25	0.36	0.59	0.63	**1.0**	**1.5**	**3.4**	**3.8**	0.16	0.19
manganese	0.09	0.10	0.006	0.007	0.55	0.59	0.36	0.39	0.001	0.001
nickel	0.07	0.09	0.24	0.26	0.29	0.41	0.26	0.34	0.02	0.02
selenium	0.09	0.10	0.46	0.60	0.27	0.32	0.47	0.51	0.010	0.01
uranium	0.001	0.001	0.001	0.005	0.002	0.003	0.003	0.003	0.0001	0.0001
zinc	0.03	0.03	0.09	0.09	0.11	0.12	0.24	0.25	0.01	0.02

Notes: TRV = Toxicity Reference Value; **Bold** and highlighted values indicate a hazard quotient equal to or greater than 1.0.

Table IX-2 Chronic Exposure Hazard Quotients for Mammalian Receptors Based on 10% Soil and Sediment Bioaccessibility - Baseline and Project Phase

Parameter	Caribou		Grizzly Bear		Shrew		Medium			
							Carnivore		Herbivore	
	Baseline	Project	Baseline	Project	Baseline	Project	Baseline	Project	Baseline	Project
Lower TRVs										
arsenic	0.01	0.01	0.003	0.003	0.05	0.05	0.001	0.001	0.008	0.01
cadmium	0.006	0.04	0.007	0.02	0.51	**2.1**	0.006	0.02	0.02	0.08
chromium	0.06	0.08	0.02	0.02	0.66	0.7	0.04	0.04	0.09	0.13
copper	0.03	0.03	0.02	0.02	0.21	0.22	0.06	0.07	0.08	0.09
iron	0.6	**1.0**	0.34	0.51	**18.5**	**19.6**	0.12	0.16	**1.2**	**2.1**
manganese	0.11	0.12	0.10	0.10	0.10	0.11	0.01	0.01	0.44	0.47
nickel	0.10	0.14	0.04	0.06	0.3	0.3	0.11	0.12	0.23	0.35
selenium	0.11	0.12	0.03	0.04	0.72	0.75	0.13	0.14	0.17	0.20
uranium	0.001	0.001	0.0004	0.0005	0.01	0.01	0.0001	0.0001	0.003	0.003
zinc	0.02	0.03	0.02	0.02	0.39	0.40	0.05	0.05	0.07	0.07
Upper TRVs										
arsenic	0.004	0.004	0.002	0.002	0.03	0.03	0.001	0.001	0.005	0.006
cadmium	0.004	0.03	0.006	0.02	0.39	**1.6**	0.005	0.02	0.02	0.06
chromium	0.05	0.07	0.01	0.02	0.57	0.61	0.03	0.03	0.08	0.11
copper	0.02	0.03	0.02	0.02	0.20	0.21	0.06	0.06	0.08	0.09
iron	0.22	0.3	0.11	0.17	**6.2**	**6.5**	0.04	0.05	0.40	0.69
manganese	0.09	0.10	0.08	0.08	0.08	0.09	0.01	0.01	0.35	0.37
nickel	0.06	0.09	0.03	0.04	0.19	0.22	0.07	0.08	0.15	0.22
selenium	0.10	0.12	0.03	0.04	0.71	0.74	0.13	0.14	0.17	0.20
uranium	0.001	0.001	0.0002	0.0002	0.003	0.003	0.00005	0.0001	0.001	0.001
zinc	0.02	0.03	0.01	0.02	0.38	0.40	0.05	0.05	0.07	0.07

Table IX-2 Chronic Exposure Hazard Quotients for Mammalian Receptors Based on 10% Soil and Sediment Bioaccessibility - Baseline and Project Phase (continued)

