STUDY ON LAND AND RESOURCE USE BY THE INNU AND NASKAPI

HOWSE PROPERTY IRON ORE PROJECT

HOWSE MINERALS LIMITED

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1 INTRODUCTION

This study complies with the guidelines of the Canadian Environmental Assessment Agency (CEAA) for an environmental and social impact statement on the HOWSE Project iron ore deposit, which is located on the mineral properties of Howse Minerals Limited (HML) in Labrador. This study addresses the Proponent's obligation to integrate traditional knowledge into its analysis of social and environmental effects by collecting information and data on the use of land and resources in the study area. In addition, the study includes concerns voiced by land users regarding the construction of infrastructure and facilities and the use of the site's industrial operations in the interest of collecting information on the use of the study area and its resources.

The Project affects three groups in particular, namely the MATIMEKUSH–LAC JOHN, UASHAT MAK MANI-UTENAM and KAWAWACHIKAMACH First Nations, who are the primary holders of Aboriginal and treaty rights in the Howse Project study area. We have divided the main parts of this analysis according to the two nations, the Innu and the Naskapi. There is a sensitive area called KAUTEITNAT at the edge of the project area that is of particular interest to these groups.

A traditional knowledge approach requires the participation and collaboration of Aboriginal users in their capacity as providers of key information and observers influenced by their apprehension and their understanding of the mining project. Consequently, direct interviews with these informants are an essential element of our research methodology.

The current study is a necessary complement to the environmental impact statement and constitutes the primary source of knowledge about natural and cultural heritage, as well as the use of the project area and its resources for traditional purposes (ACEE, 2014) and the potential repercussions on the three groups involved.

1.1 PROJECT DESCRIPTION

HML plans to develop the iron ore deposit at the Howse Project. The deposit is located in Labrador, between Irony Mountain (Kauteitnat), Pinette Lake and Phase 1 of TSMC's Direct Shipping Ore (DSO) project (Figure 1). The Howse Project is located 25 km northwest of Schefferville, Quebec. The mine is centred at coordinates 67˚8'19.07"W, 54˚54'31.18"N; the property's mineral rights are registered to Labrador Iron Mines (LIM) (49%) and HML (51%) in the form of two mining concessions, 021314M and 021315M, which replace concession 0201430M (Figure 1).

The Proponent believes that mining can begin shortly, as the Project does not require many new installations and some of the necessary infrastructure is already available (e.g., railway tracks, access road, camp, mining equipment and explosives storage area) near TSMC'S Phase 1 complex, which is currently under construction for the DSO project. The Howse Mining Project was not part of TSMC'S initial plans, but had been part of LIM's plans (LIM, 2009). Due to a delay in the construction of the DSO project (haul road toward Project 2a – DSO 4, Goodwood and

Sunny deposits – and Project 2b – DSO 4 Kivivic deposits), TSMC reached an agreement with LIM, allowing it to mine the Howse deposit in order to maintain its annual production.

FACILITIES AND INFRASTRUCTURE REQUIRED TO MINE THE HOWSE DEPOSIT

Open pit mine: surface area of approximately 72 ha with a maximum depth of 160 m. The annual production capacity of raw ore is expected to be 1.3 million tonnes (Mt) for the first year and 2.2 Mt per year until the end of the mine's service life in 2027. Maximum production is expected to be 10,000 tonnes per day, which should be reached in 2017.

Stockpiles: surface areas of approximately 66 ha for the overburden and 4 ha for topsoil. Stockpiles will be surrounded by drainage ditches linked to a sedimentation pond.

Waste rock dumps: surface area of approximately 67 ha. The dumps will be surrounded by drainage ditches linked to a sedimentation pond.

Crushing and screening facility: surface area of approximately 3 ha. Powered by generators, this facility will be built on a platform that will be 100 m wide by about 150 m long.

Access and haul road: the existing road built by the Iron Ore Company of Canada (IOCC) for former mining activities will be used (1.3 km) and an additional 2.0 km will be constructed to link the Howse Project to the current road network of TSMC'S DSO project. This road will be used by mining trucks and light vehicles.

Water management facilities: peripheral wells will be installed on the mine's perimeter to lower the water table below the level of the pit. Whenever necessary, dewatering will be carried out using diesel-powered pumps. Water from rainfall and melted snow will be collected in drainage ditches and sent to a sedimentation pond before being released into the environment.

1.2 STUDY OBJECTIVES AND CONSTRAINTS

Overall, the study will:

1) Identify current and past parameters relating to the land and use of the study area and its resources by the two Innu groups (Matimekush–Lac John and Uashat mak Mani-Utenam) and the Kawawachikamach group.
2) Compile a range of data on aspects such as toponymy, ecology, hunting and fishing, as they are named and assessed by the groups.
   AND FINALLY,
3) Understand the concerns of Innu and Naskapi users with respect to the components of the Howse Project and their potential effects on traditional activities and community life.

Certain limitations or constraints became apparent when conducting this study. The most important of these is the Project's location, which is an area with several other former or current mining projects. This leads to confusion between the cumulative effects and the specific effects expected to result from the Howse Project. The impact of earlier projects is currently being considered with respect to the Howse Project and gives rise to the same concerns for the stakeholders we met with.

The other constraint applies to traditional activities practiced by elder informants who do not go to the study area frequently, but have perceptual knowledge of its current use and can share their prior knowledge of the area, which spans several decades. These elders recommended that we meet with younger users of the study area as they are more active there.

The segmentation of user groups into three categories (trapline holders, those affected by projects effects on a daily basis and the Naskapi who hold treaty rights) makes it very difficult to standardize the interviews into a single, uniform user profile and to draw different conclusions than those reached by previous studies conducted for other projects. Each user segment has its own interests: the people of Matimekush–Lac John claim that mining project effects affect their daily lives: those from Uashat mak Mani-Utenam are concerned about their traplines and the Naskapi worry about the joining of government-regulated interests with the non-government regulated lands of Labrador.

A number of studies (two Aboriginal traditional knowledge (ATK) studies linked to two impact statements) have been conducted in recent years and, although in high demand, ended up indicating similar concerns in the same areas. Stakeholder fatigue has proved to be a significant constraint. The length of the interviews, considering the amount of information being sought, also proved problematic, undoubtedly due to limited time and available manpower.

2 METHODOLOGY

2.1 STUDY AREA

The study area was designed to cover some of the Project's peripheral areas in order to identify lands and water bodies used by the Innu and Naskapi. It includes some of the facilities and infrastructure from TSMC's DSO-Phase 1 complex and the Timmins pits, as well as a series of lakes: Lac des Neiges, Morley Lake, Goodream Lake, Triangle Lake, Curlingstone Lake, Lone Lake, Burnetta Lake, Rosemary Lake, Elross Lake and a section of the Howells River shoreline. These water bodies surround Irony Mountain in all directions. The study area includes several trails that provide direct access to the numerous land use sites. Two traplines (207 and 211) from the Saguenay beaver reserve are within the limits of the study area, and their owners are from Uashat mak Mani-Utenam (Figure 2).

2.2 ABORIGINAL TRADITIONAL KNOWLEDGE (ATK)

ATK is defined as: "knowledge that is held by, and unique to, Aboriginal peoples. [It] is a body of knowledge built up by a group of people through generations of living in close contact with nature. ATK is cumulative and dynamic. It builds upon the historic experiences of a people and adapts to social, economic, environmental, spiritual and political change. [ATK] must be understood to form a part of a larger body of knowledge which encompasses knowledge about cultural, environmental, economic, political and spiritual inter-relationships" (ACEE, 2012). The term ETK

(Ecological Traditional Knowledge) refers to an ATK subset which is “the sum of the ideas and conceptions that Aboriginals possess about their natural habitat[1]” (Pouliot, 2014), meaning that it analyzes various aspects of the environment. In this case, ATK is an essential component in the analysis of the potential environmental effects of the Howse Project.

In addition, “ATK is a cumulative body of knowledge, know-how, practices and portrayals maintained and developed by a people whose history is interlinked with the natural environment” (Pouliot, 2014). ATK thus requires participation from the holders of such traditional knowledge. This is why it was necessary to conduct direct interviews with ATK holders.

2.3 IDENTIFICATION OF INFORMANTS

The informant selection process was achieved with the collaboration of Mr. David André of Matimekush–Lac John and Mr. George Guanish of Kawawachikamach. In the case of Uashat, the process was facilitated by Mr. André Michel. The selected informants were split into several subgroups. It should be noted that few women were able to take part in the interviews.

- Matimekush–Lac John
  Six elders
  Six young users
- Kawawachikamach
  Two elders (including a woman)
  Three young users
- Uashat mak Mani-Utenam
  Two groups of families who hold traplines 207 (one woman was present) and 211 (two women were present)

All of the interviews were conducted in the meeting rooms of each community’s band council. Only one meeting took place in a Mani-Utenam residence (trapline 207).

2.4 DATA COLLECTION TOOLS

2.4.1 Interview Planning

One of the key tasks was to create a questionnaire that took the study objectives into account. We used the sample questionnaire in Clément’s study (2009 1, 2009 II) for TSMC’s DSO project and adapted it to this study’s requirements (Appendix 1).

The questionnaire considered the following items:

- Names of important areas and sites (toponyms)
- General use of lands and camps
- Annual cycle of activities (species harvested, length of outings, transportation)

[1] All of the quotations written in a language other than English were translated.

- Revenues from activities and land use costs
- Other users
- Wildlife (mammals, fish, birds, etc.)
- Flora
- Kauteitnat
- Potential effects of the Project on the use of the land and its resources

As previously mentioned, in light of the length of the meetings and the number of informants present, it was not possible to discuss each item in detail. The following report is therefore limited to the information collected during these interviews. Furthermore, as mentioned below, for the last five years, mining operations have been taking place in the study area, which is primarily used as a passageway to other locations. As a result, some informants simply did not answer some of our questions about the study area in particular because they do not linger there. This is not due to a lack of interest for the study area, but because there was some redundancy in the consultation process.

Moreover, an interview consent form was signed by each of the elder informants from Matimekush–Lac John and Kawawachikamach to meet the ethical requirements of our study and to prove that their decision to take part in the interview process was free and informed. However, the form was not signed by young users and Uashat mak Mani-Utenam informants (Appendix 2). As a result, the names of the informants were kept anonymous in the following report.

2.4.2 Documentary Research

Over the years, multiple investigations and studies have been carried out in the Schefferville area. Many of them focused on the same subject, used the same methodological approach and reached specific conclusions relating to their particular issues.

- <u>Government guidelines on impact statements for mining projects:</u>

  All of the Project's narrative reports proved useful in understanding the scope and scale of construction and development in the study area. The CEAA guidelines (ACEE, 2014) for an impact statement provided the regulatory framework and the ATK consideration requirements for the impact statement process. References to the conclusions of previous project impact studies, notably for the New Millenium Iron (NML) DSO project, revealed the Canadian Government's growing concern for the place of Aboriginals in the assessment process.

- <u>Land use studies for impact statement purposes:</u>

  The "legendary" reference for the systematic evaluation of traditional land use was produced by Richard Laforest under the guidance of the Atikamekw and Montagnais Council; it is entitled *Recherche sur l'occupation et l'utilisation du territoire de Schefferville* (1983) and has always remained confidential. No equivalent study has been conducted since. Recent ATK studies on the history of Matimekush–Lac John land use were largely inspired by it, using the ethnography, toponymy and geopolitical parameters from the 1983 study and integrating them into their land use reports and impact statements. Here we are talking about the two land use studies conducted by Daniel Clément for the New Millennium DSO 1 and 2 project impact statements (January and December 2009).

A confidential land use study of family traplines was also conducted in 1998 for the Innu Takuaikan Uashat mak Mani-Utenam (ITUM). While it could prove extremely useful to land relations between the Matimekush–Lac John and Uashat mak Mani-Utenam groups, special permission is required to examine it and we were unable to access it.

With respect to the Naskapi, Allan Cooke's historical study (1976) focuses on the great Naskapi migrations in northern Quebec until their definitive settlement in Schefferville, during the 1950s. In addition, Michael H. Weiler (January and December 2009) carried out two land use studies on the Naskapi for the same NML DSO 1 and 2 projects for which Clément conducted his own studies, as previously mentioned. These studies are of interest because they describe three land use surveys covering three different periods: 1983, 1993 and 2006.

Special Research Studies on Toponyms

The works of St-Onge (1979) and Paré (1990) relating to toponymy studies on the Schefferville Innu and Naskapi, respectively, were briefly reviewed. Moreover, Laforest's 1983 research on land use contains an unpublished list of regional toponyms, as does the 1998 ITUM family trapline study.

2.4.3 Interviews and Participatory Mapping

- <u>The first interview sessions</u> were carried out in Matimekush on September 25 and in Kawawachikamach on September 26, 2014. We used **focus groups or discussion groups** in both cases. The groups were composed of elders from the two communities who had access to a topographic map (scale of 1:50,000) of the study area. A presentation of the Project and the main issues took place prior to the discussions. The sequence of the meetings was as follows: analysis of the area and understanding of the study, identification of the main toponyms and camp locations, travel routes and means of transportation, activity cycles, area resources, importance of Kauteitnat, current and past project activity constraints, and future effects of the Howse Project. Note-taking was the means used to document the conversations with translation of Innu and Naskapi into English and French and of map data. The group interviews were driven by direct participation for the identification of areas, roads, water bodies and information relevant to project constraints on the map of the study area.
- <u>The second interview sessions</u> took place during the last week of October in Matimekush–Lac John and Kawawachikamach and involved discussion groups composed of young Innu and Naskapi users. The interview process was nearly identical to the one used for

the elders, but the results were slightly different. The discussions with young users had been suggested by the group of elders.

- The interviews with the holders of traplines 207 and 211 were conducted individually (with each family) and followed the same approach and the same sequence of questions. The information was documented with written notes and on the same map of the study area as the one used during the meetings with the other groups. These interviews took place at Uashat mak Mani-Utenam during the first week of November 2014.

2.5 DATA ANALYSIS

The process of gathering ATK data from the three groups on the impact of the Howse Project on their traditional activities encountered a number of information biases caused by past or ongoing mining projects, notably the DSO and IOCC projects. Several of the comments were made spontaneously by our informants and focused on the current and cumulative damages and effects of these projects. We tried to find a way to analyze the effects of the other projects in their context and thus make it possible to assess the true potential effects of the Howse Project in its own unique context.

The following approach allowed for an appropriate assessment of the extent of the data collected to meet the initial objectives:

- Structuring the factual data from the last five years on the use of the study area for traditional activity purposes by identifying the outings, camp sites and resources harvested during the outing;
- Documenting any and all information about Kauteitnat;
- Identifying the cumulative effects of other projects that have constrained traditional activities to date (roads, dust, infrastructure, etc.) on the periphery of the study area and on resources;
- Identifying user concerns with respect to the Howse Project and their questions about mitigation measures.

An overall analysis was carried out by compiling data from the two discussion groups held with the elders, the two discussion groups held with the younger representatives and the meetings with the two trapline holders in relation to the main items depending on the type of questionnaire (land use data, Kauteitnat, cumulative effects, impact of the Howse Project). The participatory mapping information facilitated the grouping of land use and other data on the study area. The information on cumulative effects and the impact of the Howse Project was grouped according to the results of the interview sessions.

3 HISTORY OF LAND USE IN THE STUDY AREA

3.1 HISTORIC PERIOD

According to Laforest (1983) and Clément (2009), **the first proof of land use** in the Quebec/Labrador peninsula and south-central region (Schefferville) dates back to 7000 BP and the first contacts. A number of populations were leaving maritime areas (end of the Maritime Archaic tradition, 3000 BP and the first contacts) and migrating inland via watersheds. The purpose of these migrations was to hunt caribou and fish at certain times of the year, before returning to the coast. The tradition of moving inland and returning to the coast began during this period, known as the Shield Archaic period, and was transmitted over time. These populations are the ancestors of the Montagnais-Naskapi (Laforest, 1983). Up until the first contacts, the region's use had improved on the economic, technological and spatial organization levels.

The first contacts with European groups took place in the late 15th century and the early 16th century when they reached the main Quebec-Labrador entry routes. Norman, Breton and Basque fishermen were therefore present on the St. Lawrence River at that time. As part of an effort to find a route to India, explorers reached Labrador or Newfoundland (Caboto, Gaspard Corte-Real and Jacques Cartier). Further expeditions were organized and revealed the potential for fur destined for the European market: Frobisher for Baffin Island and the Hudson Strait, Henry Hudson for Ungava Bay and the Labrador coast. Other explorers also established contacts with Amerindian groups to facilitate the acquisition of pelts. These Amerindians would play a role in the relations between European merchants and fur producers from inland areas (Laforest, 1983) and it was at that time that the trading post at Tadoussac was created. (Figure 3).

The colonization of land that occurred in the 17th and 18th centuries was caused by fierce competition between merchants involved in the fur trade (Clément: 2009). The Council of Québec created the Tadoussac Trade or King's Domain (*Domaine du Roi*), which extended from Murray Bay to Cap du Cormoran, including inlands up to the watershed delineation. This competition took place between tenants of the King's lands and the Hudson's Bay Company. Numerous trading posts were thus created both inland and on the coast, the most well-known being the *Seigneurie de l'Isle aux Oeufs* and *Seigneurie Mingan*, which developed outposts in Sept-Îles, Moisie and Mingan. Hamilton Inlet also proved highly important for relations with the area's Amerindians and its numerous concessions, which included the *Lac des Naskapis* (Ashuanipi Lake), Winokapau, North West and Fort Nascopie trading posts. The Hudson's Bay Company managed Rupert's Land, with trading posts in Neoskweskau and Nemiscau (Laforest, 1983). This network of sites led to the migration of Amerindians toward the south-central region, where they became the main fur suppliers (Figure 4).

According to the first writings of missionaries and approximate interpretations by chroniclers of the period, the following seven **Amerindian populations migrated toward the south-central region (in the 17th and 18th centuries)** and were spread out between the coast and the region's inland areas:

- The **Montagnais** between Québec and Tadoussac;
- The Montagnais and the **Papinachois** around Betsiamites;
- The **Chisebec** and the **Oumamioue**k in the Moisie and Sept-Îles region;
- The **Cuneskapi** on Ashuanipi Lake;
- The **Ouchestigouetch** east of the latter;
- The Nitschikirinouets on Nichicun Lake (Figure 5).

These groups were composed of bands of families with 10 to 40 people (Laforest, 1983).

At the end of the 18th century, the monopoly of large merchant companies grew very rapidly over the northern and south-central regions, with fierce competition between the new North West Company, the Hudson's Bay Company and concession holders of the King's Domain. This led to the establishment of a number of trading posts in the Ungava region (Laforest, 1983). Despite the proliferation in trade, the abundance of caribou allowed Amerindian groups to operate independently from trade merchants. Two herds of caribou indeed migrated in the area and were sufficient to meet the bands' needs. The first "spent the summer on the western shore of Ungava Bay, but migrated in the autumn farther south to spend the winter as far away as Caniapiscau Lake. That herd corresponds to the current Herd of Caniapiscau, Delorme and Opiscotéo lakes. The second herd spent time on the Atlantic coast and in the autumn migrated west, crossing the George River. The George River herd still exists today" (Clément, 2009, p. 30). Caribou hunting became the source of a family-based social organization and of a land use system governed by the hunters' movements. An abundance of caribou affected relations with traders, because the Montagnais-Naskapi devoted all their energy to the hunt. However, fur-bearing animals were found elsewhere, mainly south of the caribou hunting grounds. Caribou was therefore the primary source of subsistence, and when groups turned to the trapping of fur-bearing animals, there was a risk of famine, because they moved away from their usual diet and from caribou migration areas (Laforest, 1983). In addition, as there were only a few beavers in the central plateau, this entailed the shortage of another means of subsistence.

In the mid-19th century, **the number of caribou in the central plateau declined,** and other species, most notably the beaver, also diminished significantly or disappeared entirely. Several forest fires decimated the region's caribou herds and affected natural migrations. Other causes could also be responsible for the scarcity of animal resources, such as natural phenomena or improvements in harvesting technologies. Cases of families suffering from famine were reported in Fort Chimo, Fort Rupert, Nichicun, Caniapiscau and near Koksoak River (Cooke, 1979). Dozens of families starved to death as a direct result of changes in caribou migration. On the other hand, trading posts were having a hard time supplying hunters with ammunition, which they demanded be traded in exchange for furs. However, the hunters were faced with a problem: they had no furs and consequently no ammunition to hunt the rare caribou (Laforest, 1983). Fort Nascopie also faced great difficulties because the Innu were unable to conduct their usual trades. Because of the scarce resources and food shortages, the Innu tried to find other means of ensuring their survival. They either turned to the fur trade or migrated toward the coasts of the St. Lawrence and of Hamilton Inlet in Labrador, toward the sea. Those who headed in the direction of the St. Lawrence travelled via the Manicouagan, Trinité, Sainte-Marguerite and Moisie rivers.

The distribution of Amerindian groups in the 19th Century in the south-central region was reconfigured according to watersheds, ecological regions and groups of migrating caribou:

- **Petesekapau Unnut**: Band from Petesekapau Lake, in the north
- Meneyik Unnut: Menihek Lake
- Kaniapeshkau Unnut: Caniapiscau Lake
- **Tshemanipistuk Unnut**: Sainte-Marguerite River, to the south
- **Mista Shipu Unnut**: East of Sainte-Marguerite River, now commonly known as Moisie River
- **Mishikamau Unnut**: To the northeast, Mishikamau Lake, a crossing point toward Labrador
- Wesakwopetan Unnut: Near Shelter Bay (Figure 6)

Other Innu bands settled along Mingan River, North West River, Davis Inlet, George River and Nichicun Lake. The bonds between these bands were tight due to the migration of game, weddings, trade and kinships (Laforest, 1983). For their part, the Naskapi could be found near Fort Chimo and Fort Nascopie (Cooke, 1976).

3.2 MODERN PERIOD 1900-1950

The land use system described above was to be the subject of adjustments in the 20th century because of new development factors, the establishment of Indian reserves and the creation of beaver reserves.

The closing of the Fort Nascopie trading post in 1868 due to long-term supply problems was a major event that would lead to changes in the land use habits of the above-mentioned groups in the central plateau. One group turned toward Fort Chimo (probably Naskapi-Montagnais people north of Fort Nascopie), which had re-opened in 1866. Other families headed to the Sept-Îles, Mingan and North West River posts (Laforest, 1983). Families from the Caniapiscau, Petitsikapau and Nichicun bands joined the Sainte-Marguerite group, while those from the Michikamau and Ashuanipi bands settled with the Moisie families. The latter spent their summers at the Moisie and Sept-Îles trading posts and at the Uashat mission.

The Sept-Îles reserve was created in 1909. Families continued to set up their summer camps in Moisie and Uashat. In 1926, there were an estimated 60 Innu families in Uashat and 200 Innu in Moisie, but they had administrative ties with the Sept-Îles band. There were more than 800 individuals in 1950 (Laforest, 1983). The grouping of Innu from this reserve into two different locations was the result of migration areas and the position of the Sept-Îles trading post. The designation of their identities is quite revealing of their allegiances. The explanations provided by Mailhot and de Vincent (Laforest, 1983) reveal the following identity trends based on migration routes and summer camps: the Innu from the Sept-Îles reserve are called UASHAUNNUT and originally lived near Sept-Îles Bay. Those who went up Sainte-Marguerite River are known as the TSHEMANIPISTUK UNNUT and migrated toward Caniapiscau Lake. The Moisie Innu, for their part, are called MISTA SHIPU UNNUT, meaning the Innu who use the “Great River”; they went as far as the George River. The Innu who lived on the reserve could use either the Sainte-Marguerite or Moisie rivers to reach their lands. Part of the Mista Shipu Unnut was split into families and had lands around Menihek Lake. They maintained relations with nearby bands, most notably those from North West River in the Michikamau region. This is significant because Michikamau Lake is a commercial buffer zone.

The period covering the first half of the 20th century gave a considerable boost to the trapping of fur-bearing animals, an activity that relied heavily on trading posts for the supply of domestic goods and products. New land use strategies were developed and the upper parts of watersheds and of the central plateau were once again occupied (Laforest, 1983). The Innu continued their traditional activities and the territory was divided according to the abundance of resources. There was an increase in both the dependence on trapping activities and in competition between traders (Hudson's Bay Company and other private companies) due to the opening of new inland trading posts. One such post, Fort McKenzie (1916-1948), opened at the source of Swampy River and drew families from Ungava, the Gulf of St. Lawrence and Hudson's Bay. This competition encouraged the Innu to take part in the fur trade. However, a new phenomenon occurred, namely the appearance of white trappers who ventured inland as a way to earn money, especially in the North West River region of Labrador. As a result, traditional land use was modified. The first government subsidies, which were handed out in 1910, as well as seasonal job offers were also crucial events in the lives of the Uashat Innu.

Another defining moment was the 1949 creation of the Mani-Utenam Reserve, established to relocate both the bands living in Sept-Îles and the Innu living in Moisie to this site in order to facilitate their integration in the agglomeration of the city of Sept-Îles. The Saguenay beaver reserve was also created in 1954 and included Matimekush and John Lake, but the landowners were all from Uashat at the time the reserve was established. Before Schefferville was founded, only people from Uashat mak Mani-Utenam (Mista Shipu Unnut) used to migrate to the area. The new Indian Act (1952) forced the federal government to implement housing, health, education and social security programs, thus providing incentives for the Innu to leave their land and move away from their traditional activities (Figure 7).

In the early 1950s, mining development took off in Schefferville with the mining of iron ore. This development would require the building of transport (railway) and port facilities in Sept-Îles. These mining operations led to the creation of the city of Schefferville, near Knob Lake, in order to house workers, as well as the industrial and commercial facilities required to meet IOCC's needs. This offered appealing opportunities for the Innu, who could take part in the building of the railway and find employment. Knob Lake thus welcomed a large number of Innu when operations began, which indisposed the company and its workers due to pollution, and the Innu were given land at John Lake in 1956. That same year, 175 Naskapi from Fort Chimo settled near the railway installations. The company then demanded that the Naskapi be moved to the John Lake site with the Innu, which was a very strange request considering the migration habits of the two bands and their different origins. At the time, the status of these Innu linking them to their original bands of Uashat mak Mani-Utenam was not recognized by the federal government. It was only in 1968 that the Schefferville Innu were officially recognized as an autonomous band. They were relocated to a site at Pearce Point, but several families chose to stay behind in John Lake. Today, they can be found at the Matimekush Reserve (Laforest, 1983). The Naskapi were also relocated to the edges of that reserve until they obtained their own village in Kawawachikamach.

Before the advent of mining, **land use from 1900 to 1950** was characterized by the movement patterns of the various Innu groups. The region of Schefferville was used by the Mista Shipu Unnut group, which is a Moisie subgroup of the Uashau-Innuat, a band formally recognized by the federal government. In June, they travelled from the north to the south to reach the different summer camps, and then from the south to the north for the great fall migration. This route led from the mouth of the Moisie River up to Menihek Lake and was punctuated by long portages. Throughout the migration, the large group was divided into smaller family groups according to the location of their lands. At Menihek Lake, a number of secondary routes were used to reach the different destinations. This lake was the main centre for migrations to other destinations that started at the mouth of the Mista Shipu (Moisie) (Laforest, 1983). The lake is located a few kilometers south of Schefferville, a city that was a thriving at the time. It is no accident that the Innu were present when the iron ore was discovered.

The annual cycle was the following:

- The summer ascent: The Mista Shipu migrated toward Menihek Lake with breaks to hunt for small game and fish and headed from there to other destinations.
- The fall hunt: Camps were set up near water bodies to hunt caribou.
- Wintering: Trapping of fur-bearing animals and small game, as well as caribou hunting depending on abundance.
- The spring descent: In April, they descended toward the spring meeting sites, hunting otters along the way to Menihek and Ashuanipi. Migratory bird hunting was the primary spring activity before travelling on the Mista Shipu river.
- Navigating the sea: Toward the Moisie, Sainte-Marguerite and Uashat sites.

3.3 LAND USE BY THE INNU SINCE 1950

Numerous changes occurred when the IOCC established itself in Schefferville. It brought about a shift to a sedentary lifestyle for part of the Mista Shipu Unnut in Knob Lake, along with the possibility of being closer to sites where they could conduct their traditional activities. The industrial facility provided the company with an opportunity to group the Innu together at John Lake. Government interventions and the presence of other Canadians nearby would also have a strong influence on the social model being established in terms of land use. These new changes would alter the traditional land use model that had been in use for decades.

3.3.1 Constraining Changes

As stated by Clément (2009), who echoed the argument made by Laforest (1983), political, economic and social factors accounted for the changes in the land use habits of the Matimekush–Lac John Innu.

The creation of the Saguenay beaver reserve in 1954 and the splitting of the territory into individual traplines were considered a direct repudiation of the Mista Shipu Unnut’s land management system by the State. The policy, which was ostensibly to protect resources, effectively meant that the State took control of their land and resource management. This territorial configuration went against their consensual right to share and belong to the land.

Another important event was the signing of the James Bay and Northern Quebec Agreement and the Northeastern Quebec Agreement, which had the effect of imposing a legal and administrative framework to third party Uashat mak Mani-Utenam and Matimekush–Lac John, who were not signatories to the agreements. This meant that families and their descendants no longer had control over the traditional management of these lands and had to follow someone else’s rules.