Parameter	Musk Ox		Small						Wolf	
			Carnivore		Herbivore		Omnivore			
	Baseline	Project	Baseline	Project	Baseline	Project	Baseline	Project	Baseline	Project
Lower TRVs										
arsenic	0.004	0.005	0.01	0.08	0.01	0.01	0.03	0.03	0.0002	0.0002
cadmium	0.006	0.03	0.01	0.05	0.03	0.12	0.24	0.99	0.00004	0.0002
chromium	0.05	0.07	0.08	0.08	0.15	0.21	0.37	0.43	0.003	0.003
copper	0.03	0.03	0.18	0.19	0.13	0.14	0.17	0.18	0.002	0.002
iron	0.53	0.9	0.3	0.4	**1.9**	**3.3**	**8.9**	**10.2**	0.10	0.14
manganese	0.12	0.13	0.003	0.005	0.69	0.74	0.45	0.49	0.0004	0.0004
nickel	0.09	0.13	0.25	0.28	0.37	0.55	0.31	0.44	0.01	0.01
selenium	0.09	0.10	0.45	0.60	0.27	0.32	0.47	0.51	0.01	0.01
uranium	0.001	0.001	0.000	0.01	0.004	0.005	0.004	0.005	0.00002	0.00003
zinc	0.03	0.03	0.09	0.09	0.11	0.12	0.24	0.25	0.01	0.01
Upper TRVs										
arsenic	0.003	0.003	0.01	0.05	0.01	0.01	0.02	0.02	0.0001	0.0001
cadmium	0.005	0.03	0.01	0.04	0.03	0.10	0.19	0.76	0.00003	0.0001
chromium	0.04	0.06	0.07	0.07	0.13	0.18	0.31	0.37	0.002	0.00
copper	0.03	0.03	0.18	0.19	0.13	0.14	0.16	0.17	0.002	0.002
iron	0.18	0.29	0.10	0.12	0.6	**1.1**	**3.0**	**3.4**	0.03	0.05
manganese	0.09	0.10	0.002	0.004	0.55	0.59	0.36	0.39	0.0003	0.0003
nickel	0.06	0.08	0.15	0.18	0.23	0.35	0.20	0.27	0.004	0.005
selenium	0.09	0.10	0.45	0.60	0.27	0.31	0.46	0.50	0.008	0.01
uranium	0.001	0.001	0.0002	0.005	0.002	0.002	0.002	0.002	0.00001	0.00002
zinc	0.03	0.03	0.09	0.09	0.11	0.12	0.24	0.25	0.01	0.01

Note: TRV = Toxicity Reference Value; **Bold** and highlighted values indicate a hazard quotient equal to or greater than 1.0.

Table IX-3 Chronic Exposure Hazard Quotients for Avian Receptors based on 100% Soil and Sediment Bioaccessibility - Baseline and Project Phase

Parameter	Eagle		Hawks, Owls and Falcons		Upland Breeding Birds					
					Large		Medium			
					Carnivore		Carnivore		Herbivore	
	Baseline	Project	Baseline	Project	Baseline	Project	Baseline	Project	Baseline	Project
Lower TRVs										
arsenic	0.003	0.01	0.006	0.01	0.005	0.03	0.001	0.001	0.002	0.002
cadmium	0.002	0.008	0.065	0.26	0.004	0.004	0.008	0.03	0.01	0.06
chromium	0.02	0.02	0.18	0.19	0.01	0.03	0.09	0.10	0.12	0.15
copper	0.08	0.09	0.20	0.21	0.13	0.15	0.24	0.25	0.12	0.13
iron	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
manganese	0.001	0.001	0.001	0.002	0.009	0.02	0.001	0.001	0.16	0.17
nickel	0.02	0.02	0.05	0.06	0.00	0.01	0.08	0.08	0.09	0.12
selenium	0.07	0.10	0.18	0.20	0.07	0.13	0.18	0.19	0.05	0.07
uranium	0.0001	0.001	0.0003	0.001	0.0001	0.002	0.0001	0.0001	0.001	0.001
zinc	0.03	0.03	0.17	0.18	0.01	0.02	0.13	0.14	0.15	0.16
Upper TRVs										
arsenic	0.002	0.008	0.005	0.008	0.003	0.02	0.001	0.001	0.002	0.002
cadmium	0.001	0.005	0.04	0.16	0.002	0.003	0.005	0.02	0.008	0.04
chromium	0.03	0.03	0.19	0.20	0.02	0.04	0.10	0.11	0.13	0.16
copper	0.07	0.08	0.18	0.19	0.11	0.13	0.21	0.22	0.11	0.12
iron	0.07	0.07	0.8	0.8	0.22	0.29	0.13	0.13	0.34	0.49
manganese	0.0003	0.0004	0.001	0.0008	0.005	0.01	0.001	0.001	0.08	0.09
nickel	0.02	0.03	0.06	0.06	0.01	0.02	0.08	0.08	0.08	0.11
selenium	0.07	0.09	0.17	0.19	0.069	0.12	0.17	0.18	0.05	0.07
uranium	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
zinc	0.03	0.03	0.17	0.18	0.01	0.02	0.13	0.14	0.15	0.16