A significant portion of the ancestral lands of Matimekush–Lac John and Uashat mak Mani-Utenam families is located in Labrador and is thus subject to the legislation of the Province of Newfoundland and Labrador. Until 1968, the Innu from both communities were considered residents of Labrador. However, the Province of Newfoundland and Labrador changed its position in 1968 and they have been considered residents of Quebec ever since. This change made it illegal to practice traditional activities in Labrador, even though the beaver reserve traplines are located in Labrador. This has been an ongoing contentious issue. The Innu were also subjected to new rules, such as the necessity to hold permits to hunt certain game. Caribou hunting has also been closely monitored.

In both Quebec and Labrador, the Innu must comply with laws and regulations pertaining to the management of land and wildlife resources. The governments have allowed the creation of recreational sites and outfitting businesses, and have imposed multiple economic measures that have altered Innu land use. The invasion of this area has altered the traditional nature of the land use. As a result, the Innu occupy a significantly smaller territory than during the period from 1900 to 1950.

It should be mentioned that, originally, all the individual traplines of the Saguenay beaver reserve of the Naplekunnu (Innu living in Schefferville) were part of a single spatial unit that represented their land. However, the Matimekush–Lac John and Uashat mak Mani-Utenam Innu have now been combined into a single beaver reserve management unit. When the reserve was created, the Naplekunnu were listed as part of the Sept-Îles band. Naplekunnu traplines tend to be located north of Ashuanipi Lake. This is the result of the settlement of some users in Schefferville for mining development. Several Uashaunnut Innu have traplines near Schefferville, while those of the Matimekush–Lac John Innu are located far outside this area. It may seem confusing to determine why the Uashaunnut have their traplines near Schefferville or in Labrador while those of the Naplekunnu are located well outside the boundaries of the mining area. The answer lies in how land use was traditionally structured and individual choices made to remain close to employment opportunities. Many Innu did not move to the site of their trapping ground, choosing instead to remain in Uashat mak Mani-Utenam.

3.3.2 Travel Routes

At the time, land use by the Matimekush–Lac John Innu takes place from a fixed point, namely Schefferville. The migration movement no longer follows the former traditional annual cycle of ascending and descending for long periods of time, but has become a process of going back and forth to supply sites some distance away. The routes contain few camps; the Innu reach their sites in one day. The previous transportation network changed once settlement occurred, but now contains additional transport options, such as trains and roads built by the company, or snowmobiles and motorized canoes. Traffic near Schefferville is dense, but gradually eases as you move away from the city. According to Laforest (1983), there are many travel routes, but they are poorly documented, unlike in earlier times.

3.3.3 Annual Cycle

The economic, political and social changes disrupted the Innu’s way of life and transformed the ways in which the land was used, as well as the annual cycle of activities. Nevertheless, hunting and trapping still remained important for the economy of the Matimekush–Lac John people. The annual cycle was as follows:

- Fall prior to the freeze-up: Caribou hunting both north and south of Schefferville
- Fall after the freeze-up: Trapping of fur-bearing animals nearby and in remote areas
- Wintering: Few activities, the main preoccupation being the status of caribou migration
- End of winter: Caribou hunting and trapping resume
- Spring: Waterfowl hunting and net fishing during the spring break-up
- Summer: Fishing on the numerous lakes and rivers nearby and farther away

3.4 LAND USE BY THE NASKAPI SINCE 1956

As previously mentioned, in 1956 the Naskapi arrived in Schefferville from Fort Chimo to profit from mining opportunities and because, according to Cooke (1976), government officials had forced their hand. For several decades, the federal government had provided them with supplies while they lived in the Fort McKenzie and Fort Chimo settlements. When they arrived in Schefferville, the federal government and the IOCC decided to group them together, with the Innu at John Lake and subsequently at Matimekush, when it became a reserve. As of 1956, land and resource use was shared between the two groups according to internal sharing arrangements. This period of sharing would last nearly 20 years. However, the Northeastern Quebec Agreement slightly destabilized this harmony by imposing priority interests regarding land and resource management in a way that benefitted the Naskapi, at the expense of the Innu (Laforest, 1983, Clément, 2006). Nevertheless, the traditional cohabitation and use of ancestral lands and resources remained well-established and stable. Michael H. Weiler conducted three land use studies of the region by the Naskapi, and we will reproduce the key information gathered here. The author divided his analysis into categories: caribou hunting, fishing, waterfowl hunting, small game hunting, trapping, access routes and camps.

3.4.1 1954 to 1982

During this period, the Naskapi were first located at John Lake (1956 to 1972) and later at Matimekush (1972 to 1984). Caribou were the Naskapi's primary means of subsistence. The George River herd was being replenished after having nearly disappeared at the turn of the century. The Naskapi had some difficulty adapting to their new sedentary way of life; some of them participated in the local mining economy while others tried to survive through wildlife harvesting and government subsidies (Weiler, 2009).

Caribou Hunting

Although the presence of caribou fluctuated and was unpredictable at the beginning of the period, hunting was still a significant source of the Naskapi food supply (Weiler, 2009) and the meat was shared with other community members. The hunt required the building of camps, even though it took place in the vicinity of Schefferville. Several hunters used trucks and snowmobiles to carry hunting products. Caribou hunting was conducted in three areas of the broader Schefferville area:

- On parts of the ridge between Schefferville and Howells River, including the northern part of Sunny Mountain and Greenbush and the western side descending into the Howells River valley;
- In the area west of Howells River, including the western part of the valley and the wooded section of the adjacent plateau;
- In the Attikamagen Lake area and the series of lakes to the north of it.

Of these three areas, the largest density of caribou was recorded further north, on Sunny Mountain/Greenbush, which is used primarily in the fall. When the herd increased, the two other areas were used during winter if the herd had dispersed. According to Weiler (2009), no hunting data is available for sites near mining operations and facilities.

Fishing

Fishing was an extremely important source of food during the first years following the Naskapi relocation, in light of the decrease in the number of caribou. Fishing nets were used and the frequency at which catches were verified was quite demanding. Camps had to be set up to check the nets and stay near fishing areas for periods of time. Fishing areas were located in water bodies upstream from the Swampy Bay basin and Attikamagen Lake. The Elross, Fleming and Kivivic lakes in the Howells River valley were also popular locations. Despite its proximity, Howells River was not used frequently because of traffic and the security gate.

Small Game Hunting

Small game was harvested in addition to the other activities of fishing, berry picking and trapping. This type of hunting could also be conducted in areas near the community. The most productive season was winter, because of the presence of the Willow Ptarmigan. Small game hunting activities were carried out in the areas northwest, south and southwest of Attikamagen Lake.

Waterfowl
Migratory bird hunting was an important part of the food supply chain at the time: spring lakes were not yet secure, and caribou were less mobile and absent from the area. Migratory birds were appreciated in the spring and provided an opportunity to fill food caches. They were easy to kill as they migrated and landed in sites that were easily accessible. In the fall, during their return journey, they stopped to eat wild fruits on the shores of water bodies or on mountain ridges. The areas most frequently used were Attikamagen Lake, the upstream section of Swampy Lake and the Ferrum River basins near the Annabel, Gillard and Roullois lakes, and Harris Lake near the Howells and Goodwood rivers.

Trapping
Trapping did not play a major role in the way of life of the Naskapi until this period because of their mobility and preference for caribou. However, its importance in Innu activities grew whenever a source of income was urgently needed. Several trapping sites are well-known: one is the upper and central part of the Howells River basin, and another is around Baussac Lake and in the area northeast of the Basseau and Matemace lakes. Others are located in the area of the Swampy Bay and Ferrum rivers around the Gillard, Roullois and Grouvel lakes, and at Attikamagen Lake.

Camp Sites
Only two camp sites were identified during this period: one in Vacher Lake and the other in an area between the Peter and Matemace lakes, which would eventually become the site of the Kawawachikamach village.

Travel Routes
There were two main travel routes:

- From Howells River toward Ungava Bay with the Ashuanipi region, via the lower part of the Koksoak, Caniapiscau and Goodwood rivers in the north, and the Menihek and Ashuanipi lakes in the south;
- From Swampy Bay and its links to the Ungava region, via the lower Koksoak and Caniapiscau rivers with the Attikamagen and Petitsikapau lake plateau, and ultimately Michikamau Lake.

3.4.2 1982 to 1993

Several factors led to changes in the Naskapi's way of life. The building of the Kawawachikamach village during this period and the move to that location caused profound changes in the community's social, cultural and economic vision, as well as in its values and aspirations. The closing of the IOCC mine in 1982 disturbed the economic, physical, human and social environment of the new community. A number of constraints and benefits suddenly vanished. The caribou of the George River herd grew in size and could now easily cross the ridge during its fall migration. Such factors would change land use habits and the harvesting of species.

Caribou Hunting
With the great abundance of caribou and its migration through the ridge (Howells and Schefferville) in the fall, this area became the preferred hunting ground. The proximity of the caribou to the city and the fact that it could be reached through a number of IOCC routes attracted local hunters to this particular type of hunting, which did not require excessive costs or camps. The part of the ridge that included the Swampy Bay River basin to the east and a western section of the Howells River valley constituted the caribou hunting areas.

Fishing
Fishing activities are concentrated east of the Attikamagen Lake area and in the upper basin of Ferrum River where the Tait, Hayot, Roullois and Pluton lakes are located. Fishing activities were also recorded on both sides of the ridge, along the upper basin of Swampy Lake River and in lakes surrounding Howells River. Several lakes located near mining operations were avoided through fear of contamination.

Small Game Hunting
It has already been mentioned that this type of hunting was of secondary importance when there was an abundance of other harvesting activities. Little information was provided about this period.

Waterfowl
The only indication of migratory bird being harvested was along the water bodies of the Swampy Bay River basin, such as the Vacher, Guisot, La Miltière and De Miley lakes. This activity did not take place exclusively in the spring.

Trapping
There were two main preferred trapping areas. One is located in a part of the Swampy Bay River basin and the other is on the eastern shore of the Howells River valley. Most of the fur-bearing animals of interest were trapped in these locations and in the forest: marten, weasel, ermine, wolverine, lynx, squirrel, beaver, muskrat, mink and otter. The Red Fox, Arctic Fox and wolf could also be harvested.

Travel Routes
The previously described travel routes continued to be used.

3.4.3 2006 Survey

This survey only gathered data on the Howells River basin, not on other areas of interest to the Naskapi. It is worth mentioning that this part of the territory, which is near Schefferville, is a widely-used area (Weiler, 2009).

Caribou Hunting
The survey showed intense caribou hunting activities in the Howells River basin, with the exception of the vicinity of Schefferville. The densest concentration of caribou hunting activities was recorded along the ridge between DSO 2 and the Goodwood crushing facility. Another dense

area is located in the Howells River basin, between the Kivivic and Stakit lakes. During the fall migration, it is along these areas that the largest amount of hunting activities takes place when the caribou arrive in very large numbers via the numerous hills from which they can be observed. After the migration, several small groups of caribou remain behind, wintering and dispersed throughout the Howells River valley and in wooded areas west of the plateau. Hunting occurs long after the migration, during winter. After the decrease in the caribou population in the 1990s and its reappearance in large numbers in the area following the end of mining operations, hunting once again became accessible, and the Howells River area was considered a hunting ground. Given the proximity of the hunting area, this activity is inexpensive and does not require much time.

Big Game Hunting – Bear and Moose

The Black Bear was included in the hunting activities of the Naskapi and is an important part of their subsistence. It is only recently that moose appeared in the Schefferville area. They can live in the wooded section of the territory and most notably in the Howells River valley. The Black Bear population is very large in the valley and the Swampy Bay River basin.

Fishing

The survey revealed that Howells River and the lakes in its valley were the Naskapi users' favourite spots to fish the large quantities of Brook Trout and chub. Lake Trout, Northern Pike, Lake Whitefish and ouananiche are also found in several lakes. The informants stated that fish no longer existed in the lakes located near the former mining pits.

Small Game Hunting

The wooded area of the Howells River valley is conducive to the harvesting of ptarmigan, grouse, porcupine and the Snowshoe Hare. Porcupines nearly disappeared from the area, but returned a decade ago. The partridge, hare and porcupine are the three most harvested species around the Swampy Bay River.

Waterfowl

There are three ecological regions for waterfowl: the Howells River valley, the ridge and the Swampy Bay River. There is also Attikamagen Lake, which is the most well-known and most popular area; it is where activities are the most intense and productive. During the spring migration, the Canada Goose and duck are harvested in large numbers in Howells River and its surrounding lakes, where there are several Ashkui. During the summer, several Canada Geese and species of duck can be found in the valley. During the fall, the hills and the ridge host flocks of Canada Geese drawn by wild fruits, and shot by hunters.

Trapping

Trapping activities take place mainly in the Howells River valley, but also in other areas. The combination of the dense forest and water bodies provides natural conditions that are conducive to the proliferation of fur-bearing animals. The marten, weasel, squirrel and lynx are all present in these silvicultural areas. Conditions in these wetlands are also favourable for otter, mink and muskrat. On the other hand, the number of beavers is moderate, but is on the rise. There are large quantities of wolves and Red Foxes in the valley and they are harvested in great numbers. Wolves are very active during the caribou migration. Moose also seem to be present in the area, but none were killed by informants. The situation is similar in the Swampy Bay River basin.

Wild Fruit Picking
The valley's microclimate is prone to a type of vegetation that encourages the growth of plants and fruits. Blueberries, bilberries, lingonberries, cloudberries and crowberries are all fruits that have proliferated, as have the tamarack, Labrador tea, birch, moss and special woods used to make tools and crafts. Several plants are also used for their medicinal properties. The fruit varieties all grow abundantly and are gathered in the Swampy Bay River basin.

Travel Routes
Howells River is one of the traditional north-south routes. There are also trails along the river that are used for snowmobile transportation. There is one such trail north of Rosemary Lake and another at Stakit Lake.

Camps
Several camps are located in areas containing animal and plant resources, notably at the Kivivic, Elross and Fleming lakes in the Howells River basin, as well as at the entrance to the central part of Stakit Lake.

These three surveys show that the areas favoured by the Naskapi between 1956 and 2006 are largely located around the Howells River valley and the Swampy Bay River basin. The Naskapi are also fond of the area that includes the ridge, which is located between the city and the other watersheds near Howells River. Harvesting activities seem to fluctuate as a result of the decrease in the number of caribou when the Naskapi first settled in Schefferville until herd numbers rose again after the IOCC closure. These activities are also facilitated by the presence of the road network.

4 TOPONYMY AND DESIGNATION OF TERRESTRIAL/AQUATIC SPECIES AND EDIBLE BERRIES IN THE STUDY AREA

This section will provide a list of toponymic elements identified during informant interviews, as well as the designation of species in the study area. For a number of reasons, we did not subdivide this content into the two languages. A Naskapi elder confirmed that:

- the majority of locations (sites, lakes, rivers and access routes) in the area were named by the Innu;
- the names of species are similar in both languages;
- the Naskapi use some watershed names that were given by English or French speakers instead of using Innu names in certain cases and the Naskapi language is mainly used for a number of toponyms outside of the study area and the region.

It is likely that the Naskapi named spaces, watersheds and sites in the Fort McKenzie, Fort Chimo and Ungava areas when they used these areas. However, the informants seemed comfortable with the linguistic mix (Innu/Naskapi) in the Schefferville area. The young Innu and Naskapi also use allophone names for roads, watersheds and operating sites. In the course of our interviews, the elders often used Innu toponyms while also referring to the allophone toponyms to be more specific and to clearly express their views. The influence associated with the naming of sites and the replacement of toponyms by those from allophone languages are always very clear during the development of a territory and is a recurring phenomenon in Quebec. The study area thus shows signs of external influence. We will only list the names of the locations, as well as the animal, fish and wild fruit species that were mentioned during the interviews.

Geographic Locations:

- **Kauteitnat**: Heart-shaped mountain (Irony Mountain)
- Menihek Shakainiss: Pinette Lake
- Messeku Nipi: Peat lake
- **Papateu Shipu**: Howells River
- **Kapashekuauiass**: Small wooded area (toward Goodwood)
- **Tekutaut Meshkenu**: Mountain ridge road, company road
- Tshitshitua Mani Meshekenu: Virgin Mary road

Names of Land Animal Species:

- **Atik(u)**: Caribou
- Amishk(u): Beaver
- Atshakash: Mink
- Matsheshu: Fox
- Nitshik(u): Otter
- Uapistan: Marten
- **Kak(u)**: Porcupine
- Uapush: Hare

Fish:

- **Matamek**: Brook Trout
- **Uanan**: Ouananiche
- **Kukamess**: Lake Trout
- Tshinusheu: Pike

Migratory Birds:

- **Nishk**: Canada Goose
- **Muak**: Loon
- **Kuaikan**: Black Scoter

- **Auiu**: Long-tailed Duck
- **Inniship**: American Black Duck

Partridges:

- Innineu: Grouse
- **Uapineu**: Snow Partridge (Willow Ptarmigan)

Wild Berries:

- Inniminanakashi: Blueberry
- **Shikuteu**: Crowberry
- Uitshiminanakashi: Cloudberry
- Nissiminanakashi: Bog Bilberry

5 USE OF THE STUDY AREA BY THE INNU

The current use of land and Innu-Aitun (Innu traditional knowledge) reflect the economic factors of the period since the opening and closing of the IOCC mine, the development of Schefferville and the recent renewal of mining activities. Many of the Innu elders have stopped their traditional activities, but do not deny that they sometimes head to their more distant lands for journeys of various durations. They claimed that they have not been involved in recent activities conducted in the study area, but mentioned that the young users were very active there. The latter provided us with good information on the various uses of the sites in the study area for short seasonal activities, as well as for specific harvests. They view the area near Matimekush–Lac John as an alternative for the practice of Innu-Aitun and inexpensive harvesting activities.

The other informants that we met were the holders of traplines 207 and 211 from Uashat mak Mani-Utenam, next to the study area. While far away from mining areas, they clearly belong to the study area even though they do not maintain a sustained presence or carry out daily activities there. The informants provided us with information on the area's new structure of land use by family members, which attempts to harmonize everyone's rights and interests. The elder who owns trapline 207 came up with a new way to distribute the land from Menihek Lake to Ushkuass Lake into four or five territorial sectors shared among the children of brothers and brothers-in-law, to better reconcile trapline use by those who also live in Matimekush–Lac John.

It is important to understand that people living in Matimekush–Lac John are the most frequent users of the study area, which is located near the communities and can easily be accessed through the existing road network. By comparison, the users of Uashat mak Mani-Utenam come by train when temporarily staying at their traplines. Proximity to the study area is a factor that predisposes some users to the more regular practice of Innu-Aitun; those who live further away may have a more restricted presence, but nevertheless retain their land use rights (Figure 8).

5.1 TRAVEL ROUTES

The study area contains a series of roads built by the IOCC. These roads, some slightly altered and others upgraded for the current TSMC and LIM operations, are used by the Innu for their traditional activities. Two major gravel roads cross the study area. The first and most northern is called the Tshitshitua Mani Meshkenu, or Virgin Mary road; it begins in Schefferville and leads up to the Annabelle and Leroy lakes. The other, known as Teketaut Meshkenu, mountain road or Greenbush Meshekenu, runs parallel to the other road and also begins in Schefferville. It leads up to Le Fer Lake and crosses the mountain ridge where the main IOCC iron ore sites were located. Once it reaches KAUTEITNAT, which it borders on its eastern side, it is divided into two segments that lead toward Greenbush in the northeast and toward the Howells River valley in the west. The latter segment, which goes to Papateu Shipu (Howells River), is frequently used by the Innu for a number of traditional activities. A side trail unites these two roads (Tshitshitua Mani Meshkenu and Teketaut Meshkenu) and crosses the planned Howse mine site up to Kauteitnat. There is also another existing road that originates from Schefferville and heads in a southwest direction to Wishart Lake. From that location, the Innu use ATVs or snowmobiles to reach Papatau Shakaikan (Stakit Lake) in the west. Informants also use small access roads such as the small Pinette Lake road or other abandoned trails to reach the gravel road that leads to Elross Creek. On the road used by TSMC for the DSO project, there is a security gate and a security escort to take users past the mining operations. A bypass road had been planned by TSMC, but it is not yet operational.

5.2 MEANS OF TRANSPORTATION

The configuration of roadways, as shown on the general reference map, makes pick-up trucks the preferred mode of transportation. Other means of transportation are also used according to the season, harvest or lack of roads:

- Four-wheel drive pick-up trucks: are the main means of transportation, suited to the existing gravel roads, with the capacity to carry people, food, harvests, and other supplies and equipment (ATV, canoe).
- ATV: is the most appropriate alternative for offroad travel and for getting to harvest sites that are not easily accessible (e.g., Pinette Lake) in late spring, summer and fall. Some use them the entire way for small excursions originating in Matimekush–Lac John.
- Snowmobile: is the preferred transportation method in winter. It is used for long excursions outside of the area, but it is also very useful for trips closer to the community and on certain lakes in the study area (Figure 8). It is also appropriate for ice fishing, winter trapping and caribou hunting.
- Motorized canoe: is useful for excursions to distant places that cannot be reached by truck. It is used for trapping and fishing.
- Traditional canoe: is useful as auxiliary equipment for trapping and fishing.

5.3 CAMPS

As previously mentioned, mining and community/municipality development factors have changed habits of mobility and land use for Innu-Aitun purposes. The setting-up of a long-term camp in the study area is no longer routine, as most users now pass through it for specific, short-term harvesting purposes, depending on the season and the sites visited. The distances covered between the site visited and their homes in Matimekush–Lac John are quite small (10 to 30 km). The accessibility provided by the gravel roads allows them to make daily return trips using their own means of motorized transportation. The study area is a place where animal, fish and plant species are relatively abundant and can be harvested easily. According to the elders interviewed, permanent wooden camps are located farther away, on lands where they used to practice traditional activities. The elders also stated that several permanent camps existed well before the company’s arrival in the area. Many of these former camp sites can still be used today for daily fishing or hunting purposes, or for short journeys.

A few permanent camps still remain around Rosemary Lake and are used by several people for temporary and short-term stays; this seems to be the case for people from Uashat mak Mani-Utenam. Depending on the purpose of the activity and the season, users can remain there for longer periods of time. The use of tents is common, with white-cloth Innu tents made by Matimekush–Lac John artisans. The informants mentioned the presence of camp sites where tents can be installed, but where other types of shelters (basic cloth shelters supported by wooden stakes) can be built temporarily.

The general reference map shows the camps/tents mentioned by informants, but it is not comprehensive because of the numerous uses throughout the sector. Users do not assign fixed locations for themselves, with the exception of certain camps. Each camp site identified is used for one or more Innu-Aitun practices.

1) The Rosemary Lake area has been mentioned as a site containing both permanent and temporary camps. It is at the boundary of Papateu Shipu and close to other watersheds.
2) On the road from Kauteitnat leading to the shore of Papateu Shipu.
3) In the Papateu Shipu valley.
4) In the Triangle Lake area.
5) At Lac des Neiges.
6) At Inukshuk Lake.
7) A number of former camp sites identified at Goodream Lake, Dizzie Lake, Pinette Lake and between Inukshuk Lake and the company road.
8) A former camp next to the current security gate.

It can be assumed that if the caribou proliferate, the number of temporary camp sites in the study area will increase. However, the study area is not in an area where the practice of Innu-Aitun requires the building of permanent camps; tents are sufficient. This absence of permanent camps is due to the area’s proximity to the community and the possibility of a quick trip by truck (or other means) to return home once the activities have been conducted.

5.4 ANNUAL ACTIVITY CYCLE

The organization of yearly activities reflected a major change in the annual cycle after 1982, namely the lack of a major source of subsistence in the area: caribou. Caribou hunting was a key element of the annual activity cycle following the creation of the city and the adoption of a more sedentary lifestyle by the Matimekush–Lac John community. This major change put certain activities on the same level in terms of their practice and priority, and resulted in a rebalancing of activities. As a result, the hunting of migratory birds and small game and fishing and trapping acquired importance based on time invested, interest and yield in terms of subsistence, while at the same time these activities were balanced according to season and opportunity. Young informants claimed that a lot of their time was being devoted to the search for employment once mining activities resumed, or that they held full-time jobs. They allocated their time among their jobs and hunting or fishing activities. The availability of these users therefore has an effect on the annual cycle.

In the fall, the activities of fishing and the hunting of small game (hare or partridge) and migratory birds returning south and spread throughout the area are balanced with the practice of Innu-Aitun activities in terms of time and interest, given the absence of caribou in the area. Some users can travel farther, outside the area (100 km and more to the west), if they are told that caribou were spotted. Trapping also takes place during the fall, but the furs of some riparian and silvicultural species are not yet ready to be sold because they are not sufficiently mature (according to the elders). However, beavers are harvested more for their meat than for the sale of their fur. The picking of lingonberries, which are also food for the Canada Goose, is very important for numerous families during that time of the year. A new species of big game, the moose, recently appeared in the area, but the Innu do not hunt it.

The same system used to balance activities also takes place **in winter**: small game hunting, fishing and trapping. Considering that employment activities typically decrease during this period, users say they practice these activities fully. Fishing is conducted on frozen lakes or on the shores of some rivers at the same time as trapping, especially for lynx. Small game hunting takes place frequently, usually whenever the opportunity arises.

In the spring, the return of the Canada Goose takes precedence over other activities and keeps the majority of the community occupied. Other duck species are also hunted and most activities are temporarily set aside until the Canada Goose has moved on.

Fishing starts again **in summer**, after the dangers associated with the thaw have passed. Waterfowl remain in the area. The picking of wild fruits is also important for some families.

This overview of annual cycle activities was not quantified by our informants with respect to the number of catches or time spent because of the opportunistic and often unplanned nature of such activities. As we will see, harvesting areas were only defined in the mind of each informant.

5.5 CARIBOU HUNTING

The Labrador and Quebec Innu hunt caribou from a group commonly known as the George River herd, but our informants told us that this herd has been decimated. According to them, after the closing of the IOCC mine some 20 years ago, there were so many caribou that they wandered freely throughout the Schefferville area. Caribou hunting was the main activity of the Innu in the fall, as the herd's northern migration passed through the area. During that time, caribou proliferated in the study area, and many sites were dedicated to this hunting activity. Hunted caribou were an essential constituent of the Innu food supply in Matimekush–Lac John and in Uashat mak Mani-Utenam. An informant told us that the herd was estimated at 800,000 heads.

Over the last five years (according to an average estimate of all the data collected), caribou have gradually disappeared from the region. Based on informant estimates, the George River herd now contains between 15,000 and 18,000 heads. The Innu are no longer familiar with the details of caribou migration routes. Some said that small groups had been spotted west of the region, but they did not specify if any animals had been killed. This phenomenon is intriguing for the Innu, who speculate on the reasons for its decline. Today, the important Innu-Aitun practice of hunting caribou no longer exists in the study area, which has undermined not only the Innu food base, but also the traditions associated with this type of hunting. It is now necessary to go farther in order to hunt caribou, and additional user costs are required given the absence of roads.

5.6 CANADA GOOSE AND WATERFOWL HUNTING

Canada Goose hunting is the primary spring activity. The hunt is organized by Innu groups who are related, and who occupy different water bodies waiting for flocks of Canada Geese. The latter are frequently found in three areas: all around Rosemary Lake, Triangle Lake and Pinette lake. Howells River is also an appropriate site, but as it is harder to reach in spring because of the thaw, the young do not make the extra effort and prefer Rosemary Lake instead. The young make return trips between the sites and the village, or sleep one night under a tent or in an available wooden camp. This hunting activity also starts again in the fall, when Canada Geese are spread out and easily caught because they land frequently. Canada Geese are also an essential part of Innu food subsistence. In the study area, the preferred site is primarily Rosemary Lake. In fact, informants stated that they actually preferred to go farther away in order to avoid mining activities.

Waterfowl is also hunted during nearly three seasons (spring, summer and fall). The goose, loon (spring), American Black Duck and Long-tailed Duck are the most harvested species. According to one of the elders, numerous sites are used by ducks to lay their eggs. Another elder said that the Innu do not collect eggs out of respect for reproduction; this was only done in the past when survival was at stake.

5.7 TRAPPING

According to the elders, numerous trapping activities are carried out around Matimekush–Lac John, but trapping is not as common as it once was. In the study area, beaver trapping is carried out late in the spring and some riparian (mink) and silvicultural (marten, fox) animals are harvested. The lynx is also present, but is difficult to trap.

Trapping seems to have lost some of its importance in the study area even if, from the elders' point of view, resources remain available. However, the daily back and forth to monitor traps is rather demanding and requires a lot of time, which is especially problematic for those with full-time jobs. Other elders said that the lack of caribou encourages people to resort to trapping, but outside the study area and farther down the Greenbush road and in its vicinity. The reasons given include the presence of permanent camps outside of the study area for longer journeys and the fear of contamination near mining sites. Beaver meat is prized by the Innu and is part of their regular diet. Furthermore, the animal trade is quite complex and, ultimately, the provider loses a lot of money when selling furs to an intermediary. An elder stated that this type of activity was practically a full-time job and that large quantities of furs were necessary in order to ship them to a place in Ontario where auctions (markets) were held. This was done some 20 years ago.