Table IX-3 Chronic Exposure Hazard Quotients for Avian Receptors based on 100% Soil and Sediment Bioaccessibility - Baseline and Project Phase (continued)

Parameter	Upland Breeding Birds							
	Medium		Small					
	Omnivore		Insectivore		Herbivore		Omnivore	
	Baseline	Project	Baseline	Project	Baseline	Project	Baseline	Project
Lower TRVs								
arsenic	0.03	0.04	0.05	0.07	0.02	0.02	0.03	0.03
cadmium	0.09	0.30	0.21	0.70	0.04	0.13	0.15	0.60
chromium	0.63	0.79	**1.0**	**1.4**	0.39	0.54	0.56	0.69
copper	0.73	0.82	**1.6**	**1.8**	0.48	0.52	0.51	0.54
iron	NP	NP	NP	NP	NP	NP	NP	NP
manganese	0.09	0.18	0.17	0.38	0.37	0.40	0.52	0.56
nickel	0.42	0.44	0.53	0.55	0.23	0.35	0.30	0.41
selenium	0.21	0.27	0.40	0.53	0.51	0.57	0.31	0.37
uranium	0.003	0.005	0.003	0.01	0.003	0.003	0.002	0.002
zinc	0.20	0.24	0.45	0.54	0.21	0.22	0.50	0.53
Upper TRVs								
arsenic	0.02	0.03	0.03	0.05	0.01	0.01	0.02	0.02
cadmium	0.05	0.19	0.13	0.43	0.02	0.08	0.09	0.37
chromium	0.61	0.76	0.99	**1.3**	0.37	0.51	0.53	0.66
copper	0.63	0.71	**1.4**	**1.6**	0.42	0.45	0.44	0.47
iron	**4.4**	**5.0**	**7.3**	**8.7**	1.0	**1.6**	**2.3**	**2.8**
manganese	0.05	0.09	0.09	0.19	0.19	0.20	0.27	0.29
nickel	0.34	0.36	0.43	0.45	0.19	0.29	0.25	0.33
selenium	0.20	0.25	0.37	0.49	0.48	0.53	0.29	0.34
uranium	NP	NP	NP	NP	NP	NP	NP	NP
zinc	0.20	0.24	0.44	0.54	0.21	0.22	0.50	0.52

Table IX-3 Chronic Exposure Hazard Quotients for Avian Receptors based on 100% Soil and Sediment Bioaccessibility - Baseline and Project Phase (continued)