5.8 FISHING

Numerous water bodies are located in the study area and they contain a variety of fish resources. Fishing nets and rods are used to catch the different fish in summer and fall: a variety of salmonids as char, whitefish, Lake Trout and ouananiche. There are a number of fishing sites in the study area, notably in Rosemary Lake, Triangle Lake and lac des Trois Épinettes. Ice fishing is also conducted using a very special technique. Brook Trout (matamek) are the target of this type of fishing. Several groups of fishermen gather at the same time to do this type of fishing, which provides an additional element to their food supply.

5.9 SMALL GAME

Partridge, hare and porcupine are the most hunted small animals during fall and winter. Hunting techniques are specific to each species: the rifle for partridges, the use of sticks to knock out porcupines and the snare for hares. This type of hunting takes places when the opportunity arises during the harvesting of other species. These small animals can be found throughout the entire study area. The Innu really appreciate them, and they vary their food supply.

5.10 BERRY PICKING

Blueberries and cloudberries (in peatland areas) are the most-picked wild berries in summer. Raspberries can also be found in some locations. Lingonberries proliferate, but only in the fall. It is mainly women who do the picking while men carry the fruits back to the harvest sites. Informants clearly stated that they still picked fruit in the study area, but more often in the vicinity of Rosemary Lake.

5.11 IRONY MOUNTAIN OR KAUTEITNAT

Kauteitnat, or “heart-shaped mountain”, is an important topographic centre for the Matimekush–Lac John and Uashat mak Mani-Utenam Innu. This mountain and its surroundings contain all of the attributes and advantages required for Innu-Aitun practices. The mountain itself constitutes **an ecosystem** that protects all its elements (Innu elder). Its morphology and the fact that is elevated are signs of importance for the Innu and the elders in particular. It reaches an elevation of 3,000 feet, which is rather modest when compared to other mountains, and users can easily reach its peak. It is located in relatively flat terrain and is surrounded by water bodies with abundant resources. Kauteitnat used to be a part of the caribou migration route. Herds that originated from the southwest would stop there in the fall, and some small, scattered groups of caribou even stayed near the site until late winter. The Kauteitnat-caribou relationship is very revealing of Innu hunting habits and constitutes a survival myth, which is the necessity of such a relationship as a major cultural symbol for this Innu group. Kauteitnat belongs to all Innu and inspires the practice of rites of thanks for the benefits it provides. This makes it a sacred mountain that must be appreciated and protected.

Historically, the mountain was used as an observation promontory to locate caribou and, to a lesser extent, other species. Innu would head toward the summit to get a better view of the approaching caribou in the fall or spot the dispersed groups in winter. A Mani-Utenam elder said: “We were able to see steam from the breath of caribou as it dispersed into the cold air, even if they were very far away.” This observation post was so effective that it was used to gather information about this resource. Kauteitnat was also used as a point of orientation for hunters, who relied on this mountain to find their routes and their way. Kauteitnat is considered as an area that is sensitive to the integrity of the surrounding biodiversity.

The renewal of mining activities in the study area over the last five years has had an effect on the Matimekush–Lac John Innu, who are its primary users. This area is serviced by old roads from mining that took place between 1950 and 1980. The Innu are required to abide by the security gate for the DSO project and stricter security standards. The above portrayal of the use of the study area and the harvesting of resources is clouded by the absence of caribou, which is the primary resource for Innu-Aitun practices. Furthermore, this depiction shows that the resource is being replaced by a more active harvesting of other resources. Employment has also diluted the level of use by users. The situation varies, but users still show their interest in using this area, even in a fragmented manner, and in practicing their traditional activities. Informants have stated that there are sites where young students are brought to learn about traditional life and learn basic practices and harvesting techniques. This shows a concern about the necessity of transmitting this way of life and its characteristics. It is also worth noting that the elders are no longer active in the study area; they go farther afield and spend longer periods of time on their lands. The study area is thus used as a passageway to other harvesting areas.

6 USE OF THE STUDY AREA BY THE NASKAPI

The land use model used by the Naskapi in the study area is similar to the portrait established for the Innu, but comprises specific political, economic and social factors. Unlike the Innu, whose group is split between users originating from two communities, the Naskapi are a single entity living in a single community and constituting one Aboriginal nation. Their use of the region's harvesting areas is rather recent, dating back to the 1950s, when they were relocated to Schefferville. As the study area is located in Labrador, the provisions of the Northeastern Quebec Agreement do not apply. Their relations with other Innu users are courteous and friendly, and there are no cases where the use of the area has created conflicts. The area is shared in an informal manner and on a goodwill basis, without specific guidelines. According to the informants, a significant part of their activities take place in the Attikamagen Lake and Swampy Bay areas, but the Kauteitnat, Goodwood and Greenbush areas are also used and harvested.

6.1 TRAVEL ROUTES

With Kawawachikamach as their starting point, the Naskapi use the same existing travel routes as the Innu to access the various water bodies and sites located in the study area. They take the mountain road (Teketaut Meshkenu), which leads northeast up to Goodwood and Greenbush. This road crosses the mountain ridge where the IOCC's main iron mine sites were located. It then follows the eastern side of Kauteitnat, where it becomes two separate roads leading to Greenbush and the Howells River valley in the west. The part of the road leading to Papateu Shipu (Howells River) is used very frequently by the Naskapi. Another mining road crosses the planned Howse mine site and leads to Kauteitnat. There is also another existing road that leads southwest from Schefferville toward Wishart Lake and, from there, up to Papatau Shakaikan (Stakit Lake) in the west; it is accessed by snowmobile in winter.

6.2 MEANS OF TRANSPORTATION

The Naskapi are forced to use means of transportation adapted to the topographic configuration of sites and roadways, as shown on the map. There a four ways to travel in the study area:
The four-wheel drive pick-up truck is the main means of transportation. It is suited to the existing gravel roads and can carry both people and the various equipment required for expeditions. The ATV is the most appropriate alternative for offroad travel and for getting to harvest sites that are not easily accessible in late spring, summer and fall. The snowmobile is used as a transportation method in winter, including on certain lakes in the study area (Figure 8). It is also appropriate for ice fishing, winter trapping and caribou hunting. The traditional canoe is very useful as auxiliary equipment for fishing and trapping.

6.3 CAMPS

Based on the data gathered, the Naskapi only have a few permanent camps in this area. They mainly use the study area as a means of getting to camps that are farther north or in the vicinity of Attikamagen Lake and Swampy Bay, which was confirmed by Weiler's 2009 survey. The Naskapi claim that there are temporary camps on the road to Greenbush/Goodwood, in Kanishekemat and in Kapashekuiaiss (small woods), but they are located outside of the area. There is a zone where tents were erected on the eastern side of Kauteitnat several years ago, for the purposes of hunting caribou and Canada Geese. There is also a cluster of camps sites used to set up tents near Rosemary Lake. Other camps that the informants were familiar with are located on the eastern side of the Howells River basin. Some Naskapi apparently also used the Boot Lake area to erect tents.

Another interesting factor is that even if the principle of Innu traplines are respected by the Naskapi, the agreements provide the legal protection of these traplines. Based on the comments of some informants, the Naskapi harvest and practice their activities more easily in areas that they previously occupied or that they have been given since their arrival in Schefferville. Despite a longer Innu historical presence, the Kauteitnat area is well known to both Aboriginal communities.

6.4 ANNUAL ACTIVITY CYCLE

Our Naskapi informants did not explicitly refer to an annual activity cycle, but their situation and harvesting obligations force them to practice traditional activities throughout the seasons, according to the arrival, passing, migration context, location and presence of game.

- **In the fall**: As the main activity is no longer possible (there are no caribou), the hunting of the Canada Goose is important during the southward migration. There is also fishing and the hunting of partridges (grouse/Innineu). Some Naskapi also make incursions in the Kuujjuaq area to hunt caribou from the Leaf River herd, according to the season.
- **In the winter**: The hunt for the Willow Ptarmigan (uapeneu) and trapping are important activities, but ice fishing also takes place. One elder mentioned that wooded areas and the mountain were favourable locations for partridges and hares.
- **In the spring**: The hunting of the Canada Goose and waterfowl resumes. It is an important occupation for the Naskapi, both within and outside the study area. Informants also mentioned that they went to different locations to avoid areas near mining activities.
- **In the summer**: Fishing, wild-berry picking and waterfowl hunting are the primary activities.

6.5 CARIBOU HUNTING

The Naskapi hunt caribou from the George River herd. They can also, on some occasions, hunt caribou from the Leaf River herd in the government-regulated lands of Ungava. Informants claimed that there had not been any caribou in the area for a few years. The rarity of the species has impacted their way of life. They had hunting grounds on the western side of Kauteitnat and used to hunt in groups. They must now find other ways to hunt caribou, but these are costly and require long journeys northward.

6.6 CANADA GOOSE AND WATERFOWL HUNTING

The hunting of Canada Geese is an important activity in the spring, when they arrive in large flocks. This hunt primarily takes place outside the study area. However, several groups did shoot Canada Geese along both sides of the Howells River basin, which seems to be a favourable location, according to informants.

The hunting of other waterfowl, such as the loon, the American Black Duck (Inniship), the Black Scoter (Kuaikan) or the Long-tailed Duck, is also much appreciated. It is done on certain lakes in the area.

6.7 SMALL GAME

The grouse is highly prized in the fall, as is the Willow Ptarmigan in winter. Needless to say, this type of hunting serves as a complement to other activities that are conducted at the same time. The study area is conducive to the presence of these species. Grouse are hunted along access routes in the fall and Willow Ptarmigans are hunted on small plateaus in the winter.

6.8 TRAPPING

Trapping activities are less common in the study area. Some Naskapi may lay traps here and there in wooded areas to catch martens, but they do so as they pass through the area to conduct a different activity. This is also true of the mink when they are fishing in riparian areas.

6.9 FISHING

The Naskapi head to the Curlingstone and Rosemary lakes and Howells River to fish salmonids such as Lake Trout and ouananiche. In the winter, ice fishing is conducted to catch Brook Trout. These activities are also carried out in Goodwood as well as in the Attikamagen and Swampy bay lake areas, outside of the study area.

6.10 BERRY PICKING

The Naskapi head to the edges of Kauteitnat to pick wild berries such as blueberries, raspberries and bilberries. Lingonberries are the main fruit collected there in the fall. Blackberries are also in high demand, and cloudberries are collected in peatland areas. These picking activities are mainly conducted in the summer, but lingonberries are inevitably collected intensively in the fall, at the same time that the Canada Geese and waterfowl pass through on their way south.

6.11 IRONY MOUNTAIN OR KAUTEITNAT

The heart-shaped mountain, or Irony Mountain (Kauteitnat), does not have the same symbolic or ritual signification for the Naskapi, who have only lived in the region for about 50 years. According to an elder, Kauteitnat is a strategic site for the hunting of caribou and a repository of food resources for wildlife. It is well located and convenient, as well as being an excellent, very easily accessible observation site. This mountain is part of Naskapi heritage for the practice of traditional activities, and is unique not only in how it is used, but also for the concentration of wildlife that feeds, stops, mates and rests there.

As previously mentioned, the Naskapi share the study area with the Innu for their traditional activities, but these activities are not only conducted in this area (according to a young informant). The Naskapi have a steady presence in the area. They have the same attitude toward the harvesting of resources and use the same access routes as the Innu, but tend to go farther north, toward Greenbush. The Naskapi also use the same parameters as the Innu for their resource management system, but have fewer resting places, land-use sites and harvest sites. This is perhaps due to their propensity to occupy the same sites they used when they first arrived in the area. While the number of informants was smaller, the information received can only be taken as a general, albeit well-established, indicator.

7 INFORMANT CONCERNS – HOWSE PROJECT

The following is a list of Innu and Naskapi concerns and apprehensions as expressed by the informants. We have summarized the effects anticipated by participants, while trying to separate out the cumulative effects of other mining projects. Few measures were suggested by the participants to mitigate the potential effects.

7.1 CONCERNS

- The contamination of surface and underground water bodies: the study area is composed of numerous lakes, rivers and streams that are interlinked through the natural tributary flow process. According to informants, this aquatic network is lively and dynamic and its constituents are all connected. The planned project site is near this network, at the side of a mountain (Kauteitnat) with very particular winds and wind directions. The iron-bearing substances and particles carried by flows and generalized runoff can cause negative effects. In addition, there are a number of underground water sources in the area that could be contaminated through the infiltration of polluted runoff water into the groundwater. The contamination of this water would affect fish and riparian fur-bearing animals, as well as the aquatic ecosystem.
- The project's site and its waste areas are very close to Kauteitnat. The pit that will be dug could have an impact on the stability of the soils and sub-soils that support the eastern side of the mountain. One of the fears is that this side of the mountain could partially collapse, mainly as a result of vibrations and blasting.
- The dispersal of dust into the air can also cause pollution for users, as well as for animal and plant species. This aspect was a key topic of the discussions, as it can affect human health, species' appearance (such as the Willow Ptarmigan or White Partridge becoming orange), wild fruits, medicinal plants and the general landscape.

- Waste and tailings stored in fixed locations will be harmful in the long term if not handled appropriately.
- As a result of experiences with other mining pits, the informants stated that they would prefer if the pit was filled with solid matter once mining has ended.
- The stretch of road that links Tshitshitua Mani Meshkenu with the Tekutaut Meshkenu road and leads to Kauteitnat will disappear between Goodream Creek and the mountain. This hinders the movements of users who head to the mountain and, from there, use part of this road to reach Rosemary Lake and Howells River. If this stretch is eliminated, users will no longer be able to move between certain sites in a direct, efficient manner.
- The landscape surrounding Kauteitnat will be modified and as a result, the mountain, with its numerous symbols deeply rooted in Innu culture, will no longer be the same.
- The project will also modify caribou migration as soon as the herd returns. The informants claimed that they were convinced that caribou herds would no longer use these areas because of the noise and traffic. Other species will also be affected by these factors, and their behaviour and habits will change.
- The project will add new control and security measures to the existing ones, and they will restrict freedom of movement. The DSO security gate and road escort already restrict travel, which the informants dislike. The bypass road is not functional and has yet to be completed.
- The fly-in/fly-out system is also a significant concern. The informants do not know where people are coming from, and they worry that they could carry diseases and contaminate the local population.
- The positive benefits associated with the employment of Aboriginals are of little value if the company does not provide them with meaningful jobs or discriminates against them by giving them low-status jobs.

7.2 MITIGATION MEASURES

The concept of mitigation measures for the potential effects described above is poorly understood by the Innu and the Naskapi. They say that it is impossible to reduce effects to such a degree that they will be able to live comfortably with their daily presence and find them bearable (Innu elder). The effects are damaging and cause prejudice to community members and their activities and to the habitats of species (Innu elder). The Howse Project will surely have an impact because activities such as pit development, production, crushing and transportation will take place. An Innu elder stated: “We have already lived with mining activities in the past and now it feels like an old wound is being opened.” Nothing was done to mitigate the effects of earlier activities on people and on nature. They therefore wonder whether it is possible to reduce the pit, waste, dust, contamination, traffic, noise and disappearance of species. They also mentioned that they were not engineers, so they cannot give advice on how to achieve this. They did, however, ask questions about how to reduce the impact of the above-mentioned effects:

- How can toxic spills in water bodies and underground water be stopped?
- How can dust be prevented from spreading throughout the landscape and in nature, threatening species and bothering people?

- How can we ensure that drilling and dynamiting will not affect the mountain's stability?
- How can we reduce ore transportation in the area, which occurs in various proportions?
- How can we ensure that production activities will not restrict the freedom of movement of local users?
- What can be done to prevent security from taking charge of users when they move through the area?
- At the time of the mine's closure, will the company fill up the pit?
- In the event that caribou no longer want to migrate toward these areas, what does the company intend to do?
- Will the economic benefits in terms of employment be more positive for outsiders than for people from the two communities?
- Why did the TSMC company not apply impact mitigation measures for the DSO project?

These questions can be taken as guidelines for mitigation measures or, at the very least, for analysis and clarification.

7.3 CUMULATIVE EFFECTS

Informants say that the effects of previous projects conducted between 1950 and 1980 continue to have an impact on their quality of life: the multiple, very deep pits that were not restored, the dangers associated with such pits, the impossibility of using these mining areas for their other activities, land degradation (it is no longer as it used to be) and the impact of iron concentrations all around water bodies are all residual effects that continue to affect the Innu and the Naskapi. These projects had an impact on the traditional life of the elders that we met, and younger community members also view them as a nuisance.

In terms of the TSMC/LIM DSO project associated with the Howse Project:

- The company told us that there would be no effects on air quality, but we are currently experiencing them;
- Truck traffic and dust emissions continue;
- The road has been blocked and security hinders people's freedom of movement;
- Species are endangered, such as certain fish and partridges that are turning orange;
- The same impact in its various forms will be transferred to the Howse Project;
- Near the old pits, there is no more life, and no possibility of reusing the land, except for roadways.

According to the informants, the cumulative effects have an ongoing impact on people and their environment. They say that the effects of the Howse Project will go on after the mine's closure.

7.4 FUTURE INVOLVEMENT IN THE PROJECT

Informants said that there has to be a greater interaction in the dissemination of information between the company's management and community members with regard to impact mitigation measures and the creation of a group to monitor the actions to be taken, assess them and keep the population informed on their status. Financial agreements are not sufficient to offset the impact of such projects.

7.5 ADDITIONAL COMMENTS

A number of Innu informants say that this project must be the last one to take place in the region of Schefferville or on the traplines held by members of Uashat mak Mani-Utenam. They have been summoned to answer the same questions for many years now. The companies only want their consent. The Howse Project must be the last time that iron is removed from the region; it has already cost the environment too much. Despite past projects, a Naskapi elder said that "animals, fish and migratory birds have managed to survive even if there have been cycles, but we are now faced with great season, climate and wind changes. Snow falls later, the cold is less intense and wind directions are abnormal when they should be blowing in a specific direction during a given season." This comment leads us to believe that major climate changes have now reached abnormal proportions in the area and have an impact on biodiversity. This may be the reason why there are no more caribou (Innu elder) and the behaviour of other species is changing.

8 CONCLUSION

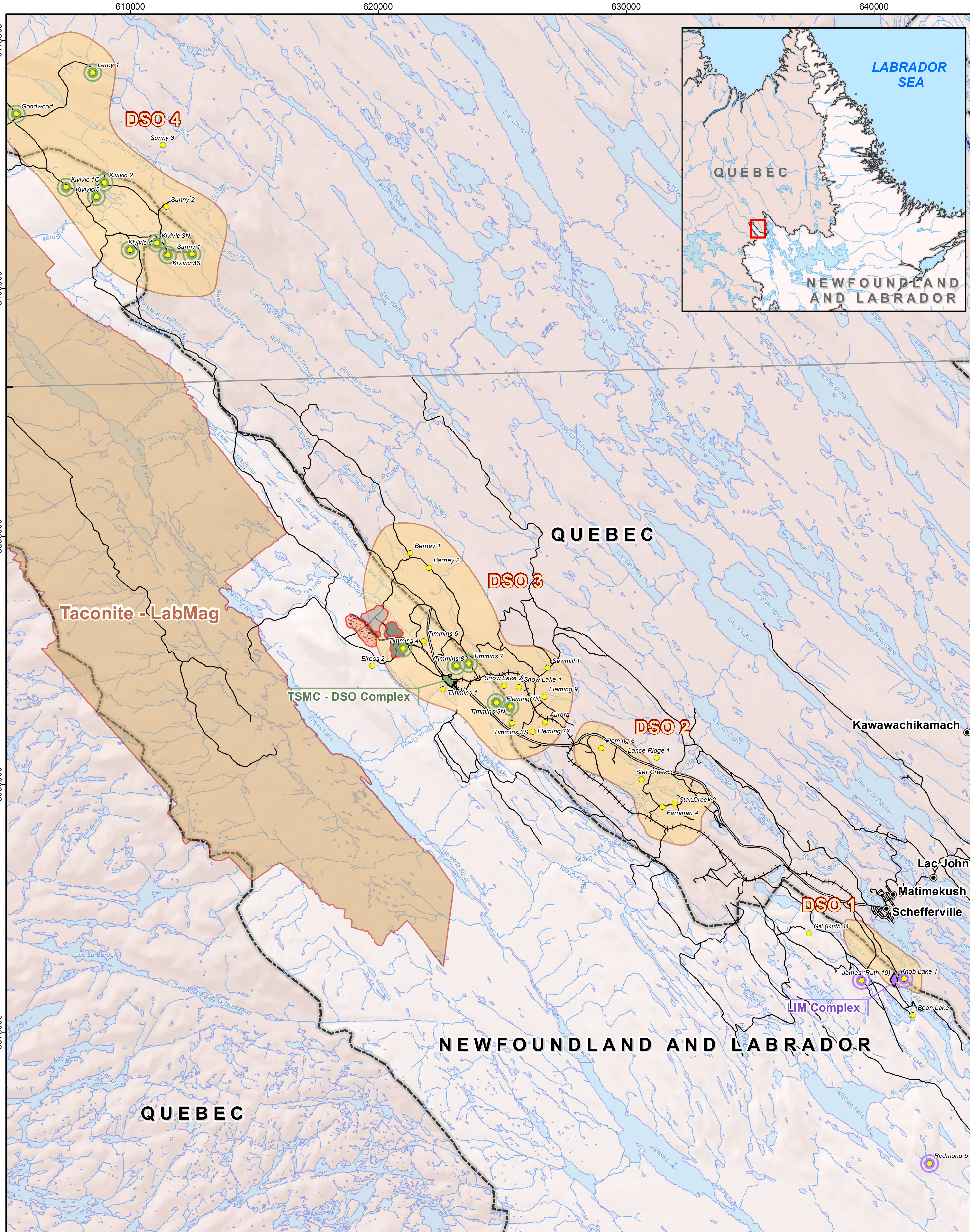
This ATK study concerning land use in the study area has led to a certain number of findings. The Innu and Naskapi both know the study area very well and use it continuously, even though their attitude toward traditional actives has changed somewhat as a consequence of modernity, the constraints of sedentary activities and mining activities. This knowledge allows us to deduce that the cultural and land integrity of the study area has historically remained relatively unchanged, despite the jolts of industrial encroachment, modern life and globalization.

It is also worth noting that the Innu and the Naskapi have experienced the effects of former mining projects and seem to have found some kind of balance between the uncertainties of such projects and their ancestral ways of life. However, and in terms of the current projects, they are able to fully understand the issues affecting their lands and the activities, habitats and behaviours of certain species of game animals and birds in relation to the project's main components. They can also ask informed questions and demand appropriate answers.

The Howse Project is located next to a sensitive area, namely KAUTEITNAT, which is viewed as an important symbol of Innu culture. The informants seemed to agree that if this mountain retains its natural integrity, the project can go forward, provided the company can provide assurances to that effect. In light of the comments collected, the safeguarding of the mountain's integrity must also be accompanied by a series of other actions that aim to reduce the impact on water, air, soil and species. The elders were very clear about these matters.

The consultation process was conducted in a way that disseminated all of the information about the project. For our part, we wished to reflect the information we received on land use in the study area as accurately as possible. We believe that this text accurately echoes the various comments made and that the interpretations made are true to the spirit of such comments.

LIST OF FIGURES



LEGEND

Infrastructure and Mining Components

- DSO - Deposit
- LIM Actual or Planned Deposit Operation
- LIM Complex
- TSMC Actual or Planned Deposit Operation
- DSO Complex - TSMC
- DSO - Other Site
- Taconite - LabMag

Howse Infrastructures

- Proposed Howse Pit
- Proposed Low Grade/Overburden Stockpile
- Proposed Crushing/Screening Facility
- Proposed Waste Rock Dump

Basemap

- Town
- Railroad
- Road
- Watercourse
- Water body
- Provincial Boundary

FILE, VERSION, DATE, AUTHOR:
GH-0571, 00, 2015-01-13, E.D.

N

0 2 4 6 8 10
Kilometers

UTM 19N NAD 83

SCALE: 1:150 000

SOURCES:

Basemap
Government of Canada, NTDB, 1:50,000, 1979
SNC Lavalin, Groupe Hémisphères, Hydrology update, 2013.

Infrastructure and Mining Components
New Millennium Capital Corp., Mining sites and roads
TATA Steel Minerals Canada Limited/ MET-CHEM, Howse Deposit Design for General Layout., 2013

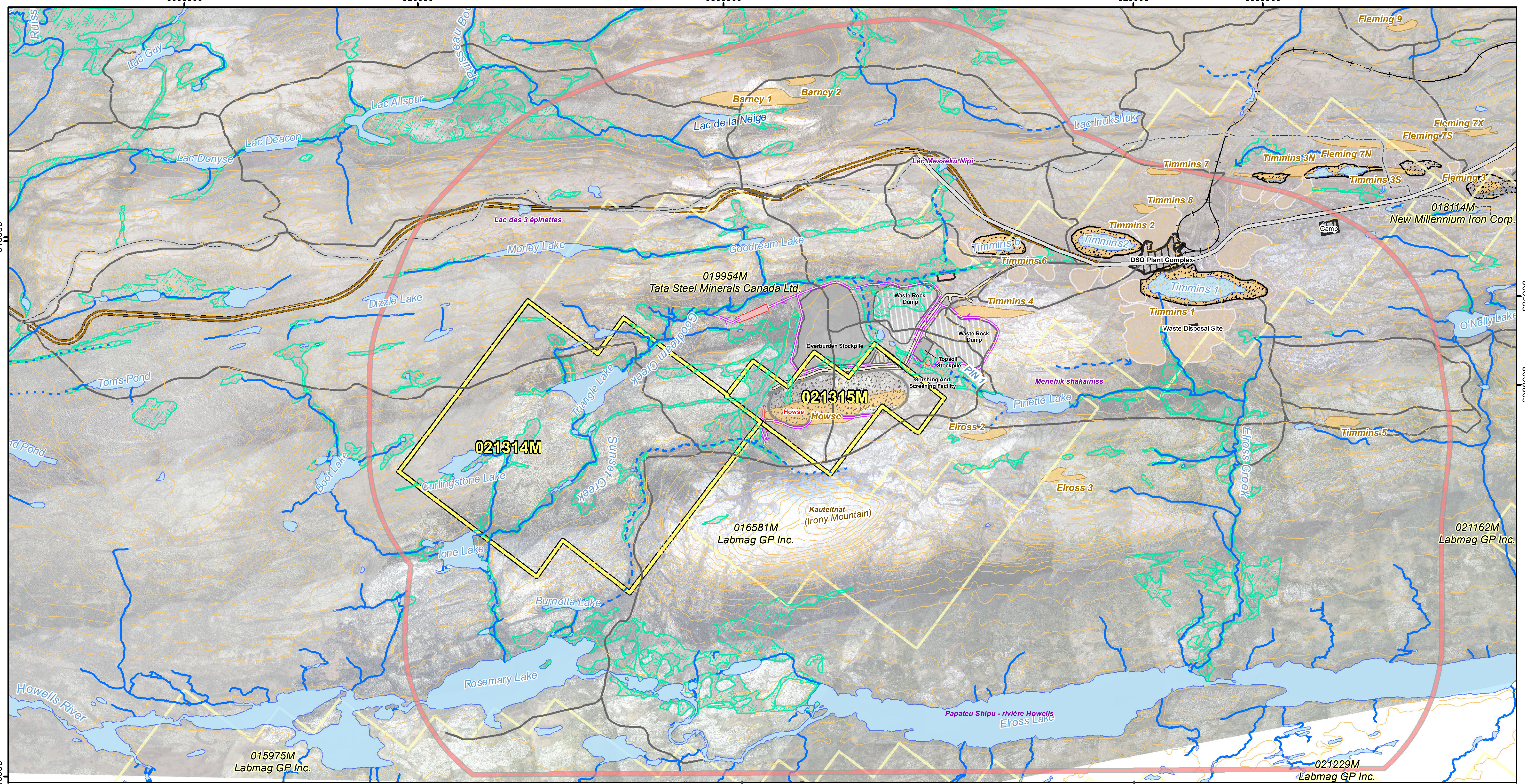
ENVIRONMENTAL IMPACT ASSESSMENT
HOWSE PROPERTY PROJECT

Location

Howse Minerals Limited

GroupeHemispheres
13, rue Saint-Louis, Bureau 201, Lévis (QC) Canada, G6V 4E2
1453, rue Beaubien est, Bureau 301, Montréal (QC) Canada, H2G 3C6

Figure 1



LEGEND

Infrastructure and Mining Components

Proposed Infrastructures
- Proposed Howse Pit
- Proposed Low Grade/Overburden Stockpile
- Proposed Crushing/Screening Facility
- Proposed Waste Rock Dump
- Proposed Sedimentation Pond
- Proposed Ditch and Outlet
- Road to DSO Area 4
- Proposed Mine Haul Road

Existing Components
- Existing Railroad
- Existing Sedimentation Pond
- DSO Howse - Claim Labrador Iron Mines Limited(49%)/ Howse Minerals Ltd.(51%)
- Other Claim
- Elross Lake Area Iron Ore Mine (ELAIOM) Plant Infrastructure Footprint
- Existing Dump
- Existing Pit
- Deposit

Basemap
- Permanent Watercourse
- Intermittent Watercourse
- Storm Runoff
- Disappearing Stream
- Artesian Spring
- Water body
- Contour Line (50 ft)
- Provincial Border
- Existing Road
- Main Access Road
- Wetland
- Local Study Area

*Hydronyms are oriented along the direction of water flow

FILE, VERSION, DATE, AUTHOR:
GH-0572a-00, 2015-02-02, E.D.

N

0 500 1 000 1 500 2 000
Meters
UTM 19N NAD 83

SCALE: 1:44 000

SOURCES:
Basemap
Government of Canada, NTDB, 1:50,000, 1979 Government of NL and government of Quebec, Boundary used for claims
SNC Lavalin, Groupe Hémisphères, Hydrology update, 2013

Infrastructure and Mining Components
New Millennium Capital Corp., Mining sites and roads
TATA Steel Minerals Canada Limited/ MET-CHEM Howse Deposit Design for General Layout, 2013

ENVIRONMENTAL IMPACT ASSESSMENT
HOWSE PROPERTY PROJECT

Land Use Study Area

Howse Minerals Limited

GroupeHemispheres
13, rue Saint-Louis, Bureau 201, Lévis (QC) Canada, G6V 4E2
1453, rue Beaubien est, Bureau 301, Montréal (QC) Canada, H2G 3C6

Figure 2

SCHEFFERVILLE

CARTE NO: 2

LA PÉNINSULE DU QUÉBEC-LABRADOR ET SA RÉGION CENTRE-SUD

LÉGENDE

- Limite de la péninsul Québec-Labrador
- Limite approximative de la région Centre-Sud
- Frontière du Labrador
- Ligne de partage des eaux

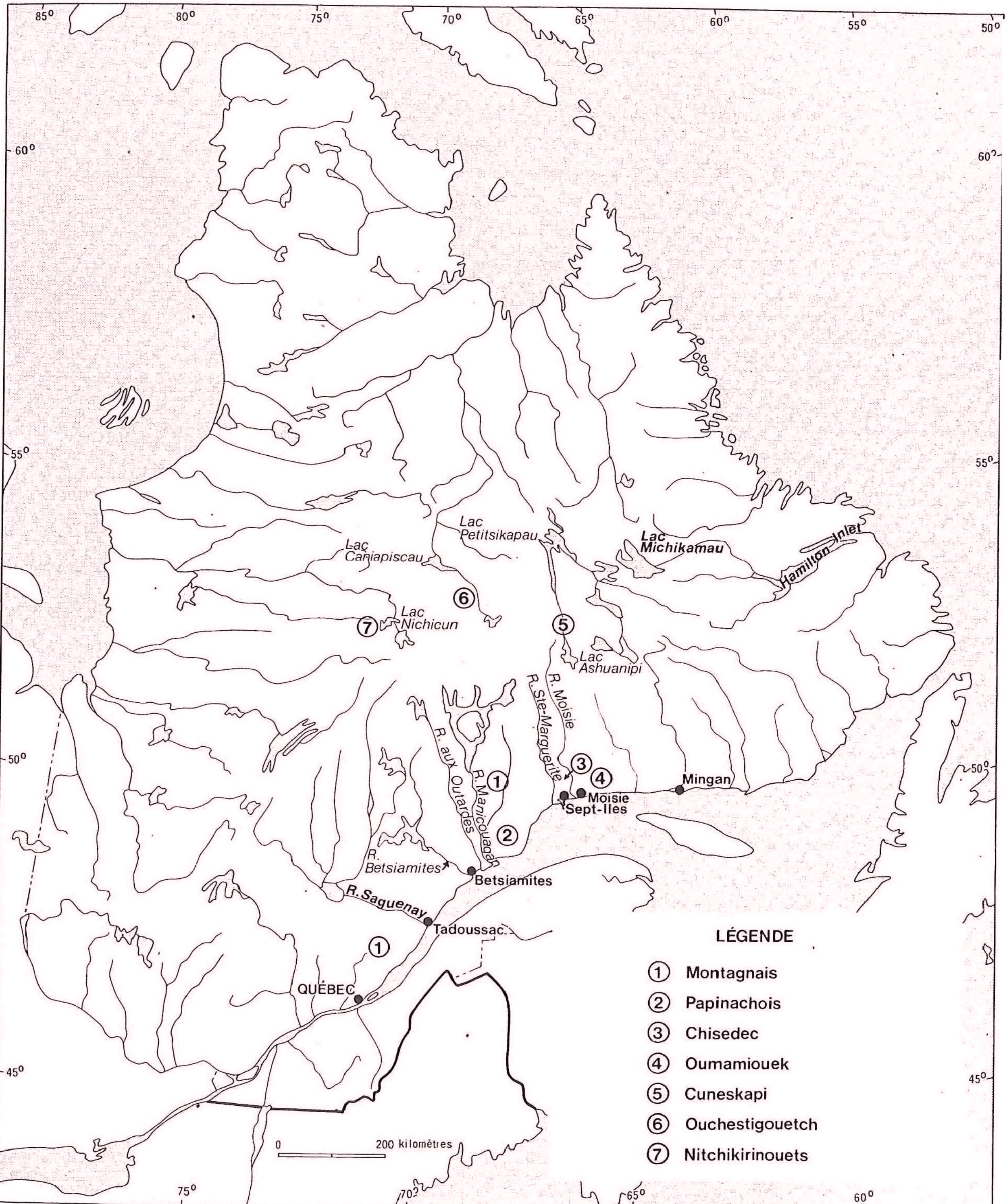
ÉCHELLE: 1:5 000 000

KM 0 100 200

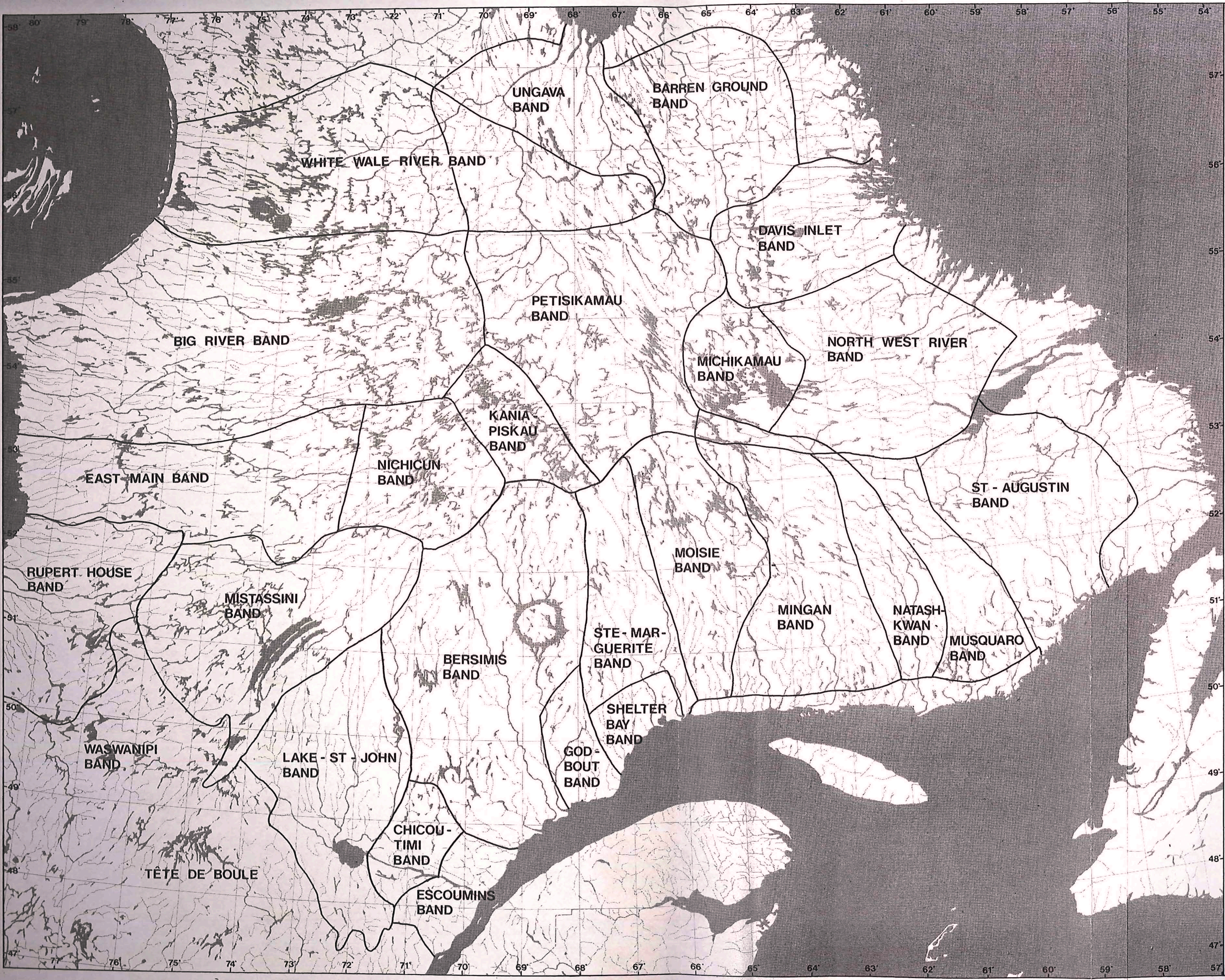

SCHEFFERVILLE
CARTE NO: 3
POSTES DE TRAITE, SEIGNEURIES ET CONCESSIONS AU QUÉBEC - LABRADOR
LÉGENDE
Poste de traite
Limite approximative de la terre de Rupert
Limite approximative de la seigneurie de la terre ferme de Mingan
Limite approximative de la concession faite à la veuve Formel à Hamilton Inlet
Limite approximative du Domaine du Roi (1652)
Limite approximative du Domaine du Roi (1733)
ÉCHELLE:1:5 000 000
KM 0 100 200
Fort (Georges River Post)
Fort Chimo
Fort McKensie
Poste du lac Minowean
Erlandson Poste (Fort Trial)
Poste de Davis Inlet
Poste de la Baleine
Fort Nascopie
Poste de Michikamau
Fort du lac Caniapiscau
Fort Georges
Poste de North West River
Poste de Winokapau
Poste du lac Nichicun
Poste du lac des Naskapis
Eastmain
Poste du lac Néoskweokau
Fort Rupert
Poste de Nemiscau
Poste du lac Manicouagan
Mistassini
Poste de Moisie
Poste de Sept Îles
Poste de Mingan
Seigneurie de l'Isle aux Oeufs
Poste du Cap du Cormoran
Poste de Waswanipi

CARTE NO: 4

IDENTIFICATION DES POPULATIONS AMÉRINDIENNES RÉGIONALES AUX XVIIème ET XVIIIème SIÈCLES



Sources: Mailhot, 1983: 87
Parent, 1978: 15-16
Samson, 1975: 84-88, 92-97
Speck, 1931: 558



SCHEFFERVILLE

CARTE NO: 5

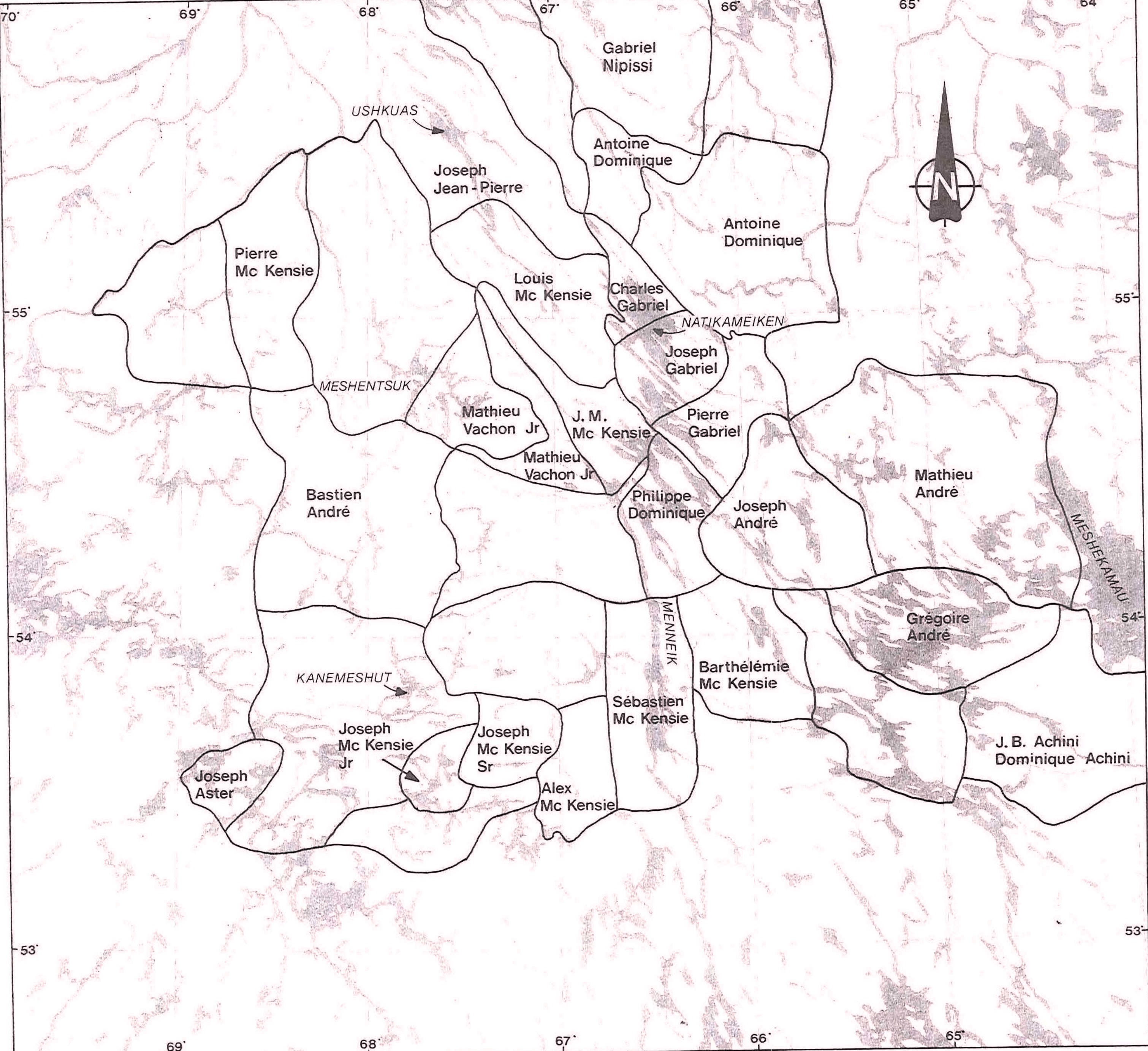
TERRITOIRES DES BANDES INDIENNES DE LA PÉNINSULE QUÉBEC LABRADOR VERS 1850

LÉGENDE

—— Limite approximative des territoires des bandes indiennes

ÉCHELLE: 1:5 000 000

KM 0 100 200



SCHEFFERVILLE

CARTE NO:14

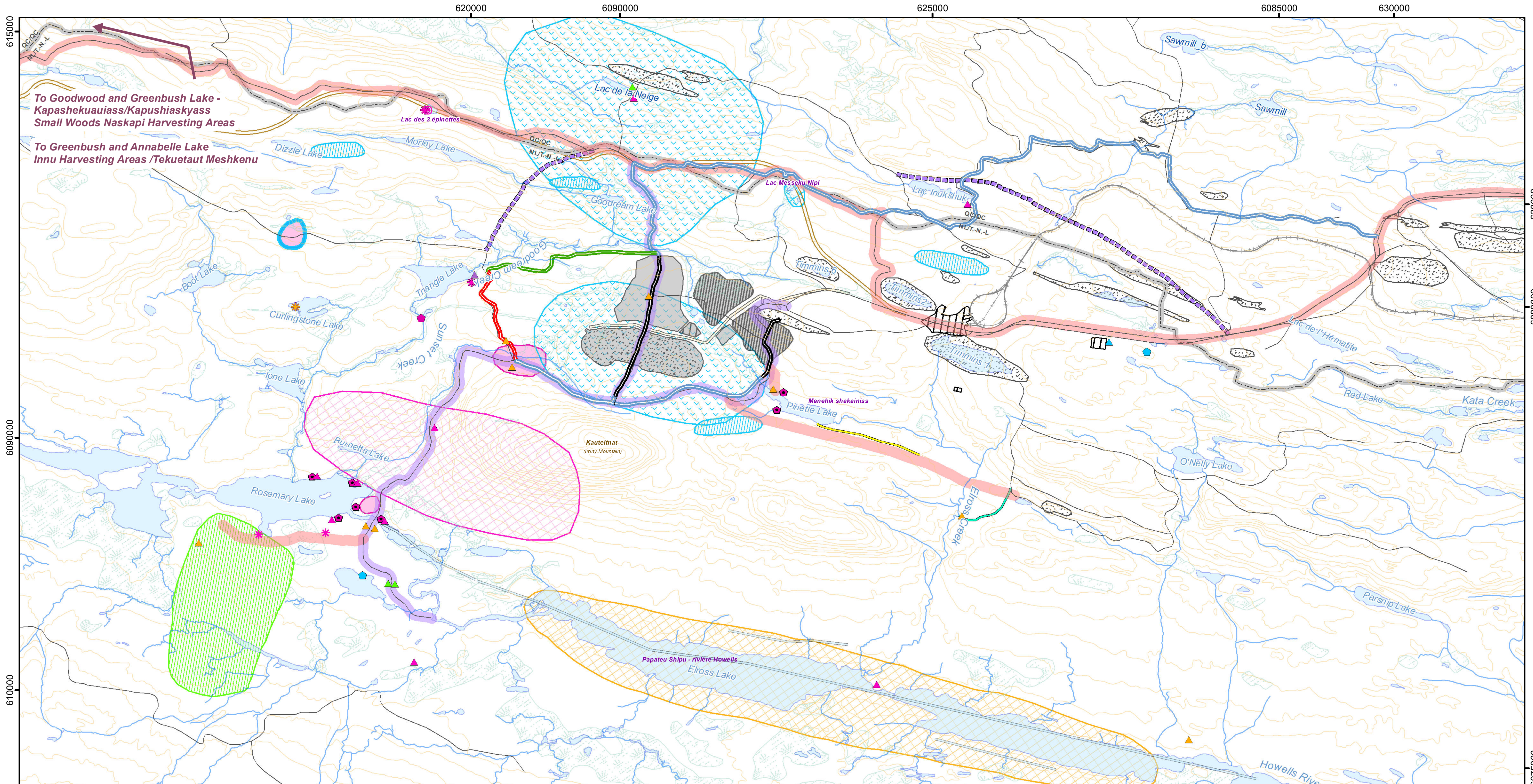
TERRITOIRE DES FAMILLES MONTAGNAISES DE SCHEFFERVILLE EN 1960

LÉGENDE

——— Limite approximative d'un territoire familial

ÉCHELLE: 1: 2 000 000

KM 0 20 40 60 80



LEGEND

Camps/ Tents
- Naskapi
- Innu
- Unknow Owner
- Naskapi - Old
- Innu - Old

Innu Harvesting Areas
- Hunting Area
- Camp Area

Naskapi Harvesting Area
- Goose Hunting

Innu Harvesting Locations
- Beaver Hunting
- Goose Hunting
- Fishing
- Trout Fishing
- Canoe

Naskapi Harvesting Spot
- Trout Fishing

Access Roads
- To remove
- Access Road - Itinerary
- Winter Skidoo Trail
- Partridge Harvesting Road - Itinerary
- Proposed ByPass Road
- Old Access Road
- ATV Road - Skidoo Trail

Old Innu Harvesting Site
- Caribou Killing Site

Old Innu Harvesting Areas
- Old Partridge Area
- Old Goose Hunting
- Old Berry Picking Area
- Old Camp Area

Old Naskapi Harvesting Area
- Old Camp Area

*Hydronyms are oriented along the direction of water flow

Infrastructure and Mining Components
- Road to DSO Area 4
- Existing Railroad
- Deposit
- Proposed Howse Pit
- Proposed Topsoil/ Overburden Stockpile
- Proposed Crushing/ Screening Facility
- Proposed Waste Rock Dump
- Proposed Mine Haul Road
- Elross Lake Area Iron Ore Mine Plant Infrastructure Footprint

Basemap
- Existing Road
- Contour Line (15 m)
- Provincial Border
- Watercourse
- Waterbody
- Wetland

Final Bypass Road
- Existing
- To Build
- To Improve

FILE, VERSION, DATE, AUTHOR:
GH-0584-00, 2015-01-21, E.D.

0 2 4
Kilometers

UTM 19N NAD 83

SCALE: 1:50 000

SOURCES:

Basemap and Land Use Components
Government of Canada, NTDB, 1:50,000, 1979
Government of NL and government of Quebec,

Mining Components
TATA Steel Minerals Canada Limited/
MET-CHEM Howse Deposit Design
for General Layout., 2013
Groupe Hémisphères, Hydrology and update, 2013

ENVIRONMENTAL IMPACT ASSESSMENT
HOWSE PROPERTY PROJECT

Land Use and Traditional Aboriginal Knowledge

Howse Minerals Limited

GroupeHemispheres

13, rue Saint-Louis, Bureau 201, Lévis (QC) Canada, G6V 4E2

1453, rue Beaubien est, Bureau 301, Montréal (QC) Canada, H2G 3C6

Figure 8

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APPENDICES

APPENDIX I
Interview Questionnaire

Utilisation du territoire et savoir traditionnel autochtone (STA) – Innu Aitun

GUIDE D'ENTREVUE

Introduction

Le formulaire de consentement doit être signé avant le début de l'entrevue.

a) Présentation de l'équipe
b) Brève description du projet
c) Portée et objectifs du processus de l'étude d'impact environnemental et social
d) Objectifs de cette entrevue concernant l'utilisation du territoire et des ressources, ainsi que le savoir traditionnel autochtone:
   1 Information générale sur l'utilisation du territoire et des ressources dans la zone d'étude;
   2 Identification et localisation des sites d'importance pour les activités traditionnelles, mais aussi des sites culturels et spirituels dans l'aire d'étude;
   3 Discussion concernant les perceptions, préoccupations et attentes liées au projet et à ses effets anticipés sur le territoire et les ressources dans l'aire d'étude.
e) Questions / commentaires avant de débuter l'entrevue?

** Cette entrevue sera réalisée à l'aide de la carte de la zone d'étude

La plupart des questions doivent être répondues selon l'année de référence – août 2013 à juillet 2014 – et selon l'aire d'étude. Les exceptions sont mentionnées dans le questionnaire.

Utilisation du territoire et savoir traditionnel autochtone (STA) – Innu Aitun

GUIDE D'ENTREVUE

1. Identification des participants

Date: _____________ **Heure début:** ___________ **Heure fin:** ___________

#Lot de piégeage :______ **Titulaire actuel :** ________________________

Nom des participants	Liens (s)	Âge	Genre

Interviewer: ______________________ **Traducteur:** ______________________

Lieu: __________________________ **Enregistrée?** _____

Utilisation du territoire et savoir traditionnel autochtone (STA) – Innu Aitun

GUIDE D’ENTREVUE

2. Noms des lieux et sites d’importance (toponymes)

2.1. Pouvez-vous identifier les sites qui sont particulièrement importants dans l’aire d’étude ? Les sites naturels (par exemple, les eaux des rivières ou des lacs qui ne gèlent pas l’hiver (askhui)), sites de chasse à la sauvagine, de chasse au caribou, de pêche), mais aussi les sites qui sont d’importance culturelle ou spirituelle (lieux d’enterrement, lieux de naissance, anciens camps, etc.).

# sur carte	Élément	Nom du lieu officiel	Nom (Innu Aimun)	Traduction

Utilisation du territoire et savoir traditionnel autochtone (STA) – Innu Aitun

GUIDE D'ENTREVUE

3. Utilisation générale du territoire et camps (avec la carte)

Titulaire du lot de piégeage

3.1. Quel est le rôle du titulaire du lot de piégeage?

3.2. Dans quelles circonstances avez-vous fréquenté l'aire d'étude au cours de l'année de référence?

3.3. Généralement, combien de personnes utilisent le lot de piégeage /aire d'étude?

3.4. Est-ce que l'utilisation du lot de piégeage / aire d'étude se limite à certains types d'activités?

3.5. Combien de personnes utilisent le lot de piégeage / aire d'étude en réalité?

3.6. Quel est le niveau d'effort que vous allouez aux activités traditionnelles? Temps plein, temps partiel, autre)?

3.7. Si on regarde la carte, pouvez-vous y inscrire l'endroit où se situent vos camps?

3.8. De quel(s) type(s) de camp s'agit-il?

3.9. S'agit-il de camps temporaires ou permanents?

3.10. Où se situent les sources d'eau potable à proximité de ces camps?

3.11. Comment vous rendez-vous à ces camps? (SVP, dessinez la route sur la carte. Si cela s'applique, distinguer selon les saisons).

3.12. Combien de temps vous faut-il pour vous rendre à vos camps? (pour chaque saison)

3.13. Quand vous allez à vos camps, combien de temps y restez-vous en général? (pour chaque saison)

3.14. Vous arrive-t-il de pratiquer des activités traditionnelles sans rester à votre camp (un aller-retour dans la même journée)? (pour chaque saison)

3.15. Y a-t-il des camps que vous avez abandonnés au cours des dernières années? Où? Pourquoi? (par exemple, le vieux camp près du lac Triangle, au sud du ruisseau Goodream?)

Autres utilisateurs

3.16. Dans quelles circonstances avez-vous fréquenté l'aire d'étude au cours de l'année de référence?

3.17. Quel est le niveau d'effort que vous allouez aux activités traditionnelles? Temps plein, temps partiel, autre)?

3.18. Si on regarde la carte, pouvez-vous y inscrire l'endroit où se situent vos camps?

3.19. De quel(s) type(s) de camp s'agit-il?

3.20. S'agit-il de camps temporaires ou permanents?

Utilisation du territoire et savoir traditionnel autochtone (STA) – Innu Aitun

GUIDE D'ENTREVUE

3.21. Où se trouvent les sources d'eau potable situées près de ces camps?

3.22. Comment vous rendez-vous à ces camps? (SVP, dessinez la route sur la carte. Si cela s'applique, distinguer selon les saisons).

3.23. Combien de temps vous faut-il pour vous rendre à vos camps? (pour chaque saison)

3.24. Quand vous allez à vos camps, combien de temps y restez-vous en général? (pour chaque saison)

3.25. Vous arrive-t-il de pratiquer des activités traditionnelles sans rester à votre camp (un aller-retour dans la même journée)? (pour chaque saison)

3.26. Y a-t-il des camps que vous avez abandonnés au cours des dernières années? Où? Pourquoi? (par exemple, le vieux camp près du lac Triangle, au sud du ruisseau Goodream?)

4. Cycle annuel des activités

4.1. **À l'aide de la carte et du tableau ci-dessous**: Quelles ont été vos principales activités au cours de l'année entre les mois d'août 2013 et juillet 2014? SVP indiquez quels sont les éléments marqueurs saisonniers (gel, dégel, etc.).

Utilisation du territoire et savoir traditionnel autochtone (STA) – Innu Aitun

CYCLE ANNUEL DES ACTIVITÉS
Année de référence : août 2013 à juillet 2014
(Section en gris: les questions seront posées plus tard dans l'entrevue)

# sur carte	Quand (mois)	Activité	Espèces récoltées	a) Combien de fois? b) Durée des séjours? c) Nombre de personnes?	Modes de transport	Le projet aura-t-il un impact sur cette activité? Comment?	Si oui, mesures de bonification / évitement / mitigation proposées?

Utilisation du territoire et savoir traditionnel autochtone (STA) – Innu Aitun

# sur carte	Quand (mois)	Activité	Espèces récoltées	a) Combien de fois? b) Durée des séjours? c) Nombre de personnes?	Modes de transport	Le projet aura-t-il un impact sur cette activité? Comment?	Si oui, mesures de bonification / évitement / mitigation proposées?

Utilisation du territoire et savoir traditionnel autochtone (STA) – Innu Aitun

GUIDE D'ENTREVUE

4.2. Au cours des 5 dernières années, avez-vous noté des changements concernant les ressources que vous récoltez dans l'aire d'étude?

- Leur présence?
- Leur distribution?
- Leur abondance?
- Leur qualité?

4.3. Selon vous, quelle(s) est/sont la/les cause(s) de ces changements et pourquoi?

4.4. Ces changements ont-ils affecté vos activités dans l'aire d'étude? Si oui, comment?

4.5. Y a-t-il des zones qui sont particulièrement sensibles dans l'aire d'étude? (ex : aire de reproduction, aire de mise-bas, aire de mue, etc.) Si oui, svp les indiquer sur la carte.

4.6. Quels sont les principaux facteurs qui déterminent le temps que vous passez à pratiquer des activités traditionnelles dans l'aire d'étude?

5. Revenus et coûts (pour l'année de référence, août 2013 à juillet 2014)

5.1. Avez-vous vendu certaines des fourrures que vous avez récoltées dans l'aire d'étude?

5.2. Si oui, combien la vente des ces fourrures vous a-t-il rapporté?

5.3. Quelle proportion des ressources que vous récoltez dans l'aire d'étude sert à la consommation familiale?

5.4. Avez-vous estimé les coûts liés à la poursuite des activités traditionnelles durant l'année de référence (véhicules, équipement, essence, autre)?