Parameter	Water Breeding Birds					
	Large				Medium	
	Carnivores		Herbivores		Carnivores	
	Baseline	Project	Baseline	Project	Baseline	Project
Lower TRVs						
arsenic	0.01	0.03	0.002	0.002	0.01	0.05
cadmium	0.001	0.001	0.004	0.02	0.01	0.01
chromium	0.01	0.01	0.05	0.07	0.04	0.08
copper	0.05	0.06	0.06	0.07	0.25	0.28
Iron	NP	NP	NP	NP	NP	NP
manganese	0.008	0.008	0.042	0.046	0.039	0.061
nickel	0.03	0.03	0.03	0.04	0.09	0.1
selenium	0.09	0.13	0.08	0.09	0.21	0.31
uranium	0.001	0.002	0.0005	0.001	0.002	0.005
zinc	0.008	0.009	0.030	0.031	0.041	0.052
Upper TRVs						
arsenic	0.009	0.02	0.002	0.002	0.02	0.05
cadmium	0.001	0.001	0.003	0.01	0.006	0.007
chromium	0.07	0.07	0.06	0.08	0.22	0.25
copper	0.09	0.09	0.06	0.07	0.34	0.37
iron	**1.0**	**1.0**	0.28	0.35	**3.4**	**3.5**
manganese	0.004	0.004	0.02	0.02	0.02	0.03
nickel	0.02	0.03	0.02	0.04	0.07	0.08
selenium	0.08	0.13	0.08	0.08	0.20	0.29
uranium	NP	NP	NP	NP	NP	NP
zinc	0.008	0.009	0.03	0.03	0.04	0.05

Table IX-3 Chronic Exposure Hazard Quotients for Avian Receptors based on 100% Soil and Sediment Bioaccessibility - Baseline and Project Phase (continued)

Parameter	Water Breeding Birds					
	Medium				Small	
	Herbivores		Omnivores		Insectivore	
	Baseline	Project	Baseline	Project	Baseline	Project
Lower TRVs						
arsenic	0.014	0.014	0.013	0.016	0.094	0.117
cadmium	0.010	0.037	0.039	0.140	0.062	0.074
chromium	0.172	0.201	0.218	0.285	0.851	**1.1**
copper	0.165	0.173	0.313	0.344	**1.8**	**2.0**
iron	NP	NP	NP	NP	NP	NP
manganese	0.102	0.110	0.092	0.120	0.217	0.416
nickel	0.085	0.109	0.067	0.093	0.250	0.253
selenium	0.117	0.129	0.201	0.227	0.413	0.530
uranium	0.001	0.001	0.001	0.002	0.007	0.014
zinc	0.086	0.091	0.114	0.127	0.237	0.318
Upper TRVs						
arsenic	0.009	0.009	0.008	0.01	0.06	0.07
cadmium	0.006	0.02	0.02	0.09	0.04	0.05
chromium	0.16	0.19	0.21	0.27	0.815	**1.1**
copper	0.14	0.15	0.27	0.30	**1.6**	**1.7**
iron	**1.5**	**1.6**	**1.5**	**1.8**	**12**	**13**
manganese	0.05	0.06	0.05	0.06	0.11	0.21
nickel	0.07	0.09	0.06	0.08	0.21	0.21
selenium	0.11	0.12	0.19	0.21	0.39	0.50
uranium	NP	NP	NP	NP	NP	NP
zinc	0.09	0.09	0.11	0.13	0.24	0.32

Notes: TRV = Toxicity Reference Value; NP = Not Predicted; **Bold** and highlighted values indicate a hazard quotient equal to or greater than 1.0. A lower TRV for iron was not available; therefore an HQ was not calculated.

Table IX-4 Chronic Exposure Hazard Quotients for Avian Receptors based on 10% Soil and Sediment Bioaccessibility - Baseline and Project Phase