5.5. Avez-vous reçu du soutien financier d'un programme en particulier pour vos activités de récolte?

6. Autres utilisateurs du territoire

6.1. (Si applicable) Est-ce qu'il y a d'autres autochtones qui ont utilisé l'aire d'étude durant l'année de référence?

6.2. Si oui, comment décririez-vous vos relations avec les autochtones dans l'aire d'étude durant l'année de référence?

6.3. (Si applicable) Est-ce qu'il y a des non-autochtones qui ont utilisé l'aire d'étude durant l'année de référence (pourvoiries, chasseurs, trappeurs, pêcheurs, tourisme d'aventure)?

6.4. Si oui, comment décririez-vous vos relations avec les non-autochtones dans l'aire d'étude durant l'année de référence?

Utilisation du territoire et savoir traditionnel autochtone (STA) – Innu Aitun

GUIDE D'ENTREVUE

7. Faune présente dans l'aire d'étude

7.1. En utilisant la carte de l'aire d'étude, svp identifier les ressources qui y sont présentes selon votre connaissance, durant l'année de référence.

Espèces		O/N	# sur carte	# Récoltées?	Abondance (abondante, modérée, rare	Commentaire
Mammifères						
Caribou sédentaire	Minashkuau-atik^{u}					
Caribou migrateur	Mushuau-atik^{u}					
Renard roux	Matsheshu					
Vison	Atshakash					
Martre	Uapishtan					
Orignal	Mush					
Ours noir et tanières	Mashk^{u}					
Loup	Maikan					
Castor	Amishk^{u}					
Lynx du Canada	Pishu					
Loutre	Nitshik^{u}					
Rat musqué	Utshashk^{u}					
Lièvre	Uapush					
Porc-épic	Kak^{u}					
autres ?						
Poissons						
Omble chevalier	Shushashui					
Omble de fontaine	Matamek^{u}					
Touladi	Kukamess					
Grand brochet	Tshinusheu					
Grand corégone	Atikamek^{u}					
Ménomini rond	?					
Meunier noir	Makatsheu					
Ouananiche	Uanan					
Meunier rouge	Mikuashai					
Méné de lac	?					

Utilisation du territoire et savoir traditionnel autochtone (STA) – Innu Aitun

GUIDE D'ENTREVUE

Espèces		**O/N**	**# sur carte**	**# Récoltées?**	**Abondance** (abondante, modérée, rare	**Commentaire**
Chabot tacheté	?					
Lotte	Minei					
Autres ?						
Faune aviaire						
Canard arlequin	Nutshipaushtikue-shish					
Garrot à œil d'or	Tshitshue mishikushk^{u}					
Bernache du Canada	Nishk					
Oie des neiges	Uapishk					
Garrot (général)	Mishikushk^{u}					
Plongeon catmarin	Ashu-muak^{u}					
Cormoran (général)	Uapitukuan					
Garrot d'Islande	Mamatau-mishikushk					
Autres ?						
Autres						
Tétras du Canada	Innineu					
Gélinotte hupée	Pashpashtshu					
Lagopède des saules	Innapineu					
Lagopède des rochers	Kashkanatshish					
Grenouille	Umatshashkuk					
Salamandre	Utshishkatakak^{u}/ Ushitshinauish					
Couleuvre	Atshinepuku					
Campagnol						
Souris	Apikushish					
Musaraigne						
Autres ?						

Utilisation du territoire et savoir traditionnel autochtone (STA) – Innu Aitun

GUIDE D'ENTREVUE

7.2. Est-ce que le caribou migre actuellement à travers l'aire d'étude ? Si oui, durant quelle(s) saison(s) ?

7.3. Avez-vous vu un troupeau de caribou de plus de 100 individus au cours des 5 dernières années dans l'aire d'étude ?

7.4. Si oui, à quelle fréquence et à quel(s) endroit(s) avez-vous observé ces troupeaux ?

7.5. Connaissez-vous des lieux de mise bas du caribou dans l'aire d'étude ou à proximité?

7.6. Nous savons que le troupeau de caribous de la rivière George est en déclin dans l'aire d'étude. Avez-vous observé ce déclin ? Si oui, depuis quand ?

7.7. Selon vous, quelles en est/sont la/les cause(s) ? Pourquoi pensez-vous que ce/ces facteur(s) en est/sont la/les cause(s) ?

7.8. Est-ce que ce déclin a affecté vos activités de chasse au caribou?

7.9. Connaissez-vous des endroits où se trouvent des tanières d'ours dans l'aire d'étude ou à proximité?

7.10. Est-ce que les canards migrent dans l'aire d'étude ?

7.11. Est-ce que les oies migrent dans l'aire d'étude ?

7.12. Où s'arrêtent-ils/elles dans l'aire d'étude? Quand ?

7.13. Avez-vous aperçu les espèces suivantes, rares ou en voie de disparition, au cours des 5 dernières années dans l'aire d'étude ? Si oui, à quelle fréquence ? À quel(s) endroit(s)?

- Carcajou (Kuekuatsheu)
- Renard arctique (?)
- Coyote (Shitaikan)
- Raton laveur (?)
- Pékan (Utshek)
- Caribou sédentaire (Minashkuau-atik^{u})
- Lièvre artique (?)
- Moufette (Shakak^{u})
- Oiseaux de proie
  - Pygargue à tête blanche (Kauapishtikuanit-missu)
  - Aigle royal (Mitshishu ou missu)
  - Faucon pèlerin (?)
- Hibou des marais (Kukuku)

7.14. Considérez-vous que d'autres espèces, mis à part celles mentionnées ci-dessus, sont en voie de disparition ou devenues rares dans l'aire d'étude?

Utilisation du territoire et savoir traditionnel autochtone (STA) – Innu Aitun

GUIDE D'ENTREVUE

8. Flore

8.1. SVP identifier les plantes que vous avez récoltées (baies, plantes médicinales, bois, etc) durant l'année de référence et l'endroit dans l'aire d'étude où vous les avez récoltées.

Espèces	Quantité récoltée (petite, moyenne, grande)	# sur carte	Commentaires

Utilisation du territoire et savoir traditionnel autochtone (STA) – Innu Aitun

GUIDE D'ENTREVUE

9. Kauteitnat

9.1. À quand remonte vos premiers souvenirs de Kauteitnat?

9.2. Quels types d'activités étaient alors pratiquées à Kauteitnat et où (svp, indiquez le lieu sur la carte)?

9.3. Qui vous accompagnait?

9.4. À quelle fréquence visitiez-vous ce site?

9.5. Et maintenant? Allez-vous toujours à Kauteitnat? Si oui, à quelle(s) occasion(s)?

9.6. Quelles sont les activités (récoltes ou autre) que vous pratiquez à Kauteitnat? Où (svp indiquez le lieu sur la carte)?

9.7. Qui vous accompagne?

9.8. Comment décririez-vous l'importance et la signification (culturelle, spirituelle, rituelle et symbolique) de Kauteitnat?

9.9. Est-ce que la communauté à mis en place des mesures de conservation pour le site de Kauteitnat?

Utilisation du territoire et savoir traditionnel autochtone (STA) – Innu Aitun

GUIDE D'ENTREVUE

10. Effets potentiels du projet sur l'utilisation du territoire et des ressources

10.1. Vous avez écouté une brève présentation du projet. Comment pensez-vous que le projet pourrait affecter négativement ou positivement les activités traditionnelles que vous poursuivez ?

(Note : les sources d'impacts pour les deux phases du projet seront brièvement rappelées aux participants par l'équipe)

Effets potentiels anticipés	
CONSTRUCTION	**OPÉRATION**

Utilisation du territoire et savoir traditionnel autochtone (STA) – Innu Aitun

GUIDE D’ENTREVUE

10.2. Quelles espèces sont plus susceptibles d’être affectées par le projet dans la zone d’étude et comment (utiliser le tableau du cycle annuel des activités)?

10.3. Quels sont les enjeux principaux qui devraient être abordés dans l’étude d’impact environnemental et social concernant l’utilisation du territoire et des ressources dans l’aire d’étude ?

10.4. Avez-vous des préoccupations concernant les effets cumulatifs des différents projets miniers actuellement en développement sur l’utilisation du territoire et des ressources? Si oui, lesquels?

Utilisation du territoire et savoir traditionnel autochtone (STA) – Innu Aitun

GUIDE D'ENTREVUE

11. Mesures de mitigation

11.1. Quelles sont vos suggestions pour éviter les effets négatifs potentiels que vous avez identifiés?

11.2. Quelles sont vos suggestions pour atténuer les effets négatifs potentiels que vous avez identifiés?

11.3. Quelles sont vos suggestions pour maximiser les effets positifs du projet?

Mesures d'évitement et d'atténuation proposées	
CONSTRUCTION	**OPÉRATION**

Utilisation du territoire et savoir traditionnel autochtone (STA) – Innu Aitun

GUIDE D'ENTREVUE

11.4. Quelles sont vos attentes par rapport à la fermeture des sites miniers et de leur réhabilitation/remise en état?

12. Prochaines étapes

12.1. Aimeriez-vous être informé de l'avancement du projet? Si oui, comment ?

12.2. Aimeriez-vous être impliqué dans les prochaines étapes de la planification du projet ? Si oui, comment ?

13. Questions

13.1. Avez-vous d'autres commentaires, questions ou préoccupations concernant le projet?

Merci pour votre participation.

Land-use and Aboriginal Traditional Knowledge (ATK)

INTERVIEW GUIDE

Introduction

The Consent Form must be signed before the interview begins.

a) Presentation of team
b) Brief project description
c) Scope and objectives of the environmental and social impact assessment process
d) Objectives of this land- and resource-use / aboriginal traditional knowledge (ATK) interview:
   1. General information regarding land- and resource-use in the study area;
   2. Identify and localize sites of importance for traditional activities but also cultural and spiritual sites in the study area;
   3. Discuss perceptions, concerns and expectations related to the Project and its anticipated effects on the land and on resources in the study area.
e) Questions/comments before we start?

** This interview will be carried out using a map of the study area

Some questions should be answered according to the reference year - August 2013 to July 2014 – and to the study area. Exceptions are specified in the questionnaire.

Land-use and Aboriginal Traditional Knowledge (ATK)

INTERVIEW GUIDE

1. Identification of participants

Date: _____________ Starting time: ___________ Ending time: ___________

Name of Participants	Relationship(s)	Age	Gender

Interviewer: ______________________ Translator: ______________________

Location: __________________________ Recorded? _____

Land-use and Aboriginal Traditional Knowledge (ATK)

INTERVIEW GUIDE

2. Place names and sites of Importance (Toponyms)

2.1. Can you identify sites that are particularly important in the study area? Natural sites, (e.g. areas of ice-free open water (ashkui) on lakes or rivers during the winter, goose hunting sites, caribou hunting sites, fishing sites, etc.), but also sites of cultural and spiritual importance (e.g. burials, places of birth, old camp sites, etc.).

# on map	Feature	Official Place Name	Naskapi Place Name	Translation

Land-use and Aboriginal Traditional Knowledge (ATK)

INTERVIEW GUIDE

3. General land-use and camp locations

3.1. In what circumstances did you carry out activities in the study area during the reference year?

3.2. How many people use the study area?

3.3. Is the study area restricted to certain types of activities?

3.4. What is the level of effort that you devote to traditional activities (e.g. full-time, part-time, other)?

3.5. If we look at the map, can you indicate where camps are located in the study area and the place name?

3.6. What types of camps are they?

3.7. Are these temporary or permanent camps?

3.8. Where are the sources of potable water located near each camp?

3.9. How do you get to your camps? (Please draw routes on map – if applicable, differentiate between seasons.)

3.10. How long does it take you to get there? (differentiate by season)

3.11. When you go to these camps, how long do you generally stay? (differentiate by season)

3.12. Do you sometimes harvest resources without staying at a camp (day trips)? (differentiate by season)

3.13. Are there camp sites that were abandoned in the past few years? Where? Why? (for example, the old camp around Triangle Lake, south of Goodream Creek?)

Land-use and Aboriginal Traditional Knowledge (ATK)

INTERVIEW GUIDE

4. Annual cycle of activities

4.1. **With map and inventory table below:** What were the main activities that you conducted in the study area during the year between the months of August 2013 and July 2014? Please indicate the markers of seasonal change (e.g. freeze up, open water, etc.).

Land-use and Aboriginal Traditional Knowledge (ATK)

ANNUAL CYCLE OF ACTIVITIES
Reference year: August 2013 to July 2014
(Section in grey = questions will be asked later during interview)

# on map	when (month)	Activity	Species harvested	(a) How many times? (b) How long do you stay? (c) How many people go?	Modes of Transportation	Will Project have an impact on activity? How so?	If yes, proposed enhancement / avoidance / mitigation measures?

Land-use and Aboriginal Traditional Knowledge (ATK)

# on map	when (month)	Activity	Species harvested	(a) How many times? (b) How long do you stay? (c) How many people go?	Modes of Transportation	Will Project have an impact on activity? How so?	If yes, proposed enhancement / avoidance / mitigation measures?

Land-use and Aboriginal Traditional Knowledge (ATK)
INTERVIEW GUIDE

4.2. During the past 5 years, have you noted any changes in the resources that you harvest in the study area:

- Their presence?
- Their distribution?
- Their abundance?
- Their quality?

4.3. According to you, what is/are the cause(s) of these changes and why?

4.4. Have these changes affected your activities in the study area? If yes, how?

4.5. Are there particularly sensitive zones in the study area (e.g., calving areas, reproduction areas, spawning areas, moulting areas, etc.) If yes, please mark them on the map and indicate their names.

4.6. What are the main factors that determine how much time you spend practicing traditional activities in the study area?

5. Revenues/costs (Reference year: August 2013 to July 2014)

5.1. Did you sell any of the furs that you trapped in the study area?

5.2. If yes, how much income did you derive from selling them?

5.3. What proportion of the resources harvested in the study area is for family consumption?

5.4. Have you estimated the costs related to the pursuit of traditional activities during the reference year? (Vehicles? Equipment? Fuel? Other?)

5.5. Have you received support from the Hunting, Fishing and Trapping Support Programme or from other programmes? If yes, how so?

6. Other land-users

6.1. (If applicable) Did other aboriginal people use the study area during the reference year?

6.2. If yes, how would you describe your relations with aboriginal people in the study area during the reference year?

6.3. (If applicable) Did non-aboriginal people use the study area during the reference year? (outfitters, hunters, fishermen, adventure tourism)?

6.4. If yes, how would you describe your relations with non-aboriginal people in the study area during the reference year?

Land-use and Aboriginal Traditional Knowledge (ATK)

INTERVIEW GUIDE

7. Fauna present in study area

7.1. Using the study area map, please identify the resources that are present to your knowledge, during the reference year.

Species		Y/N	# on map	# Harvested	Abundance (abundant, moderately abundant, rare)	Comment
Game						
Sedentary caribou						
Migratory caribou						
Red fox						
Mink						
Marten						
Moose						
Black bear and dens						
Wolf						
Beaver						
Canada lynx						
Otter						
Muskrat						
Hare						
Porcupine						
Others ?						
Fish						
Arctic char						
Brook trout						
Lake trout						
Northern pike						
Lake whitefish						
Round whitefish						
White sucker						
Landlocked salmon						
Longnose sucker						
Lake chub						
Mottled sculpin						
Burbot						
Others ?						

Land-use and Aboriginal Traditional Knowledge (ATK)

INTERVIEW GUIDE

Species		**Y/N**	**# on map**	**# Harvested**	**Abundance** (abundant, moderately abundant, rare)	**Comment**
Waterfowl						
Harlequin duck						
Goldeneye						
Canada goose						
Snow goose						
Common loon						
Red-throated loon						
Cormorant						
Iceland gull						
Others ?						
Others						
Spruce grouse						
Ruffed grouse						
Rock ptarmigan						
Willow ptarmigan						
Frog						
Salamander						
Snake						
Woodland vole						
Mouse						
Shrew						
Others ?						

7.2. Do caribou migrate through the study area? If so, at what season(s)?

7.3. Have you seen a caribou herd of more than 100 in the past five years in the study area?

7.4. If yes, how often have you seen such a herd and where?

7.5. Are you aware of caribou calving sites in or near the study area?

7.6. We know that the George River caribou herd is declining in the study area. Have you noticed this decline? If so, since when?

7.7. According to you, what is/are the cause(s) of this decline? Why do you believe that this/these factor(s) is/are the cause(s)?

7.8. Has this decline affected your caribou harvest?

7.9. Are you aware of the presence of bear dens in or near the study area?

Land-use and Aboriginal Traditional Knowledge (ATK)
INTERVIEW GUIDE

7.10. Do ducks migrate through the study area?

7.11. Do geese migrate through the study area?

7.12. Where do they stop in the study area? When?

7.13. Have you seen the following rare or endangered species in the past five years in the study area? If yes, how often? Where?

- Wolverine
- Arctic fox
- Coyote
- Raccoon
- Fisher
- Sedentary caribou
- Arctic hare
- Skunk
- Birds of prey
  - Bald eagle
  - Golden eagle
  - Peregrine falcon
- Short-eared owl

7.14. Do you consider that other species, other than those mentioned above, are rare or endangered in the study area?

8. Flora

8.1. Please identify the plants that you harvested (berries, medicinal plants, firewood etc.) during the reference year and where in the study area you harvested them.

Species	Amount Harvested (small, medium, large)?	# on map	Comments

Land-use and Aboriginal Traditional Knowledge (ATK)

INTERVIEW GUIDE

Land-use and Aboriginal Traditional Knowledge (ATK)

9. Kauteitnat

9.1. How far back in your memory do you remember Kauteitnat?

9.2. Back then, what were the types of activities that were carried out at Kauteitnat and where (please indicate location on map)?

9.3. Who accompanied you?

9.4. How often did you go?

9.5. What about nowadays? Do you still go to Kauteitnat? If so, on what occasion?

9.6. What are the activities (harvesting or orther) that you carry out at Kauteitnat? Where (please indicate location on map)?

9.7. Who accompanies you?

9.8. How would you describe the importance and significance (cultural, spriritual, ritual and symbolic) of Kauteitnat (Irony Mountain)?

9.9. Has the community put in place some site conservation measures for Kauteitnat?

Land-use and Aboriginal Traditional Knowledge (ATK)

10. Potential project effects on land- and resource-use

10.1. You have listened to a brief presentation of the Project. How do you think the Project may affect negatively or positively the traditional activities that you carry out?

(Note: sources of effects for both phases will be briefly reminded to the participants by the team)

Anticipated Potential Effects	
CONSTRUCTION	**EXPLOITATION**

Land-use and Aboriginal Traditional Knowledge (ATK)

10.2. Which species are most likely to be affected by the Project in the study area and how (use annual cycle table)?

10.3. What are the main issues that should be addressed in the impact study concerning land- and resource-use in the study area?

10.4. What are your views regarding the cumulative effects of the various projectss currently being developed on land- and resource-use in or near the study area? If yes, which ones?

Land-use and Aboriginal Traditional Knowledge (ATK)

11. Mitigation Measures

11.1. What are your suggestions for avoiding the potential negative impacts that you have identified?

11.2. What are your suggestions for mitigating the potential negative impacts that you have identified?

11.3. What are your suggestions to maximise the positive effects of the project?

Suggested avoidance and mitigation measures	
CONSTRUCTION	**EXPLOITATION**

Land-use and Aboriginal Traditional Knowledge (ATK)

11.4. What are your expectations in terms of site closure and site restoration/rehabilitation?

12. Next Steps

12.1. Would you like to be informed of the future stages of the Project? If so, how?

12.2. Would you like to be involved in the next steps of the Project planning? If so, how?

13. Questions

13.1. Do you have other comments, questions or concerns regarding the Project?

Thank you for your participation.

APPENDIX II
Consent Form

Étude d’utilisation du territoire et du savoir traditionnel autochtone (STA)

ÉNONCÉ DU PROJET ET DE L’ÉTUDE

Howse Minerals Limited (HML) (une filiale en propriété exclusive de Tata Steel Minerals Canada Ltd (TSMC) signataire d’une entente de co-entreprise non-constituée avec TSMC et Labrador Iron Mines (LIM)) propose le développement du *Projet de minerai de fer Howse* situé dans la Chaîne ferrifère Millennium au Labrador. Le site se trouve à environ 25 km au nord-ouest de Schefferville, Québec.

TSMC construit et opère déjà le *Projet de minerai de fer à enfournement direct DSO* à proximité du site du projet Howse. La construction et l’opération de la mine Howse s’appuiera sur des installations et infrastructures existantes qui ont été construites, ou qui le seront sous peu, dans le cadre du projet DSO. L’infrastructure déjà en place inclut :

- le camp de travailleurs;
- le concentrateur;
- la voie ferrée;
- l’équipement minier;
- une aire d’entreposage des explosifs.

La réalisation de ce projet entraînera des changements à l’environnement. Le projet comprend la construction d’une mine à ciel ouvert ainsi que des installations connexes telles que des piles de mort-terrain et de stériles, et nécessitera la construction d’une nouvelle route entre le site Timmins 4 et le site minier Howse. Le projet inclura les éléments suivants :

- 2 km de nouvelle route;
- Une mine à ciel ouvert;
- Piles de stockage de mort-terrain / dépôt meubles;
- Haldes de stériles;
- Installations de concassage et tamisage.

En même temps, le projet apportera des bénéfices économiques à la région en créant des emplois et des occasions d’affaires pour les membres des communautés avoisinantes, puisqu’il permettra la continuité des projets miniers mis de l’avant par TSMC et LIM respectivement.

Le projet a été inscrit conformément à la *Loi canadienne sur l’évaluation environnementale 2012* et à l’*Environmental Protection Act* de Terre-Neuve-et-Labrador.

Le Groupe Hémisphères s’est vu confié le mandat par HML pour la réalisation de l’étude des impacts environnementaux et sociaux (EIES) requise.

La Nation Naskapi de Kawawachikamach (NNK), la Nation Innu de Matimekush-Lac John (NIMLJ), l’Innu Takuaikan Uashat mak Mani-Utenam (ITUM), Innu Nation (IN), ainsi que le Conseil de la communauté NunatuKavut (NCC – anciennement la Nation Métis du Labrador) ont été informés de l’intention de HML d’entreprendre le projet Howse.

Selon notre mandat, nous devons prendre en considération les préoccupations et les attentes des communautés potentiellement affectées.

Vous êtes invité à participer à une entrevue avec les représentants de notre équipe. L‘objectif de cette entrevue est de recueillir vos connaissances et vos opinions concernant :

- l'utilisation du territoire et des ressources, y compris de l'état actuel du territoire et des ressources qui s'y trouvent ;
- la manière dont le projet Howse pourrait transformer le territoire et les ressources, et plus particulièrement les conséquences de cette transformation sur les utilisateurs du territoire ;
- l'importance de Kauteitnat et la manière dont le projet Howse pourrait affecter l'endroit;
- les effets anticipés du projet sur le savoir traditionnel, les communautés et sur les membres des communautés (les impacts socioéconomiques);
- comment les effets anticipés pourraient être atténués ou gérés;
- les mesures de suivi environnementales et sociales en vue d'identifier les effets réels du projet.

L'entrevue prendra de 1 à 4 heures. Des cartes et d'autres supports seront utilisés pour colliger l'information. Avec votre consentement, l'entrevue sera enregistrée.

Votre participation à l'entrevue est volontaire. Vous n'avez pas à répondre à des questions si vous ne voulez pas. *Votre nom ne figurera dans aucun rapport*. Les seuls participants qui pourront être identifiés sont ceux qui œuvrent dans le secteur public et qui auront participé à l'entrevue dans le cadre de leur fonction.

HML a besoin de votre consentement pour utiliser l'information que vous fournirez dans le contexte de l'EIES. Si vous êtes d'accord pour participer à l'entrevue, veuillez lire et signer le formulaire de consentement ci-joint. Votre signature confirme que vous donnez le droit à HML d'utiliser l'information que vous fournirez strictement pour les fins de l'étude d'impact environnementale du projet. Veuillez en conserver une copie pour vos dossiers personnels.

Merci.

HML et le Groupe Hémisphères

Pitama tshe natu

tshissenitakanit eshk[u] eka tapuetakanit tshetshi takuak ne atusseun mak tshe minu

uitakanit aimun

CONSENTEMENT PRÉALABLE ET INFORMÉ

Tshetshipannanut tshe natu-tshissenitakanit eshpaniuet uashka assi mak anite mamu ka tananut
Tshe natu-tshissenitakanit tshe ishpish apashtakanit assi mak Innuat utshissenitamunnuau
Howse Minerals Limited (HML) * Kanutashinenanut atusseun Howse

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ÉTUDE D'IMPACT ENVIRONNEMENTALE ET SOCIALE (EIES)

ÉTUDE D'UTILISATION DU TERRITOIRE ET DE SAVOIR TRADITIONNEL AUTOCHTONE (STA)

HOWSE MINERALS LIMITED (HML) – PROJET DE MINERAI DE FER HOWSE

- Niminu-uauitamakuti tshe ishinakuak ne atusseun mak ne kanatu-tshissenitakanit ute ianishkushtakanit (kie tshissinuatshitakan), iapit ute tekuak Howse atusseun. / J'ai reçu l'énoncé du projet et de l'étude ci-joint (lequel j'ai paraphé), qui inclut la description du projet Howse.
- Nimishta-minu-uauitamakuti ne ua utitaikanit ne kanatu-tshissenitakanit, kie niminu-tshiuenamakuti kueshte aimun. / J'ai été pleinement informé des objectifs de l'étude, et j'ai obtenu des réponses satisfaisantes à mes questions.
- Ninishtuten nin eka ui kueshte patshitinamani kueshte aimun, kie muk[u] ishpish ui punian ne e uauitaman. / Je comprends que je peux refuser de répondre à toute question, et que je peux terminer la discussion à tout moment.
- Ninishtuten nika tshi natueniten passe aimuna ianimatshenitakuaki tshetshi uitakaniti tshetshi eka mishituepanitakaniti mak tshetshi miniu-kanuenitakaniti. / Je comprends que je peux demander à ce que certaines informations sensibles soient protégées et traitées de façon confidentielle.
- Ninishtuten tshe eka uiesh mashinaikana nukuak nitishinikashun. / Je comprends que mon nom ne figurera dans aucun rapport.

Eshi-natuenitakanit ute ishpimit ka-mashinateua, nitapueten tshetshi apashtakanit nitaimun ka patshitinaman ka natshishkakuian ume ut ua aieshkuinitishunanut *kanatu-tshissenitakanit tshe ishi-ishpish apashtakanit assi mak Innuat utshissenitamunnuau* tshe utinakanit tshetshi ut ueuetashtakanit kanatu-tshisenitakanit tshe ishpaniuet uashka assi mak anite mamu ka tananut ne e tshitapajtakanit kanutashinenanut Howse, ne atusseun e tshitapaitakanit, aimun tshe mishituepanitakanit.

Sous réserve des conditions ci-dessus, je consens à l'utilisation de l'information que j'ai fournie durant l'entrevue strictement aux fins de la préparation de l'*étude d'utilisation du territoire et du savoir traditionnel autochtone* qui sera utilisée pour la préparation de l'étude d'impact environnementale et sociale pour le projet de minerai de fer Howse, qui sera rendue publique en vertu de la *Loi canadienne sur l'évaluation environnementale (2012)*.

Tshitishinikashun e mamikashtet / Nom (majuscules): __________

Ute mashinatautishu / Signature : __________

Utishinikashun ka uauitshiuet e mamikashtenit / Nom du coordonnateur (majuscules):

____

Ute tshe mashinatautishut / Signature : __________

Eshpish tshishtuakanit / Date : __________

Tanite ka mashinatautisihuiek[u] / Lieu : __________

Land Use Study and Aboriginal Traditional Knowledge (ATK)

PROJECT AND STUDY STATEMENT

Howse Minerals Limited (HML) (a wholly-owned subsidiary of Tata Steel Minerals Canada Ltd (TSMC), signatory to an unincorporated joint venture with TSMC and Labrador Iron Mines (LIM)) proposes to develop the Howse Property Project in the Millennium Iron Range, western Labrador. The deposit is located 25 km northwest of Schefferville, Québec.

TSMC is already building and operating the Direct Shipping Ore Project in the vicinity of the planned Howse Property Project. The construction and exploitation of the Howse Deposit will rely on existing infrastructure and facilities that were built (or that will soon be built) for the purpose of the DSO Project. Infrastructure already in place includes:

- workers' camp;
- crusher;
- railways;
- mining equipment;
- explosive storage area.

Undertaking the Howse Property Project will bring changes to the environment. It will create one open pit and its related overburden stockpile and waste rock dump and will require the construction of a new road between Timmins 4 pit and the planned Howse deposit. The Project will include the following:

- 2 km of new road;
- Open pit;
- Overburden/ topsoil stockpiles;
- Waste rock dump;
- Crusher facilities.

At the same time, the Project will bring economic benefits to the region and will create employment and business opportunities for community members, as it will secure continuity of mining projects undertaken by TSMC and LIM, respectively.

The Project has been registered pursuant to the *Canadian Environmental Assessment Act 2012* and the Newfoundland and Labrador *Environmental Protection Act*.

Groupe Hémisphères has been awarded a contract by HML to conduct the required environmental and social impact assessments (ESIAs).

The Naskapi Nation of Kawawachikamach (NNK), the Nation Innu Matimekush-Lac John (NIMLJ), the Innu Takuaikan Uashat mak Mani-Utenam (ITUM), Innu Nation of Labrador (IN), and the NunatuKavut Community Council (NCC - formerly Labrador Metis Nation) have been informed of HML intention to develop the Howse Project.

As part of our mandate, we must take into account the concerns and expectations of the potentially affected communities.

You are invited to participate in an interview with representatives of our study team. The objective of the interview is to gather your knowledge and opinions concerning:

- Land- and resource-use, including the current condition of the land and its resources;
- How the land and resources may be affected by the Howse Property Project, particularly the consequences of those changes on land- and resource-users;
- The importance of Irony Mountain and how it could potentially be affected by the project;
- The anticipated effects of the Project on the ATK, on communities and community members (socioeconomic impacts);
- How the anticipated effects may be alleviated or managed;
- Social and environmental monitoring measures, to identify what the actual impacts of the Project are.

The interview will last between 1 and 4 hours. Maps and other media will be used to collect information. If you agree, the interview will be recorded.

Your participation in the interview is voluntary. You do not have to answer any questions that you do not want to answer. *Your name will not be used in any reports.* The only informants who may be identified are those who work in the public sector, when they speak in an official capacity.

HML needs your consent to use the information that you provide for the purposes of the ESIA. If you agree to participate in this interview, please read and sign the following consent form. Your signature confirms that you give HML permission to use the information provided strictly for the purposes of the Project's environmental assessment. Please keep a copy of the form for your records.

Thank you.

HML and Groupe Hémisphères

ᐊᐦ ᑯ ᑮᔅ ᐃᔨᒧᐅᓐ ᑳᐱᔅ ᑎᓈᑲᓅ ᑲᓇᐋᐃᑖᑲᓅ ᒥᓯᓇᐃᑭᓐ

PRIOR AND INFORMED CONSENT STATEMENT

ᐊᐦ ᒋᔅ ᑮᔅ ᐃᔭᐤ ᐱᒪᑎᓯᔦᐅᓐ ᒐᐃᔅ ᒪᑕᐃᑖᔾ ᐃᔨᒧᐅᓐ ᐊᓈᑦ ᒐᐃᑖᑲᓅ ᐃᔭᐤ ᐊᐦ ᒐᐃᑎᒧᐅᓐ ᑮᔅ ᐊᐦ ᒋᔅ ᔅᐱᑦᑖᑲᓅ ᐊᒨᐦ ᑖᑲᓅ ᐃᔨᒧᐅᓐ ᑲᓄᐦᓯᓈ

HOWSE MINERAL LIMITED

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA) - ABORIGINAL TRADITIONAL KNOWLEDGE AND LAND-USE STUDY

HOWSE MINERAL LIMITED (HML) - HOWSE PROPERTY PROJECT

- ᐅᑕ ᑳᒥᑯᔅᓐ ᐊᑐᐦ ᒐᐅᓐ ᐋᑳᐃᑖᑲᓅ ᒥᓯᓇᐃᑭᓐ (ᒪᓯᓇᑕᐅᑎᓯᔅᓐ) ᐋᐦ ᑖᑲᐃᑲᓅ ᐊᓐᑕ ᓄᐦᐟ ᐊᓯᓈᔾ ᐊᑐᐦ ᒐᐅᓐ ᑲᓄᐦᓯᓈ Howse Property ᕽ / I have been provided with the attached Project and Study Statement (which I have initialled), which includes a description of the Howse Property Project.
- ᓄᐦᐟ ᐃᔨᒧᐅᓐ ᑳᐃᑎᒪᑯᔅᓐ ᐊᓐᑕ ᑳᐃᓯᐱᒍᑕᓅ ᑲᒪᒨᐦ ᑖᑲᓅ ᐃᔨᒧᐅᓐ, ᑮᔅ ᑳᐃᔅ ᑰᑳᒋᒐᒨᔅᓐ ᐃᔨᒧᐅᓐ ᔅᔅ ᑳᓯᐱᔅ ᑎᓇᒪᑯᔅᓐᕽ / I have been fully informed about the objectives of this study, and my questions have been answered to my satisfaction.
- ᓂᐦ ᑐᑕᑎᓯᐅᓐ ᐊᑲ ᐄᐱᔅ ᑎᓇᒪᓐ ᐃᔨᒧᐅᓐ ᑳᐃᔅ ᑰᑳᒋᒧᑯᔅᓐ ᒐᑳᓐ ᑮᔅ ᔅᔅ ᒐᒋ ᒋᐊᒪᓐ ᐅᐋᒐᑳᓐ ᐋᑳᐃᑖᑲᓅ ᒫᔾ ᐊᐱᐟ ᐱᑯᔅᓐᕽ / I understand that I may refuse to answer any questions and that I may end the discussion at any time during the interview.
- ᓂᐦ ᑐᑕᑎᓯᐅᓐ ᒐᒋ ᑰᑳᒋᒐᒧᐅᔅᓐ ᐊᐦ ᑕᐃᑖᔾ ᐃᔨᒧᐅᓐ ᐸᐦ ᑎᓇᒪᓐ ᒐᐊᑲ ᐸᒍᑖᑲᓅ ᑮᔅ ᒐᒋ ᑲᓅᐋᐃᑖᑲᓅᕽ / I understand that I may request that sensitive information be protected and treated as confidential.
- ᓂᐦ ᑐᑕᑎᓯᐅᓐ ᑎᓯᓂᑲᓯᐅᓐ ᒐᐊᑲ ᐱᔅ ᑎᓈᑲᓅ ᑮᔅ ᐊᐱᒋᑖᑲᓅ ᐊᓐᑕ ᒥᓯᓇᐃᑭᓂᐟᕽ / I understand that my name will not be used in any report.

ᐅᑕ ᒐᑳᓐ ᒪᓯᓇᑕᐃᑲᓅ, ᓂᔅ ᐊᑕᐋᑎᒪᓐ ᒐᒋ ᐊᐱᒋᑖᑲᓅ ᐃᔨᒧᐅᓐ ᑳᐱᔅ ᑎᓇᒪᓐ ᐊᓐᑕ ᐃᔭᐤ ᐊᐦ ᒐᐃᑎᒧᐅᓐ ᑮᔅ ᐊᐦ ᒋᔅ ᐊᓈᑦ ᒐᐃᑖᑲᓅ ᐃᔨᒧᐅᓐ ᐊᓐᑕ ᒐᐱᒋᑖᑲᓅ ᐊᓐᑕ ᐋᔅᐦ ᓂᐦ ᑖᑲᓅ ᐊᐦ ᒋᔅ ᑮᔅ ᐱᒪᑎᓯᔦᐅᓐ ᒐᐃᔅ ᒪᑕᐃᑖᔾ ᐊᓐᑕ ᑲᓄᐦᓯᓇᓅ ᐊᑐᐦ ᒐᐅᓐ ᐋᑳᐃᑖᑲᓅ ᐊᓐᑕ ᒐᐃᐃᐱᑖᑲᓅ ᐃᔨᒧᐅᓐᕽ

Subject to the foregoing conditions, I consent to the use of the information that I provide during the interview strictly for the *ATK and Land-Use Study* that will be used for the preparation of an Environmental and Social Impact Assessment for the Howse Property Project, which will be made public, pursuant to the *Canadian Environmental Assessment Act (2012)*.

ᐅᑎᓯᓂᑲᓯᐅᓐ ᐋᐋᐦ / Name (printed):

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ᒐᓐᑕ / Location :

Environment AECOM

Howse Minerals Limited

Quantitative Human Health Risk Assessment for the Howse Property Environmental Impact Statement

Prepared by:

AECOM
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Burnaby, BC, Canada V5A 4R4 604 294 8597 fax
www.aecom.com

Project Number:

60437924

Date:

November, 2015

Statement of Qualifications and Limitations

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Revision Log

Revision #	Revised By	Date	Issue / Revision Description
0	M.Rankin	2015-10-26	Initial Draft
1	M.Rankin	2015-11-02	Final with Client Comments addressed

AECOM Signatures

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Appendices

1. Introduction

Howse Minerals Limited (HML) proposes to develop the iron ore deposit at the Howse Project Property located in western Labrador (the Project), approximately 25 km northwest of Schefferville, Quebec. The deposit will be developed as an open pit iron mine with the support of existing adjacent infrastructure in the nearby Schefferville, Quebec area. AECOM has prepared this Report on Human Health Risk Assessment (HHRA) on behalf of HML.

1.1 Purpose and Context of this Report

The Canadian Environmental Assessment Agency (CEA Agency) has issued direction to HML on the scope of the EA in the form of the Environmental Impact Assessment Guidelines (EISGs). HML has prepared a single joint EA submission (the “Submission”) to meet the requirements of both agencies. The EISGs for the Project require that biophysical changes to the environment that may impact human health be considered in the scope of assessment.

Through Aboriginal Consultation, physical health of local residents was identified as a Valued Component (VC) within the context of potential changes to environmental chemistry that might arise from the Project. VCs are components of the natural and human environment that are considered by the proponent, public, Aboriginal Groups, scientists and other technical specialists, and government agencies involved in the assessment process to have scientific, ecological, economic, social, cultural, archaeological, historical, or other importance.

An HHRA is a systematic and well-documented process to define and quantify potential human health risks, which serve as surrogate measure of potential impacts. This report presents the results of the HHRA completed for the Project and supports the Environmental Impact Statement (EIS). The HHRA uses site data and conservative assumptions to predict the toxicological risk potential to humans during the operational phase. Through a combination of conservative assumptions including predicted air quality during blasting and far future conditions accrued from long-term particulate deposition, the HHRA risk estimates are inferred to also adequately describe toxicological risk for the construction phase, and decommissioning and abandonment phase of this project.

1.2 HHRA Supporting Documents

This document is one of a series of reports prepared to support the application process. Table 1.1 lists various documents from which information and data were obtained relevant to the Local Study Area and Regional Study Area (LSA and RSA, respectively) in the development of the HHRA:

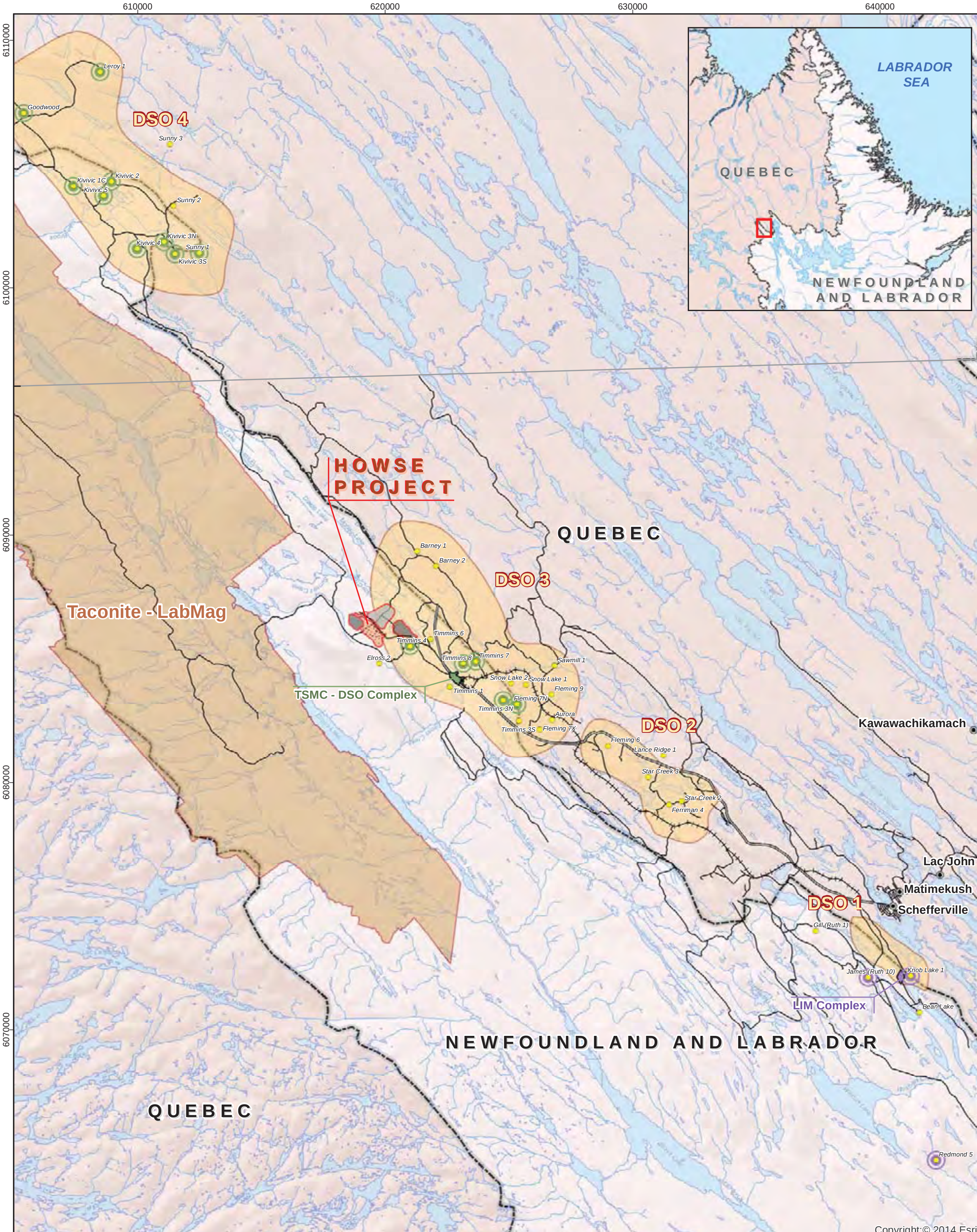
Table 1.1 HHRA Supporting Documents Used to Inform Human Health Risk Assessment

Report	Data Provided
Schefferville Iron Ore EIS (Jacques Whitford 2009)	RSA soil and surface water,
Air Dispersion Modelling Report (AECOM 2015 (Vol. 2, Appendix E))	LSA Air Quality
Hydrogeology and MODFLOW Modeling Howse Property (GEOFOR 2015, (Vol. 2, Appendix C))	LSA Groundwater quality
Aquatic Survey – Howse Pit Study Area (Groupe Hémisphères 2014)	LSA Water quality and Sediment quality
Hydrological Campaign DSO3 and DSO4 (Groupe Hémisphères 2011)	LSA Water quality
Fish and Fish Habitat Investigation for the Direct-Shipping Ore Project (AMEC 2009)	LSA Water quality
Hemisphere Field Report – 2013 Baseline Aquatic Fauna Characterization: Elross Lake Area Iron Ore Mine (ELAIOM) Environmental Effects Monitoring (EEM)	LSA Water quality
KAMI Concentrate Storage and Load-out Facility, Québec (Stantec 2012)	RSA water quality
Air Quality Monitoring Baseline Study (Stantec 2012)	RSA air quality
Howse Property Country Food Survey (June 2015)	Socioeconomic

1.3 Project Overview

This project includes the development and operation of a conventional open pit mine at the Howse Property using a drill and blast mining method (Figure 1). The extracted iron ore will be crushed and screened on-site, hauled by truck to Howse Minerals Limited (HML) DSO project rail loop loading area (less than 5 km from the Project), and then shipped by train to Sept-Îles, QC. The high-grade iron ore from the mine will be transported by haul trucks to the DSO3 product stockyard, where it will be crushed and screened before being loaded onto product reclaiming conveyors for subsequent loading onto rail cars. The low-grade ore, generated by the excavation of high-grade ore, will require beneficiation in a process plant similar to HML's processing unit currently under construction for the DSO project. The processing plant that is currently under construction will be fully utilized over the next 15 years. Hence, the low-grade iron ore will be stockpiled near the Howse deposit and will be processed through the DSO processing plant located approximately 4 km from the Howse deposit (Figure 2). The projected life of the mine is 15 years with a projected closure date in 2032.

The Project requires few new installations and some of the required infrastructure (e.g., the railway, access road, camp, mining equipment and explosive storage) are already in place at the nearby TSMC DSO project complex, which was recently put into operation. The construction of new infrastructure will be required to mine the deposit at the Howse Property. The main physical works and activities involved for the Project are: an open pit, a mobile crushing and screening facility at DSO3, dedicated areas for stockpile/dumps, new access and haul roads to connect to an existing network, power generation facilities, and water management infrastructure. No tailings or tailings process water will be generated by the Howse Project. HML plans to utilize the following approved facilities at TSMC's DSO project plant complex: a processing plant, covered processed ore stockpiles, a rail car loading system, an existing railway track, a camp to accommodate the workers, offices, a warehouse, workshops, garages, a laboratory, a landfill, and a wastewater treatment facility. None of the above listed facilities are part of the scope of the current EIS.



LEGEND

Infrastructure and Mining Components

- DSO - Deposit
- LIM Actual or Planned Deposit Operation
- LIM Complex
- TSMC Actual or Planned Deposit Operation
- DSO Complex - TSMC
- DSO - Other Site
- Taconite - LabMag

Howse Infrastructures

- Proposed Howse Pit
- Proposed Topsoil/Overburden Stockpile
- Proposed Site Infrastructure
- Proposed Waste Dump/In-Pit Dump

Basemap

- Town
- Railroad
- Road
- Watercourse
- Water body
- Provincial Boundary

FILE, PROJECT, DATE, AUTHOR:
GH-0571 , PR185-19-14, 2015-10-21, edickoum

N

0 2 4 6 8 10
Kilometers

UTM 19N NAD 83

SCALE: 1:150 000

SOURCES:

Basemap
Government of Canada, NTDB, 1:50,000, 1979
SNC Lavalin, Groupe Hémisphères, Hydrology update, 2013.

Infrastructure and Mining Components
New Millennium Capital Corp., Mining sites and roads
TATA Steel Minerals Canada Limited/ MET-CHEM, Howse Deposit Design for General Layout., 2013

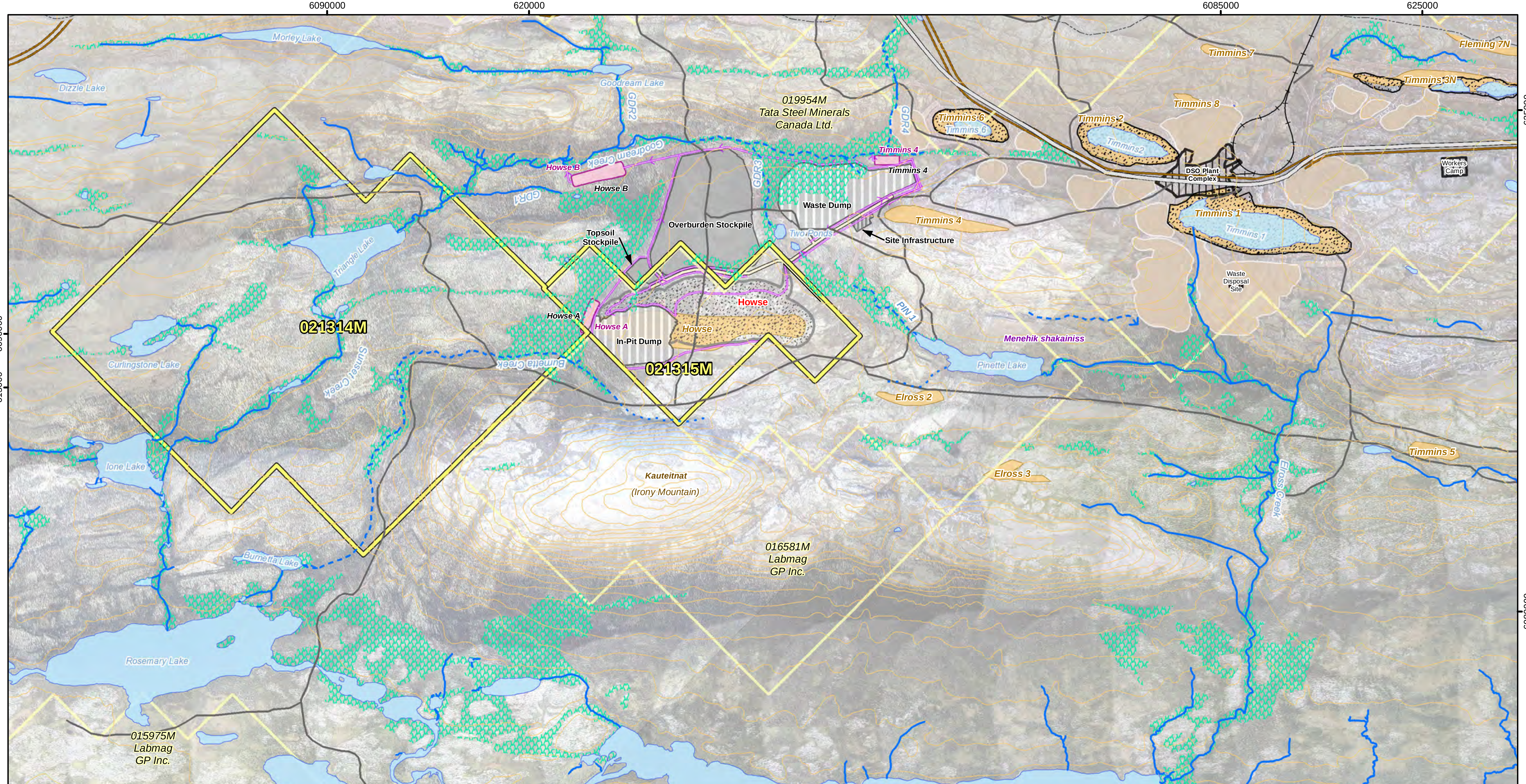
ENVIRONMENTAL IMPACT ASSESSMENT
HOWSE PROPERTY PROJECT

Howse Project
Location Map

Howse Minerals Limited

GroupeHemispheres
5731, rue Saint-Louis, Bureau 201, Lévis (QC) Canada, G6V 4E2
1453, rue Beaubien est, Bureau 301, Montréal (QC) Canada, H2G 3C6

Figure 1



LEGEND

Infrastructure and Mining Components

Proposed Infrastructures
- Proposed Howse Pit
- Proposed Topsoil/Overburden Stockpile
- Proposed Waste Dump/In-Pit Dump
- Proposed Site Infrastructure
- Proposed Sedimentation Pond
- Proposed Ditch and Outlet
- Proposed Mine Haul Road

Existing Components
- Existing Railroad
- Road to DSO Area 4
- Existing Sedimentation Pond
- DSO Howse - Claim Labrador Iron Mines Limited(49%)/ Howse Minerals Ltd.(51%)
- Other Claim

Elross Lake Area Iron Ore Mine (ELAIOM)
- Plant Infrastructure Footprint
- Existing Dump
- Existing Pit
- Deposit

Basemap
- Permanent Watercourse
- Intermittent Watercourse
- Storm Runoff
- Disappearing Stream
- Artesian Spring
- Water body
- Contour Line (50 ft)
- Provincial Border
- Existing Road
- Main Access Road
- Wetland

*Hydronyms are oriented along the direction of water flow

FILE, PROJECT, DATE, AUTHOR:
GH-0572a , PR185-19-14, 2015-10-21, edickoum

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0 500 1 000 1 500 2 000
Meters

UTM 19N NAD 83

SCALE: 1:30 000

SOURCES:
Basemap
Government of Canada, NTDB, 1:50,000, 1979 Government of NL and government of Quebec, Boundary used for claims
SNC Lavalin, Groupe Hémisphères, Hydrology update, 2013

Infrastructure and Mining Components
New Millennium Capital Corp., Mining sites and roads
TATA Steel Minerals Canada Limited/ MET-CHEM Howse Deposit Design for General Layout, 2013

ENVIRONMENTAL IMPACT ASSESSMENT
HOWSE PROPERTY PROJECT

Howse Property and HML DSO Project Infrastructure

Howse Minerals Limited

GroupeHemispheres

5731, rue Saint-Louis, Bureau 201, Lévis (QC) Canada, G6V 4E2

1453, rue Beaubien est, Bureau 301, Montréal (QC) Canada, H2G 3C6

Figure 2

The project plan is subject to the satisfactory completion of the feasibility study and acquisition of all necessary environmental approvals from Newfoundland and Labrador, and federal jurisdictions. Once approved the Project will proceed as follows:

- A detailed engineering phase
- A construction phase, that would require about 1 years
- An operations phase that is currently planned for 16 years
- A decommissioning and abandonment phase
- A post-closure phase (mainly environmental monitoring).

1.3.1 Construction and Operation Phase Emissions, Waste and Discharges

Air

Airborne particles and dust will be managed along roadways and in ore storage and processing areas. The Howse Property will not be supplied with electricity and therefore greenhouse gas emission estimates for the Howse Project were based on the need for diesel generators at the DSO3 main plant, worker camp, and for the pit-dewatering pump. Exhaust from diesel power generators will be emitted to the atmosphere and will include CO_2, CH_4, NO_2, combustible hydrocarbons and volatile organic carbons. Overall, GHG emissions from the Howse Project Property are estimated to be approximately 43,000 t CO_2 eq/yr, which represents roughly 0.4% of the total emissions for Newfoundland and Labrador.

Noise

Potential noise sources includes equipment used during the construction phase, facility operation, loading operations, road traffic during the life of the mine, and diesel generators. Within the Howse Property area noise-sensitive areas include Irony Mountain, and Pinette, Rosemary, Elross, and Triangle Lakes. The Town of Schefferville was also assessed, as it is the closest town to the Howse Mine. Project noise is not expected to be above background levels at approximately 5 kilometers from the Howse Mine.

Liquid Waste

Sewage and wastewater generated at each of the camps, the processing complex and the garage will be retained in holding tanks for appropriate off-site disposal. The contents of those tanks are transferred regularly. Except for water management around the open pit the storm water on the project property will be collected using an engineered solution.

Solid Waste

The project will continue the current practice of collecting solid waste from around the site in animal-resistant containers that are disposed of by a contractor in a waste management site near Timmins 1. The mine staff will be staying at an existing nearby camp and therefore no discussion of camp related solid waste is included in this report.

1.3.2 Decommissioning Phase

At the end of the project, site infrastructure will be decommissioned and abandoned according to the mine closure regulations.

1.4 Physical Environment

1.4.1 Topography

The Howse Property is located between Irony Mountain (840 m asl) and Pinette Lake. The topography of the area is dominated by Irony Mountain, which is a prominent bedrock knob, and the meltwater channels on the western flank of Irony Mountain. Based on the NTS map sheet 023J this area is a network of ridges and valley oriented approximately northwest to southeast that is typical of the Labrador Trough.

1.4.2 Geology

The Howse iron ore deposit was discovered in 1979 by the Iron Ore Company of Canada in a test hole drilled on a geophysical anomaly. After the discovery of the deposits further tests were carried out including gravity tests and exploration drilling. Structurally, the deposit occurs in a broad syncline with tight second order folds in the hinge area. The Howse Project Property is located in a geological formation called the Labrador-Quebec Trough. This formation is approximately 1,200 km long and up to 100 km in width and is a complexly folded and faulted geosyncline bearing sedimentary, volcanic and intrusive rocks. The Trough is divided into three regions:

- The north region (Ungava Bay Region);
- The central region (Schefferville Region), and
- The south region (The Grenville).

The Howse Project Property itself is covered by a relatively uniform layer of till overlying buried glaciofluvial sand and gravel. The landform is interpreted to be a buried kame, more or less centered on the deposit, overridden by a late glacial advance. The till in the area is generally moderately well to well drained and silty sand is the most widespread surficial material in the vicinity of the Project. In depressions where the groundwater table is perched on an impervious layer, the till may be imperfectly to poorly drained. Historical drilling records indicate that the glaciofluvial material encountered was mainly a mixture of sand and gravel, with occasional clay content.

1.4.3 Climate

The climate data for the Local Study Area (LSA) is represented by data collected within a 30 km radius centered on the proposed Howse Property Project site. This includes one governmental weather station at the Schefferville airport and one dedicated weather station for the nearby Taconite project. In the regional study area (RSA) the growing season is very short and precipitation is moderate. The Long-term temperature records for the Schefferville town site (522 m asl) indicate a mean annual air temperature of -5.3°C. The seasonal pattern of air temperature reflects its continental influence, characterized by dramatic extremes. The distribution of precipitation in Labrador is fairly uniform throughout the year. However, the mean annual precipitation varies greatly across Labrador, ranging from 600 mm to 1,400 mm, with the lower end of the precipitation range occurring in north-west Labrador, where the predominant winds provide drier (continental) air. Further climate information including Environment Canada weather normals from the Schefferville A weather station (No. 7117825) is available in the climate section of the EIS.

1.4.4 Hydrology

The Howse Project Property is drained by three watersheds, which ultimately discharge into the Howells River watershed. Under baseline conditions the local water bodies (Triangle Lake and Pinette Lake) are considered to be near neutral with some recorded measurements indicating a slightly acidic pH. The baseline water quality parameters analysed were in compliance with both the Health Canada and Quebec drinking water quality guidelines.