Parameter	Eagle		Hawks, Owls and Falcons		Upland Breeding Birds					
					Large		Medium			
					Carnivore		Carnivore		Herbivore	
	Baseline	Project	Baseline	Project	Baseline	Project	Baseline	Project	Baseline	Project
Lower TRVs										
arsenic	0.002	0.01	0.006	0.01	0.005	0.03	0.001	0.001	0.002	0.002
cadmium	0.002	0.008	0.065	0.26	0.004	0.004	0.008	0.03	0.01	0.06
chromium	0.02	0.02	0.18	0.19	0.01	0.03	0.09	0.10	0.12	0.15
copper	0.08	0.09	0.20	0.21	0.13	0.15	0.24	0.25	0.12	0.13
iron	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
manganese	0.0003	0.0004	0.001	0.001	0.009	0.02	0.001	0.001	0.16	0.17
nickel	0.02	0.02	0.05	0.06	0.00	0.01	0.08	0.08	0.09	0.12
selenium	0.07	0.10	0.18	0.20	0.07	0.13	0.18	0.19	0.05	0.07
uranium	0.0003	0.001	0.0002	0.0004	0.0001	0.002	0.00001	0.00001	0.00004	0.0005
zinc	0.03	0.03	0.17	0.18	0.01	0.02	0.13	0.14	0.15	0.16
Upper TRVs										
arsenic	0.001	0.008	0.004	0.007	0.003	0.02	0.0003	0.0004	0.001	0.002
cadmium	0.001	0.005	0.04	0.16	0.002	0.003	0.005	0.02	0.008	0.04
chromium	0.02	0.02	0.17	0.18	0.01	0.03	0.09	0.09	0.11	0.14
copper	0.07	0.07	0.17	0.18	0.11	0.13	0.21	0.22	0.11	0.11
iron	0.01	0.02	0.6	0.7	0.15	0.22	0.01	0.01	0.24	0.39
manganese	0.0001	0.0002	0.0004	0.0004	0.004	0.01	0.0004	0.0004	0.08	0.09
nickel	0.02	0.02	0.04	0.05	0.004	0.008	0.06	0.07	0.07	0.10
selenium	0.07	0.09	0.17	0.19	0.068	0.12	0.17	0.18	0.05	0.07
uranium	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
zinc	0.03	0.03	0.17	0.18	0.01	0.02	0.13	0.14	0.12	0.15

Table IX-4 Chronic Exposure Hazard Quotients for Avian Receptors based on 10% Soil and Sediment Bioaccessibility - Baseline and Project Phase (continued)

Parameter	Upland Breeding Birds							
	Medium		Small					
	Omnivore		Insectivore		Herbivore		Omnivore	
	Baseline	Project	Baseline	Project	Baseline	Project	Baseline	Project
Lower TRVs								
arsenic	0.01	0.02	0.02	0.04	0.01	0.02	0.02	0.025
cadmium	0.08	0.28	0.20	0.68	0.04	0.13	0.15	0.6
chromium	0.27	0.40	0.6	0.9	0.34	0.48	0.50	0.625
copper	0.63	0.72	**1.5**	**1.7**	0.47	0.51	0.49	0.528
iron	NP	NP	NP	NP	NP	NP	NP	NP
manganese	0.08	0.16	0.15	0.36	0.37	0.40	0.52	0.557
nickel	0.06	0.07	0.07	0.08	0.18	0.30	0.24	0.35
selenium	0.17	0.22	0.34	0.47	0.50	0.56	0.30	0.36
uranium	0.001	0.003	0.001	0.01	0.002	0.003	0.002	0.002
zinc	0.19	0.22	0.43	0.53	0.21	0.22	0.50	0.524
Upper TRVs								
arsenic	0.01	0.01	0.01	0.03	0.01	0.01	0.01	0.02
cadmium	0.05	0.17	0.13	0.42	0.02	0.08	0.09	0.37
chromium	0.26	0.38	0.54	0.8	0.32	0.46	0.48	0.60
copper	0.55	0.62	**1.3**	**1.5**	0.40	0.44	0.43	0.46
iron	**1.8**	**2.3**	**4.1**	**5.3**	0.6	**1.2**	**1.9**	**2.4**
manganese	0.04	0.08	0.08	0.18	0.19	0.20	0.27	0.29
nickel	0.05	0.05	0.06	0.06	0.15	0.24	0.20	0.28
selenium	0.16	0.21	0.32	0.44	0.47	0.53	0.28	0.33
uranium	NP	NP	NP	NP	NP	NP	NP	NP
zinc	0.18	0.22	0.43	0.52	0.21	0.22	0.50	0.52