1.5 Ecological Region and Setting

The project is located in both the mid subarctic forest (MSF) Ecoregion and the high subarctic tundra (HST) ecoregion described below:

Winters in the MSF are generally cold and snowy while summers are cool and short, approximately four to five months long. Records for the MSF are similar to climate normals for Schefferville with a mean daily minimum temperature during the coldest month of -28.9 °C and a record low of -50 °C. The severe climate and short summer causes discontinuous forest cover and inhibits continuous tree cover on upland sites. This area represents a transition between the relatively productive closed boreal forests to the south and the treeless subarctic tundra to the north. Evergreen trees dominate this Ecoregion and deciduous trees are sparse. Typical tree species include balsam fir, black spruce, white spruce and tamarack. As is typical in boreal forest areas, forest fires are a common and important part of the forest renewal process and as such forest fires tend to cover large areas. In low lying areas wetland complexes can be extensive and are characterized by patterned or ribbed fens, interspersed with forested fens.

Summers in the HST Ecoregion are typically short followed by long, windy winters. The summer growing season is short lasting approximately 80 to 100 days. The HST Ecoregion contains discontinuous permafrost in upland areas and small pockets of wetlands in depressions and around lakes where thin organic soils dominate. The various ecotypes of the HST Ecoregion are generally found at elevations higher than 650 m. These ecotypes are all treeless and are similar to the alpine tundra, supporting vegetation dominated by shrubs and graminoids.

1.6 Human Context

1.6.1 Social Communities

Two Aboriginal communities, the Naskapi and the Innu, use the land in the vicinity of the Howse Property including Pinette Lake which has recreation value for the Aboriginal people of the area. The nearby Irony Mountain is a culturally and historically significant location to the local communities and Aboriginal people, especially the Innu. .

To minimize the visual and environmental impact on wetlands, water quality and fish habitat, consultations were conducted with local aboriginal organizations and family trap line holders (Section 1.5; Howse EIS). The proposed layout of the Howse pit was selected after consultation with Aboriginal organizations and family trapline holders to accommodate Aboriginal rights or interests. The closest First Nations communities to the project site are located in the Shefferville and Kawawachikamach area of eastern Quebec. The Ville de Schefferville and Matimekush-Lac John, an Innu community, are located approximately 25 km from the Howse Property, and 2 km from the Labrador border. According to the 2011 population census results Schefferville and Matimekush-Lac John have approximately 213 and 540 presidents, respectively. The Naskapi community of Kawawachikamach is located about 15 km northeast of Schefferville.

1.6.2 Terrestrial Ecosystem Services

The human stakeholders in this area include the local First Nations stakeholder groups and residents of nearby communities identified in Section 1.6.1. Based on the socioeconomic surveys conducted for the Howse Project development a variety of aquatic birds and terrestrial mammals are harvested annually along with medicinal plants. Specific species of interest in the vicinity of the Howse property are summarized in Table 1.2. The Irony Mountain area has been identified as a locally sensitive terrestrial environment.

Table 1.2 Terrestrial plants and wildlife collected by First Nations and local hunters within the LSA

Waterfowl and Game Birds		Large /Small Mammals	
Goldeneye	Long-tailed duck	Caribou	Snowshoe hare
Canada goose	Common merganser	Beaver	Porcupine
White-winged scoter	Spruce grouse	**Vegetation**	
Common loon	Willow ptarmigan	Blueberries	Lingonberry (Partridge berry)
American black duck	Rock ptarmigan	Cloudberries	Labrador Tea

1.6.3 Aquatic Ecosystem Services

The Howse Project Property is a mountainous area that has many small lakes and streams. Locally sensitive aquatic habitats have been identified in Burnetta Creek, Goodream creek and the regions low-lying wetlands.

The site of the proposed pit itself is flanked by Triangle Lake and Pinette Lake and Goodream Creek. Based on the socioeconomic surveys conducted for the Howse Project development the fish species collected from these water bodies by local traditional food users are provided in Table 1.3.

Table 1.3 Fish species collected by First Nations within the LSA

Fish	
Brook trout	Sucker (white, longnose)
Lake trout	Landlocked char
Northern pike	Burbot
Lake whitefish	

It is expected that while in the area First Nation hunting and gathering groups utilize the aquatic resources for food (fish) and drinking water.

1.7 Scope of Supporting Environmental Data

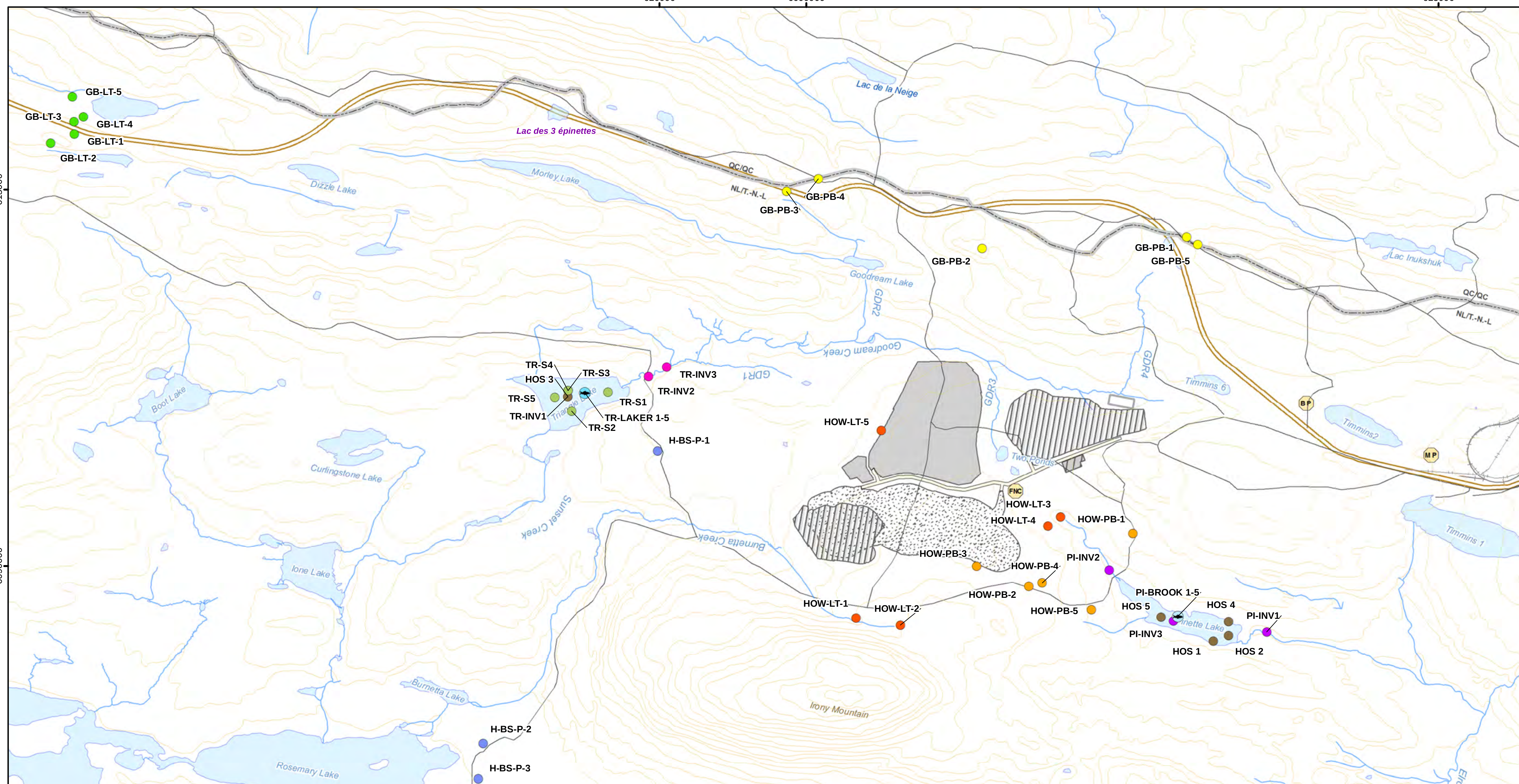
The HHRA evaluated baseline environmental chemistry data from the supporting documents identified in Table 1.1 by the various Project discipline teams:

- Surface Soil
- Subsurface Ore/Rock/Soil
- Surface Water
- Air Quality.

To complete the HHRA the following environmental media and biota were sampled within the LSA to establish or augment baseline chemistry data:

- Sediment
- Benthic Invertebrates
- Food plants
- Medicinal plants
- Terrestrial Bird Tissue
- Fish Tissue.

Sample locations from the 2015 supplemental field programs are presented in Figure 3, and the resulting chemistry data and its applications in the HHRA process are described is subsequent sections; summary chemistry data are provided in Appendix E2. Due to the lack of availability of small mammals at the site during the summer of 2015, small mammals were not collected for chemical evaluation of metals content.



LEGEND

Samples

Fishes
- Pinette Lake
- Triangle Lake

Benthic Invertebrates
- Pinette Lake
- Triangle Lake

Soil and Vegetation
- Howse Partridge Berry
- Greenbush Partridge Berry
- Howse Labrador Tea
- Greenbush Labrador Tea
- Spruce Grouse

Sediments
- Pinette Lake
- Triangle Lake

Infrastructure and Mining Components
- MP Main processing Plant
- BP Batch Plant
- FNC First Nations crusher/screener
- Road to DSO Area 4
- Existing Railroad
- Proposed Howse Pit
- Proposed Topsoil/ Overburden Stockpile
- Proposed Site Infrastructure
- Proposed Waste Dump/ In-Pit Dump
- Proposed Sedimentation Pond
- Proposed Mine Haul Road

Basemap
- Existing road
- Contour Line (50 ft)
- Provincial Border
- Watercourse
- Water Body

*Hydronyms are oriented along the direction of water flow

FILE, PROJECT, DATE, AUTHOR:
GH-0672 , PR185-19-14, 2015-10-19, edickoum

N

0 1 2
Kilometers

UTM 19N NAD 83
SCALE: 1:30 000

SOURCES:

Basemap and Land Use Components
Government of Canada, NTDB, 1:50,000, 1979
Government of NL and government of Quebec,

Mining Components
TATA Steel Minerals Canada Limited/
MET-CHEM Howse Deposit Design
for General Layout., 2013
Groupe Hémisphères, Hydrology and update, 2013

ENVIRONMENTAL IMPACT ASSESSMENT
HOWSE PROPERTY PROJECT

Sampling Location Map
Howse Minerals Limited

GroupeHemispheres

5731, rue Saint-Louis,
Bureau 201, Lévis (QC)
Canada, G6V 4E2

1453, rue Beaubien est,
Bureau 301, Montréal (QC)
Canada, H2G 3C6

Figure 3

2. Human Health Risk Assessment Approach

2.1 General Approach and Risk Assessment Framework

This HHRA quantifies health impacts of the proposed Howse pit and the project area as defined by the Howse Project Property. In an HHRA, risk is an abstract concept (non-tangible) that embraces (i) a hazard or hazardous event existing with a certain likelihood, and (ii) the adverse consequence and severity that arises from the hazard. Risks to humans are plausible to the extent that a contaminant exists, there are human receptors present, and exposure or contaminant transport pathways exist that connect the human receptors with the contaminants/stressors.

Health impacts were evaluated respecting potential changes in quality of surface water, soil, air and food during the far future operations phase (i.e., after 16 years of operations and accrued dust deposition) and inferred to apply to construction and the post-closure phases of the project. Impacts were assessed relative to the baseline scenario (i.e., current conditions) to provide context of the incremental impacts predicted for the Project. Cumulative effects associated with other proposed projects within the regional area were also considered. Though the scenarios differed, the exposure modeling methods were fundamentally the same for both the baseline and operating scenarios. The process followed basic principles of human risk assessment frameworks endorsed by Health Canada (2010a). Additional details are provided below and in Appendices D1 and D2, which describe the food chain model and the computational model, respectively.

The first step in completing the impact assessment for human health was to determine whether a certain project activity had potential to cause substantive change in environmental and chemical concentrations that may affect health. To this end, the following linkages were made between project activity and potential effect on media:

1. **Activities potentially affecting Air Quality** (considered operable and assessed in the HHRA):
   - Emissions from power generators and truck fleet
   - Fugitive dust emissions from blasting, crushing and hauling

2. **Activities potentially affecting Soil Quality** (considered operable and assessed in the HHRA):
   - Accumulation of ore-based chemical constituents from particulate air deposition

3. **Activities potentially affecting Traditional Food Quality** (considered operable and assessed in the HHRA):
   - Accumulation of ore-based chemical constituents in vegetation (e.g., berries, plants) from soil after prolonged particulate air deposition
   - Accumulation of ore-based chemical constituents in small local game (e.g., game birds, hare) from soil after prolonged particulate air deposition

4. Activities **potentially affecting Surface Water and Fish Tissue Quality** (considered operable but not assessed in the HHRA):
   - The water management plan (SNC Lavalin 2015) establishes that settling pond effluent will comply with all relevant and applicable quality standards
   - Water quality from existing local settling ponds (Timmins operation) and effluent support this position

Subsequently, quantitative risk estimation was conducted for scenarios where receptors, operable exposure pathways and substantive changes in environmental quality were plausible.

2.2 Study Area

The potential effects of the project were assessed within the vicinity of the Howse Project Property which represents areas with operable exposure pathway and the receptors. The following study areas have been defined for the HHRA and are defined spatially in Figure 4. The Regional Study Area (RSA) is considered to be the Howells River watershed and the Schefferville region. This area includes the following:

- In Labrador, Labrador West (Labrador City and Wabush), as well as the Innu Nation and the NunatuKavut Community Council (NCC)
- In Québec, the Ville de Sept-Îles, and the Innu of Ushat and Mani-Utenam (ITUM) which are considered within the LSA for land-use and harvesting activities.

The Local Study area (LSA) for the HHRA is that defined for the Air Quality assessment; this provides continuity in establishing air quality exposure factors. This area encompasses the area where the Howse Property Project facilities and activities will be located and the surrounding wildland areas visited by First Nations for traditional land use activities that may be affected.

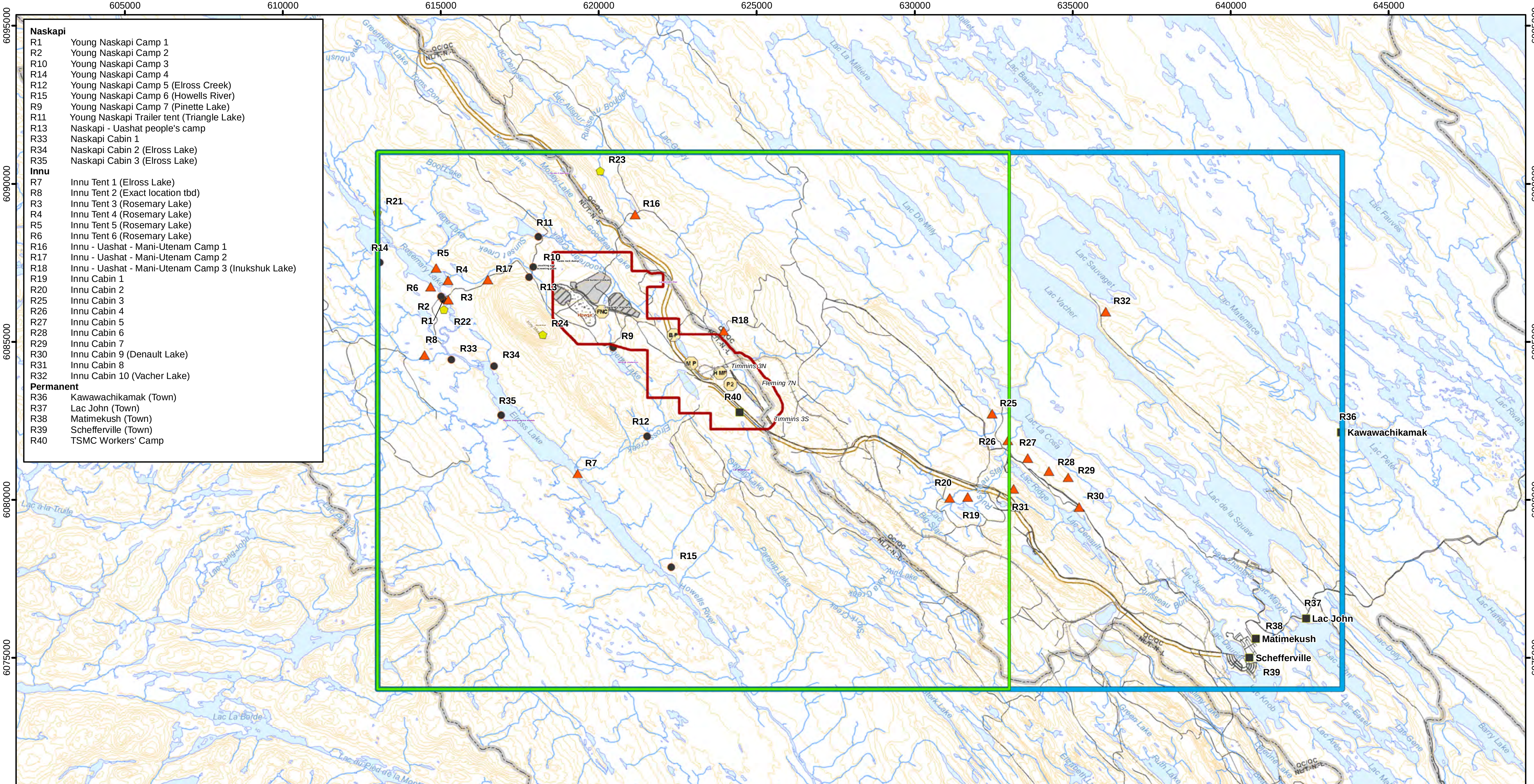
2.3 Environmental Quality Regulatory Regime

An HHRA assesses the possible linkages between contaminant sources and identified receptors. These linkages define the scope of the risk assessment and screen out those contaminant source/receptor combinations which are negligible or inoperable. This HHRA followed the risk assessment guidance and underlying principals from the following:

- The Canadian Council of Ministers of the Environment (CCME)
- Health Canada
- United States Environmental Protection Agency (EPA).

Those contaminant source/receptor combinations which were retained were quantitatively evaluated to ascertain the magnitude and potential consequences. Specifically the environmental media were screened against guidelines from the following sources:

- CCME Environmental Quality Guidelines for the Protection of Human Health
- Health Canada Drinking Water Guidelines
- The Quebec Minister of Sustainable Development, Environment and the Fight against Climate Change (MDDELCC).



LEGEND

Sensitive Receptors
- Naskapi
- Innu
- Permanent
- Other

Study Areas
- Local Study Area (LSA)
- Regional Study Area (RSA)
- Air Quality Modelling Perimeter

Infrastructure and Mining Components
- P2 Plant 2
- MP Main processing Plant
- HMP Howse Mini-Plant
- BP Batch Plant
- FNC First Nations crusher/screener
- Road to DSO Area 4
- Existing Railroad
- Deposit
- Proposed Howse Pit
- Proposed Topsoil/ Overburden Stockpile
- Proposed Waste Dump/ In-Pit Dump
- Proposed Mine Haul Road

Basemap
- Existing road
- Contour Line (50 ft)
- Provincial Border
- Watercourse
- Water Body

*Hydronyms are oriented along the direction of water flow

FILE, PROJECT, DATE, AUTHOR:
GH-0672 , PR185-19-14, 2015-11-02, edickoum

N

0 2 4
Kilometers
SCALE: 1:120 000

UTM 19N NAD 83

SOURCES:

Basemap and Land Use Components
Government of Canada, NTDB, 1:50,000, 1979
Government of NL and government of Quebec,

Mining Components
Howse Minerals Limited/
MET-CHEM Howse Deposit Design
for General Layout., 2015
Groupe Hémisphères, Hydrology and update, 2013

ENVIRONMENTAL IMPACT ASSESSMENT
HOWSE PROPERTY PROJECT

Study Area for Purposes of Air Quality Modelling Sensitive Receptors

Howse Minerals Limited

5731, rue Saint-Louis,
Bureau 201, Lévis (QC)
Canada, G6V 4E2

1453, rue Beaubien est,
Bureau 301, Montréal (QC)
Canada, H2G 3C6

Figure 4

2.4 HHRA Objectives and Key Questions

The objective of the HHRA was to evaluate the chemicals found to exceed applicable standards/guidelines and provide quantitative estimates of exposure to dose levels considered to be representative of the projects baseline and future environment. These estimates were compared to dose levels/rates considered by Health Canada or other regulatory agencies to be acceptable or “safe” and evaluated based on the numerical output of this comparison in the form of:

- Hazard Quotients for threshold contaminants; or
- Incremental lifetime cancer risks (ILCR) for carcinogenic substances.

Key questions were defined for the HHRA to address specific issues that may affect area users (e.g., First Nations). Key questions for the HHRA are as follows:

- HH1: What effect will project releases have on water and subsequently human health?
- HH2: What effect will project releases have on air quality and subsequently human health?
- HH3: What effect will project releases have on soil quality and subsequently human health?
- HH4: What effect will project releases have on food quality and subsequently human health?
- HH5: What will be the collective effect of changes to water, air, soil and food on human health?

2.5 Problem Formulation

The objective of the problem formulation is to develop a focused understanding of how chemicals emitted by the different parts of the Project might affect health of people near the Project. The problem formulation focuses the risk assessment on the receptors, chemicals, and exposure pathways of greatest concern. The methods and rationale for screening these entities are described in the sections below.

2.5.1 Screening of Substances of Interest

A broad screening was used to identify substances of interest (SOI) to be evaluated in the baseline and future scenario (Appendix A). The screening included a wide array of metals and at the request of CEAA organic compounds from air emissions were also added. The screening framework evaluated substances against available federal and provincial guidelines for metals and hydrocarbons, site-specific background concentrations, or additional regulatory sources. The screening framework consists of three broad tracks as follows:

1. Maximum concentrations of elements and hydrocarbons measured in site matrices including soil and surface water were examined. Examination of these baseline matrices informed the first component of the objective and identified substances which were at unusual concentration under baseline conditions.
   a) Concentrations of metals measured in soil samples were compared to applicable CCME and Quebec MDDEFP soil quality guidelines.
   b) Concentrations of metals measured in surface water samples were compared to applicable Health Canada and Quebec Drinking Water Guidelines.
2. To identify substances which have a potential to alter baseline conditions during the lifecycle of the proposed development, the raw materials that will be introduced to the process were considered. Concentrations of metals measured in samples of ore, waste rock, and overburden from the Howse Project Property were compared to applicable CCME and Quebec MDDEFP soil quality guidelines.

Substances with concentration in ore or waste rock in exceedance of the soil quality guidelines were considered to have the potential to impact baseline conditions for environmental media during the lifecycle of the mine development; and were retained as substances of interest.

3. At the request of CEAA, organic compounds from air emissions were considered. The air quality substance of interest screening was conducted by comparing predicted air quality for metals and VOCs to air quality standards from Newfoundland/Labrador and Quebec (Details of the air quality screening are provided in Appendix 3 of the Air Dispersion Modeling Report).

A substance which is screened in for any medium is then considered as a contaminant of potential concern in all media and routes of exposure. The screening process yielded the following contaminants of potential concern:

- Arsenic
- Barium
- Beryllium
- Chromium
- Iron
- Lead
- Manganese
- Mercury
- Molybdenum
- Selenium

Note: There are no CCME or Quebec MDDEFP soil quality guidelines for iron. Iron has been included due to local enrichment that has made this area the focus of iron mine developments.

2.5.2 Identification of Potential Receptors

The objective of the receptor screening process was to identify people who are currently living in, or using, areas in the vicinity of the Project Site. According to the socio-economic baseline studies no residents were found within the study area, therefore only First Nations (individual hunters or family groups) were identified as potential receptors for consideration in the HHRA. Worker health risk to on-site workers was not addressed as part of this HHRA assessment, and is considered as separate component within the context of Howse Project Worker Health and Safety.

In accordance with Health Canada Guidance (Health Canada 2010b) not all age groups need be assessed using complete quantitative risk assessment. The most sensitive receptors were identified as critical receptors; assessment and management of risks to critical receptors is considered protective of all individuals. Critical receptors are therefore focussed upon to estimate and manage risk in the interest of the more diverse and larger group of receptors. The critical receptors for the HHRA are defined below.

First Nations

First Nations (individuals or family groups) engaged in traditional land uses are expected to have the greatest potential exposure based on duration of visit and the activities they are involved in. The HHRA incorporated the following receptor age groups into the human health CEM for the Howse Property Project:

- Adult – Travels for hunting and gathering activities may bring individuals into the local study area for a much shorter time period than extended harvesting activities would. However, since the magnitude of exposure to contaminants is, in part, a function of the time spent on site, evaluation of risks based on an extended stay is considered a more conservative (protective) and most relevant exposure scenario to assess human health risks.
- Toddler – It is recognized that people of all ages are part of traditional hunting and gathering parties and therefore entire family units may be present during the late spring to fall period. Toddlers are considered to be more sensitive to the effects of chemicals than adults because they typically have a

greater intake rate to body weight ratio and certain behaviour activities may foster greater contact with exposure media (e.g., playing in soil). Consistent with risk assessment guidance (Health Canada 2010a), the toddler life phase (i.e., 7 months to 4 years of age) was included as a receptor in this scenario.

The critical receptors and the rationale for their selection for the Howse Property Project are presented in Table 2.1.

Table 2.1 Receptor Screening for Human Health Assessment

Receptor Population	Receptor Population Rationale	Critical Receptors	Assessed?	Critical Receptor Rationale
First Nations	The Traditional Land Use Study completed for the Howse Property Project indicated that two Aboriginal groups (Naskapi and the Innu) have traditionally used the territories located within or near the Howse Property Project area.	Adult	Yes	Assumed to have the highest potential frequency and duration of site use. Assumed to visit the site for hunting /fishing activities.
		Toddler	Yes	It is recognized that people of all ages take part in traditional hunting/gathering. Health Canada and the National Public Health Institute of Quebec recommend toddlers as a critical receptor due to their low body weight and high rate of incidental soil/sediment ingestion. Accordingly all human receptors are assumed to take part in a traditional lifestyle and consume traditional country foods throughout the year.

2.5.3 Identification of Exposure Pathways

Exposure pathway screening identifies potential routes by which people could be exposed to chemicals. A chemical represents a potential health risk only if it can reach receptors through an exposure pathway at a concentration that could potentially lead to adverse effects. The following exposure pathways were considered relevant for human receptors at the Howse Project Property:

Ingestion

- Contaminated soil that is incidentally ingested (as soil or non-respirable dust) during outdoor activities such as camping, hunting etc. will result in an ingestion exposure.
- Contaminants in drinking water will be retained by the body and result in an ingestion dose.
- Contaminated produce/vegetation that is ingested will result in an ingestion dose.
- Ingestion of contaminated fish or game will result in an ingestion dose.

Inhalation

- Airborne contaminants (either as vapour or respirable particulates as PM_{10}) at the receptors location will be inhaled and retained within the body resulting in an inhalation exposure.
- Frequency of exceedance of PM10 criteria at the off property maximum locations (assuming 1 day per week of blasting) results in PM10 concentrations in exceedance of regulatory guidelines <1% of the time.

Dermal Absorption

- Dermal contact with contaminated soil will adhere to skin surfaces and result in a dermal exposure.

2.5.4 Conceptual Exposure Model

A conceptual exposure model (CEM), which is qualitative in nature, provides the context for the quantitative risk assessment. The CEM is presented as Figure 5 and illustrates all contaminant sources, release mechanisms, transport pathways, and routes of exposure for the human health assessment at the mine site.

2.6 Approach to Exposure Assessment

For each of the identified exposure pathways, a series of numerical equations were employed to quantify the average daily chemical intake rate, normalized to body weight. Exposure equations used for the human health exposure assessment were drawn from Health Canada (2010a).

The quantitative HHRA evaluated three exposure assessment scenarios as follows:

1. Baseline Scenario
2. Project Scenario (Project plus Baseline Scenario)
3. Cumulative Scenario (Project plus Baseline Scenario plus other local operations and emissions)

The Baseline assessment used measured concentrations in site abiotic and biotic media, and is conducted in order to establish current benchmark risk estimates. This benchmark is then used in the project and cumulative assessments to examine the "incremental" risks resulting from releases associated with the Project and Cumulative Scenarios.

For the Project and Cumulative (future) scenarios, environmental concentrations of PCOCs were predicted based on source emissions and modeled air dispersion within the LSA and RSA (Figure 4 and Figure 6). Project “increment” was computed and reported as the difference and percent change in risk estimates in the Project and Cumulative Scenarios relative to the Baseline.

2.6.1.1 Exposure Frequency and Duration

For the baseline scenario, the assumptions regarding the frequency and duration of exposure for First Nations hunting and fishing groups within or near the Howse Property Project area are guided by the following principles:

1. For the purpose of local harvesting or other traditional land use activities, it is assumed that a group might occupy the site for up to 16 weeks in any year, during either summer or winter. The remainder of the year is spent in nearby communities (Ville de Schefferville, Matimekush-Lac John or Kawawachikamach).
2. While First Nations and recreational users are visiting the vicinity of the mine site, locally gathered foods (plants, berries, fish and game) would constitute a high proportion of total diet. In addition, locally gathered country foods may be preserved (canned, frozen etc.). Therefore consumption of country foods is assumed to continue throughout the year. One exception to this is the partridge berry. It is has been assumed that the partridge berry is consumed when in season (4 months per year), and that a full annual supply of partridge berry is unlikely to be sourced solely from the area of interest.