Table IX-4 Chronic Exposure Hazard Quotients for Avian Receptors based on 10% Soil and Sediment Bioaccessibility - Baseline and Project Phase (continued)

Parameter	Water Breeding Birds					
	Large				Medium	
	Carnivores		Herbivores		Carnivores	
	Baseline	Project	Baseline	Project	Baseline	Project
Lower TRVs						
arsenic	0.01	0.03	0.002	0.002	0.01	0.05
cadmium	0.001	0.001	0.004	0.02	0.01	0.01
chromium	0.01	0.01	0.05	0.07	0.04	0.08
copper	0.05	0.06	0.06	0.07	0.25	0.28
iron	NP	NP	NP	NP	NP	NP
manganese	0.001	0.001	0.04	0.04	0.02	0.04
nickel	0.01	0.01	0.02	0.04	0.01	0.02
selenium	0.06	0.11	0.08	0.08	0.14	0.24
uranium	0.0001	0.001	0.0003	0.0004	0.0003	0.003
zinc	0.003	0.004	0.03	0.03	0.03	0.04
Upper TRVs						
arsenic	0.003	0.02	0.001	0.001	0.01	0.03
cadmium	0.0004	0.001	0.003	0.01	0.004	0.005
chromium	0.01	0.01	0.05	0.07	0.04	0.07
copper	0.05	0.05	0.05	0.06	0.21	0.24
iron	0.1	0.1	0.10	0.17	0.6	0.7
manganese	0.0005	0.001	0.02	0.02	0.01	0.02
nickel	0.005	0.01	0.02	0.03	0.01	0.02
selenium	0.06	0.10	0.07	0.08	0.13	0.22
uranium	NP	NP	NP	NP	NP	NP
zinc	0.003	0.004	0.03	0.03	0.03	0.04

Table IX-4 Chronic Exposure Hazard Quotients for Avian Receptors based on 10% Soil and Sediment Bioaccessibility - Baseline and Project Phase (continued)

Parameter	Water Breeding Birds					
	Medium				Small	
	Herbivores		Omnivores		Insectivore	
	Baseline	Project	Baseline	Project	Baseline	Project
Lower TRVs						
arsenic	0.003	0.003	0.01	0.01	0.01	0.04
cadmium	0.01	0.04	0.04	0.14	0.05	0.06
chromium	0.09	0.12	0.16	0.23	0.265	0.536
copper	0.10	0.11	0.27	0.30	**1.3**	**1.5**
iron	NP	NP	NP	NP	NP	NP
manganese	0.09	0.10	0.09	0.11	0.15	0.35
nickel	0.05	0.08	0.05	0.07	0.03	0.03
selenium	0.09	0.10	0.18	0.20	0.18	0.30
uranium	0.001	0.001	0.001	0.001	0.001	0.01
zinc	0.08	0.08	0.11	0.12	0.19	0.27
Upper TRVs						
arsenic	0.002	0.002	0.004	0.01	0.01	0.02
cadmium	0.005	0.02	0.02	0.09	0.03	0.04
chromium	0.09	0.12	0.16	0.22	0.253	0.513
copper	0.09	0.10	0.23	0.26	**1.2**	**1.3**
iron	0.3	0.4	0.7	0.9	**3**	**4**
manganese	0.05	0.05	0.04	0.06	0.08	0.18
nickel	0.04	0.07	0.04	0.06	0.02	0.03
selenium	0.08	0.09	0.17	0.19	0.17	0.28
uranium	NP	NP	NP	NP	NP	NP
zinc	0.08	0.08	0.11	0.12	0.19	0.27

Notes: TRV = Toxicity Reference Value; NP = Not Predicted; **Bold** and highlighted values indicate a hazard quotient equal to or greater than 1.0. A lower TRV for iron was not available; therefore an HQ was not calculated.