The receptor characteristics that govern contact rate with substances of interest to form an internal dose are described in Table 2.2. The fundamental exposure scenarios (Baseline, Project and Cumulative) and the assumptions and differences amongst them are described in Table 2.3.

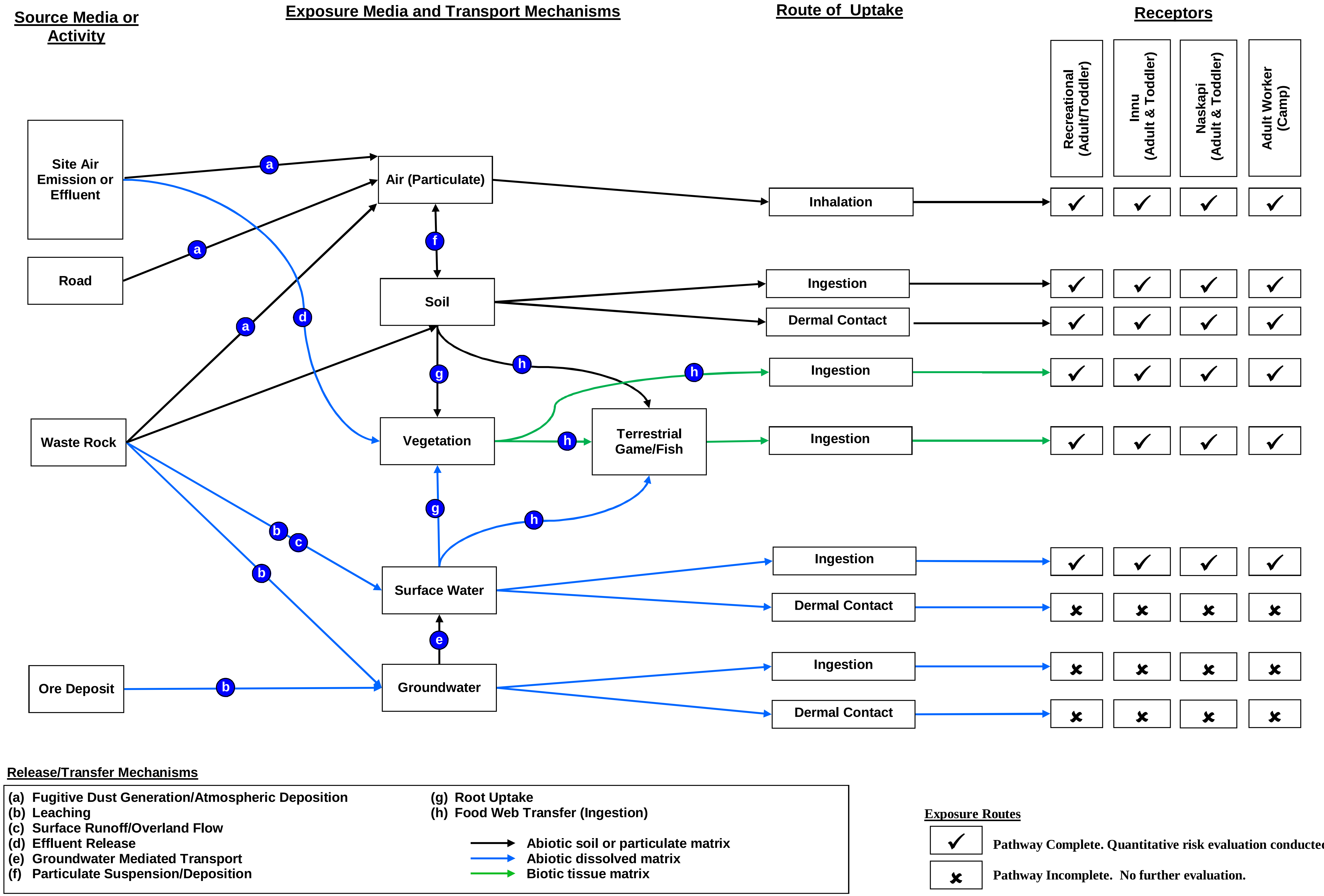
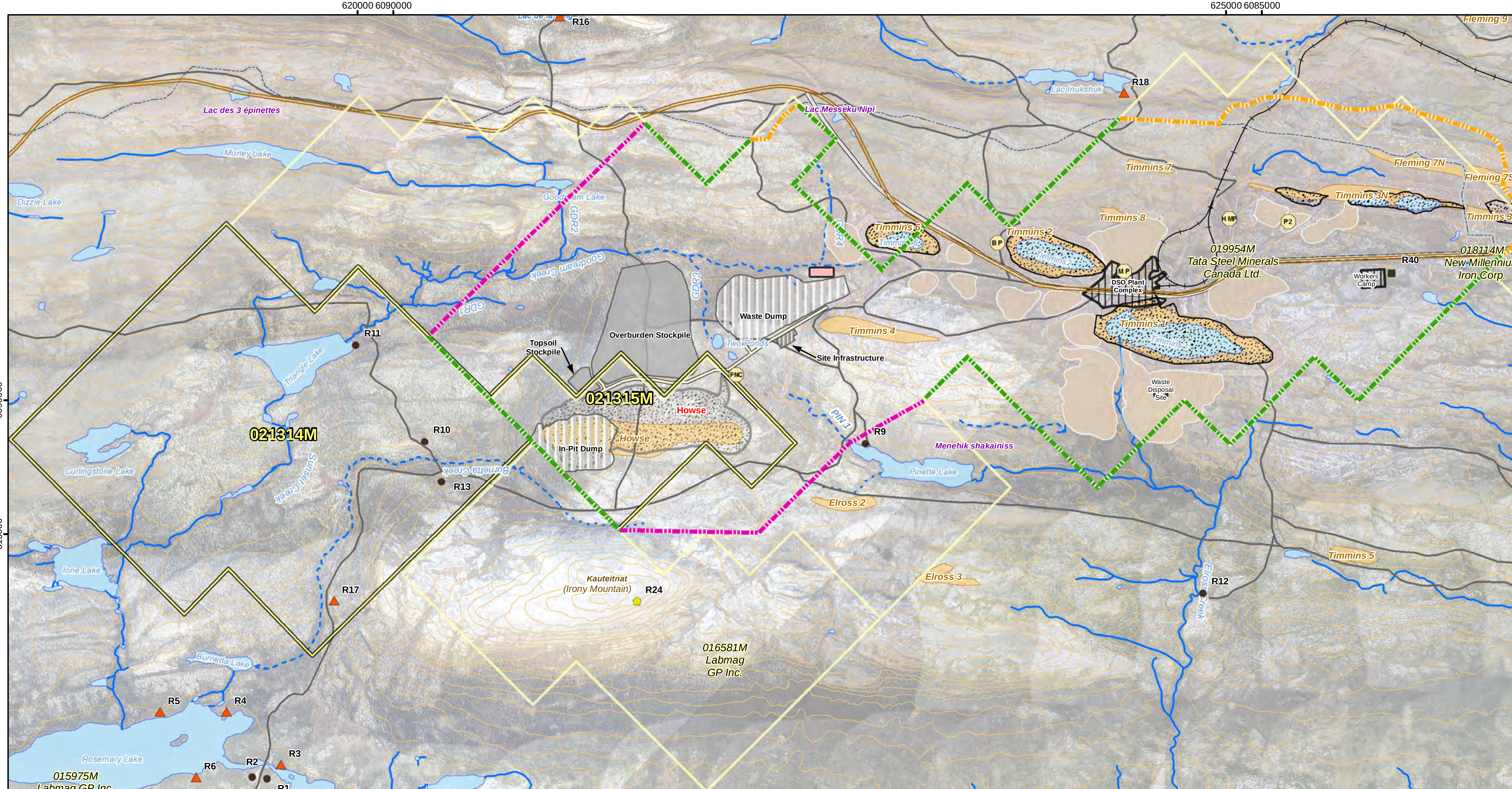


Figure 5: Conceptual Exposure Model for Human Receptors at the Howse Project Property



LEGEND

Infrastructure and Mining Components

Proposed Infrastructures
- Proposed Howse Pit
- Proposed Topsoil/Overburden Stockpile
- Proposed Waste Dump/In-Pit Dump
- Proposed Site Infrastructure
- Proposed Mine Haul Road

Existing Components
- Existing Railroad
- Road to DSO Area 4
- Existing Sedimentation Pond
- DSO Howse - Claim Labrador Iron Mines Limited(49%)/ Howse Minerals Ltd.(51%)
- Other Claim
- Elross Lake Area Iron Ore Mine (ELAIOM) Plant Infrastructure Footprint
- Existing Dump
- Existing Pit
- Deposit
- P2 Plant 2
- MP Main processing Plant
- HMP Howse Mini-Plant
- BP Batch Plant
- FNC First Nations crusher/screener

Sensitives Receptors
- Naskapi
- Innu
- Permanent
- Other/Autre

Air Dispersion Modeling Perimeter
- Administrative Boundaries using Newfoundland Methodology with Receptors on Claim Lines
- Alternative Boundary Limits within Newfoundland to Include Possible sensitive Areas into the Receptors grid
- Administrative Boundaries using a Methodology used by Quebec in a previous Impact Study

Basemap
- Permanent Watercourse
- Intermittent Watercourse
- Storm Runoff
- Disappearing Stream
- Artesian Spring
- Water body
- Contour Line (50 ft)
- Provincial Border
- Existing Road
- Main Access

*Hydronyms are oriented along the direction of water flow

FILE, PROJECT, DATE, AUTHOR:
GH-0673 , PR185-19-14, 2015-10-16, edickoum

N

0 500 1 000 1 500 2 000
Meters
UTM 19N NAD 83

SCALE: 1:31 000

SOURCES:
Basemap
Government of Canada, NTDB, 1:50,000, 1979 Government of NL and government of Quebec, Boundary used for claims
SNC Lavalin, Groupe Hémisphères, Hydrology update, 2013

Infrastructure and Mining Components
New Millennium Capital Corp., Mining sites and roads
TATA Steel Minerals Canada Limited/ MET-CHEM Howse Deposit Design for General Layout, 2013

ENVIRONMENTAL IMPACT ASSESSMENT
HOWSE PROPERTY PROJECT

Air Dispersion Modeling Perimeter
Howse Minerals Limited

GroupeHemispheres

5731, rue Saint-Louis, Bureau 201, Lévis (QC) Canada, G6V 4E2

1453, rue Beaubien est, Bureau 301, Montréal (QC) Canada, H2G 3C6

Figure 6

Table 2.2 Receptor Characteristics Carried Forward for Quantitative Assessment

	Toddler*	Adult*
Age	7 mo – 4 yr	≥20
Body Weight (kg)	16.5	70.7
Soil Ingestion Rate (kg/day)	0.00008	0.00002
Inhalation Rate (m^3/day)	8.3	16.6
Water Ingestion Rate (L/day)	0.6	1.5
Time Spent Outdoors (hr/day)	1.5	1.5
Skin Surface Area (cm^2)		
Hands	430	890
Arms	890	2,500
Legs	1,690	5,720
Face	0	0
Total Body	6,130	17,640
Soil Loading to Exposed Skin (kg/cm^2/event)		
Hands	0.0000001	0.0000001
Surfaces other than hands	0.00000001	0.00000001
Country Food Ingestion Rates (kg/day)		
Berries	0.003	0.002
Labrador Tea	0.001	0.003
Fish	0.06	0.120
Game Fowl	0.0195	0.039
Small Mammals	0.028	0.056
Caribou	0.0972	0.187

** Appendix B1 summarizes the selection of ingestion rates used in the HHRA.*

Incremental Lifetime Cancer Risks (ILCR) were calculated assuming an exposure regime of 16 weeks per year at 90th percentile of blast (1 day per week) and no blast (6 days per week) annual daily maximum values for PM_{10}. The remaining 36 weeks are assumed to be at baseline dose rates. The time-weighted dose rate (16/52 + 36/52 = 1) is not amortized over the lifetime and an ILCR is calculated. (i.e., an individual is conservatively assumed to spend 16 weeks per year at the site for all 80 years of their life).

Table 2.3 Fundamental Exposure Scenarios and Associated Assumptions

Parameter	Baseline Scenario	Project Scenario	Cumulative Scenario
Abiotic Site Media			
Soil	Site specific 95% Upper Confidence Limit of the Mean (UCLM95) soil samples collected within the LSA during 2015. Summary statistics of soil data are presented in Appendix E1.	Calculated as sum of baseline soil concentration and Project Incremental Soil Concentration (ISC) as a result of particulate deposition. See Appendix D1 for calculation of ISC.	Calculated as sum of baseline soil concentration and Cumulative Incremental Soil Concentration (ISC) as a result of particulate deposition. See Appendix D1 for calculation of ISC.
Surface Water	Site specific maximum measured concentration from Pinette or Triangle Lake.	No change from baseline	No change from baseline
Particulate	Calculated assuming baseline PM_{10} concentration of 4 $\mu g/m^3$ and chemical composition of baseline soils.	Calculated as 10.1 ($\mu g/m^3$) using 90th percentile predicted maximum PM_{10} concentrations for the project activities. Chemical composition of particulates assumed to be equal to the 95%UCLM of the ore dataset.	Calculated as 31.5 ($\mu g/m^3$) using 90th percentile predicted maximum PM_{10} concentrations for the cumulative activities. Chemical composition of particulates assumed to be equal to the 95%UCLM of the rock dataset. **Note:** In addition inhalation risks were assessed following probabilistic risk assessment principals. Details of the probabilistic risk assessment are presented in Section 3.3.4.
Biological Tissues			
Berries	The 90th percentile for unwashed partridge berry samples collected from the LSA. Barium, Iron and Manganese were the only elements that exceeded analytical detection limits. Elements not detected in berry samples were modelled from soil concentrations using literature derived transfer factors.	Modeled based on predicted soil chemistry and literature derived soil to berry transfer factors (See Appendix D1)	Modeled based on predicted soil chemistry and literature derived soil to berry transfer factors (See Appendix D1)
Labrador Tea	The 90th percentile for unwashed Labrador tea samples collected from the LSA. Barium, Iron and Manganese were the only elements that exceeded analytical detection limits. Elements not detected in berry samples were modelled from soil concentrations using literature derived transfer factors,	Modeled based on predicted soil chemistry and literature derived soil to vegetation transfer factors (See Appendix D1)	Modeled based on predicted soil chemistry and literature derived soil to vegetation transfer factors (See Appendix D1)
Fish	Maximum measured concentrations in fish collected from Triangle Lake or Pinette Lake. Beryllium, chromium and molybdenum modelled from surface water using literature derived transfer factors.	No change from baseline	No change from baseline
Game Bird	Site specific maximum measured concentrations from game bird (Spruce Grouse) collected from the LSA.	Modeled based on receptor characteristics, predicted chemistry and literature derived transfer factors. (See Appendix D1)	Modeled based on receptor characteristics, predicted chemistry and literature derived transfer factors. (See Appendix D1)
Caribou	Literature derived maximum concentrations measured in muscle tissue. (See Appendix B2).	No change from baseline	No change from baseline
Hare	Modeled based on receptor characteristics, abiotic chemistry and literature derived transfer factors. (See Appendix D1)	Modeled based on receptor characteristics, predicted chemistry and literature derived transfer factors. (See Appendix D1)	Modeled based on receptor characteristics, predicted chemistry and literature derived transfer factors. (See Appendix D1)

2.7 Approach to Toxicity Assessment

Toxicity is an inherent property of a substance, which is brought about by the physical-chemical properties of the substance and its chemical reactivity within living organisms. Toxicity assessment in this context involves identification of the potential toxic effects of chemicals, and determination of the rate of intake of a chemical that can be tolerated over a lifetime without experiencing adverse health effects. Toxicity assessment also considers the following concepts:

- Non-carcinogens (chemicals that do not cause cancer)
- Carcinogens (chemicals that have the potential to cause cancer)
- Bioavailability (the proportion of chemical in a medium that is considered to be available for uptake by a human after the human contacts the medium)

These concepts and how they are integrated into the process are described in further detail in Appendix C. A tabulated summary of the toxicity reference values adopted for the risk estimation are provided below (Table 2.4).

Table 2.4 Toxicity Reference Values used in HHRA

PCOC	TDI (mg/kg bw/day)	Chronic Effects Endpoint	Tolerable Concentration (mg/m^3)	Oral Cancer Slope Factor $(mg/kg\ bw/day)^{-1}$	Inhalation Cancer Slope Factor $(mg/kg\ bw/day)^{-1}$
Arsenic	3.00E-04	Hyperkeratosis, hyperpigmentation and possible vascular complications		1.8	27
Barium	0.2	Nephropathy			
Beryllium	2.00E-02	Small intestinal lesions.	2.00E-05		7.3
Chromium	0.001	Hepatotoxicity, gastrointestinal irritation or corrosion, and encephalitis.			46
Iron	0.7	Gastrointestinal distress			
Lead	1.00E-03	Increase in systolic blood pressure			
Manganese	0.156 (0.136)	CNS effects			
Mercury	0.0003	CNS effects			
Molybdenum	28 (23)	Increased uric acid levels			
Selenium	5.7 (6.2)	Clinical selenosis			

2.8 Approach to Risk Characterization

2.8.1 Assessment and Measurement Endpoints

For a human health risk assessment, the concept of assessment and measurement endpoint are underpinned on the basis that no significant health risk should arise from the Project. Thus, the *assessment* endpoint is that a Project should yield no significant (unacceptable) health effects to human receptors over duration of the Project life cycle, or a human lifetime. Accordingly, the *measurement* endpoint requires that toxicity reference levels (TRVs) used to judge estimated environmental exposure be reflective of no-effect levels over a lifetime of exposure.

For substances presenting a risk other than cancer, a hazard quotient is the measurement endpoint and is calculated as the ratio of the estimated daily exposure to the applicable toxicity reference value (i.e., safe dose) for each contaminant as follows:

$$HQ = \frac{TDD}{RfD\ or\ TDI}$$

Where:

HQ = hazard quotient (unitless)

TDD = total daily dose from all exposure routes (mg/kg day^{-1})

TDI = Health Canada published tolerable daily intake (mg/kg day^{-1})

RfD = US EPA published reference dose (mg/kg day^{-1})

For threshold contaminants which impart a specific health risk to the respiratory system a separate hazard quotient is calculated as follows:

$$HQ = \frac{Air\ Concentration\ (mg/m^3)}{Tolerable\ Concentration\ (mg/m^3)}$$

For substances with no threshold dose response (i.e., carcinogens) the risk estimate is a calculation of the Incremental Lifetime Cancer Risk (ILCR). ILCR is the predicted risk of an individual in a population of a given size developing cancer over a lifetime. The ILCR is expressed as the one additional person per n people that would develop cancer, where the magnitude of n reflects the risks to that population; for example, if the ILCR is 1 person per 10, the predicted risks of any individual developing cancer would be higher than if the ILCR is 1 per 100,000. The generic equation for the calculation of an ILCR is as follows:

(ILCR) = Estimated Lifetime Exposure (mg/kg-d) x Cancer Slope Factor (mg/kg-day)$^{-1}$

Due to the estimation nature of the prediction of ILCR, Health Canada recommends that ILCRs only be calculated for adult exposures.

2.8.2 Definition Negligible Human Health Risks

Negligible Hazard Quotient: Whereas a hazard quotient of unity infers the estimated exposure rate (dose) is equal to the toxicological reference value (tolerable daily intake (TDI)) and is considered protective of health, Health Canada guidance (Health Canada 2010b) generally scrutinizes HQ expressions of health risk against a value of 0.2 as a threshold of acceptable risk. The rationale is that site or project incremental exposure (i.e., that caused by the site alone) does not account for other potential exposure sources, and benchmarking acceptable risk to a value of 0.2 (i.e., 20% of the protective threshold) allows “reserved protective space” for potential exposure from other sources (e.g., soil, air, food, water). Thus, in risk assessments where a more comprehensive exposure analysis is considered, Health Canada supports interpretation of HQ values against a benchmark of unity (1.0)(Health Canada 2010b). In the present study, as described in subsequent sections, the HHRA evaluates exposure from a traditional food diet that is based on Aboriginal data, and also includes additional background contributions from sources that are not considered to be potentially affected by the Project (e.g., caribou meat). Accordingly, the benchmark for acceptable risk as expressed by the HQ metric is a value equal to or less than unity (1.0), in alignment with Health Canada policy respecting a comprehensive dietary exposure.

Negligible Incremental Lifetime Cancer Risk (ILCR): Health Canada defines a negligible incremental lifetime cancer risk as being a probability of less than 1 incremental cancer case in 100,000 individuals, or $<1x10^{-5}$. For environmental health risk, the ILCR considers only those substance considered environmentally relevant, and excludes consideration of voluntary risk such as tobacco-related lung cancer.

2.8.3 Interpretation of Risk Estimates

In the present case, the exposure scenario employs considerable conservative assumptions that are designed to err in overestimating actual risk, and this is accomplished through assumptions that overestimate particulate (PM_{10} and TPM) dispersion, exposure point concentrations, and frequency of receptors' presence for exposure. The degree of conservatism is an important concept that must be considered when interpreting risk estimates against regulatory definition of negligible risk.

To provide interpretive insight on the risk levels and conservative assumptions employed to offset various sources of uncertainty normally encountered in health risk assessment, the following categories were used to describe the risk magnitudes for non-carcinogenic compounds:

- Negligible: HQ<1.0. (consistent with Health Canada (2010a,b) guidance for a comprehensive multi-media exposure and has become accepted common practice)
- Low and likely to be negligible: 1.0>HQ≤10 (acknowledges in this case that considerable conservatism is employed by the risk assessor and that over estimation of risk is likely)
- Potentially elevated: HQ>10 (acknowledges in this case that considerable conservatism is employed by the risk assessor and that over estimation of risk is likely)

In cases where an estimated HQ may exceed any of the above categories by a change of <10% from the Baseline case, the Baseline is noted as the risk driver, and the incremental contribution from the Project is considered separately for interpretation of significance.

For carcinogenic compounds, the magnitude of the cancer risk was rated as follows with similar interpretation as note above for hazard quotients:

- negligible: ILCR $\leq 1x10^{-5}$
- low and likely to be negligible: $1x10^{-5}$ < ILCR $\leq 1x10^{-4}$
- potentially elevated: ILCR$>1x10^{-4}$

3. Risk Estimates

3.1 Baseline Scenario

The HHRA integrates baseline data collected specifically for the HHRA and data from other biophysical and social assessments conducted by other consultants in support of the Project EIS. The quantitation of baseline risks is conducted as a benchmark from which to observe the incremental human health risks as a result of the Howse project, or cumulative resource extraction activities within the LSA.

3.1.1 Exposure Assessment

Doses to human receptors were calculated based on receptor characteristics described in Table 2.2, as well as scenario specific exposure conditions described in Table 2.3. Exposure point concentrations carried forward into the quantitative exposure assessment are presented in Table 3.1

Table 3.1 Concentrations of Assessed Metals in Abiotic and Biotic Media Carried Forward into the Quantitative Dose Estimates for the Baseline Scenario

PCOC	Soil (mg/kg dw)	Water (mg/L)	Particulate (mg/kg)	Berries (mg/kg dw)	Labrador Tea (mg/kg dw)	Fish (mg/kg ww)	Grouse (mg/kg ww)	Caribou (mg/kg ww)	Hare [b] (mg/kg ww)
Arsenic	1.1E+1	5.0E-4 [c]	4.3E-8	3.9E-1 [a]	3.9E-1 [a]	3.6E-2	1.2E-2	6.0E-2	5.6E-4
Barium	4.9E+1	3.3E-3	2.0E-7	2.3E+1	8.3E+1	9.3E-2	3.4E-2 [a]	0.0E+0	2.8E-1
Beryllium	3.7E-1	1.0E-4 [c]	1.5E-9	5.6E-4 [a]	3.7E-3 [a]	1.0E-2 [a]	1.9E-4 [a]	0.0E+0	2.1E-6
Chromium	2.0E-1	2.5E-3 [c]	8.0E-10	1.5E-3 [a]	1.5E-3 [a]	1.0E-2 [a]	3.0E-5 [a]	0.0E+0	2.1E-4
Iron	4.9E+4	1.1E+0	2.0E-4	5.6E+2	3.2E+3	7.2E+0	6.0E+1	2.8E+1	5.7E+0
Lead	1.7E+1	2.5E-4 [c]	6.9E-8	2.6E-1 [a]	7.8E-1 [a]	1.0E-2	3.4E-1	1.4E-1	1.8E-2
Manganese	1.2E+3	1.0E-1	4.7E-6	3.8E+2	1.6E+3	2.3E-1	6.3E-1	0.0E+0	6.4E-1
Mercury	8.0E-2	5.0E-5 [c]	3.2E-10	2.3E-2 [a]	6.8E-2 [a]	3.2E-1	2.6E-3	2.7E-2	3.9E-4
Molybdenum	2.2E+0	5.0E-4 [c]	9.0E-9	1.1E+0 [a]	1.3E+0 [a]	5.0E-3 [a]	1.7E-2	0.0E+0	6.7E-4
Selenium	8.0E-1	1.5E-3 [c]	3.2E-9	1.5E-2 [a]	1.3E-2 [a]	1.5E+0	3.9E-1	9.4E-2	2.1E-3

Notes: a Concentrations in baseline tissues were below the analytical limits of detection. Exposure point concentrations were estimated using abiotic media and literature derived transfer factors.

b No snowshoe hare samples could be obtained. Baseline tissue concentrations are estimated using food and water ingestion rates sourced from FCSAP (2012), abiotic baseline concentrations and literature derived transfer factors.

c Concentrations were below analytical limits of detection. The limit of detection has been substituted in order to allow the greatest possible predicted concentration in biotic tissues.

3.1.1.1 Calculated Dose

The calculated daily doses (and % contribution to the total) for each route of exposure for adult and toddler receptors in the baseline scenario are presented Table 3.2 and Table 3.3 respectively.

Table 3.2 Calculated Dose (mg/kg/day) and Percent of Total (Value in Parentheses) for All Routes of Exposure for the Adult Receptor Under the Baseline Scenario

PCOC	As	Ba	Be	Cr	Fe	Pb	Mn	Hg	Mo	Se
Soil Ingestion	3.0E-6 (1.1%)	9.8E-7 (0.0%)	7.3E-10 (0.0%)	7.4E-10 (0.0%)	1.4E-2 (4.4%)	4.9E-6 (0.7%)	1.3E-5 (0.0%)	2.3E-8 (0.0%)	6.3E-7 (0.6%)	2.3E-7 (0.0%)
Particulate Inhalation	1.0E-8 (0.0%)	4.6E-8 (0.0%)	3.5E-10 (0.0%)	1.9E-10 (0.0%)	4.6E-5 (0.0%)	1.6E-8 (0.0%)	1.1E-6 (0.0%)	7.5E-11 (0.0%)	2.1E-9 (0.0%)	7.5E-10 (0.0%)
Soil Dermal Contact	7.8E-7 (0.3%)	1.2E-5 (0.3%)	9.0E-7 (4.4%)	4.8E-8 (0.1%)	1.2E-2 (3.7%)	4.2E-5 (6.1%)	2.9E-3 (3.4%)	1.9E-7 (0.0%)	5.4E-8 (0.0%)	1.9E-8 (0.0%)
Surface Water Ingestion	1.1E-5 (4.0%)	7.0E-5 (1.5%)	2.1E-6 (10.5%)	5.3E-5 (75.4%)	2.3E-2 (7.2%)	5.3E-6 (0.8%)	2.2E-3 (2.7%)	1.1E-6 (0.2%)	1.1E-5 (9.3%)	3.2E-5 (1.1%)
Berry Ingestion	1.1E-5 (4.0%)	6.4E-4 (14.2%)	1.6E-8 (0.1%)	4.2E-8 (0.1%)	1.6E-2 (4.9%)	7.3E-6 (1.1%)	1.1E-2 (12.7%)	6.4E-7 (0.1%)	3.1E-5 (27.4%)	4.3E-7 (0.0%)
Labrador Tea Ingestion	1.6E-5 (6.0%)	3.4E-3 (75.2%)	1.5E-7 (0.8%)	6.2E-8 (0.1%)	1.3E-1 (41.3%)	3.2E-5 (4.7%)	6.6E-2 (79.6%)	2.8E-6 (0.5%)	5.3E-5 (46.7%)	5.3E-7 (0.0%)
Game Bird Ingestion	6.8E-6 (2.5%)	1.9E-5 (0.4%)	1.1E-7 (0.5%)	1.6E-8 (0.0%)	3.3E-2 (10.4%)	1.9E-4 (27.6%)	3.5E-4 (0.4%)	1.4E-6 (0.2%)	9.4E-6 (8.2%)	2.1E-4 (7.1%)
Small Mammal Ingestion	4.4E-7 (0.2%)	2.2E-4 (4.9%)	1.7E-9 (0.0%)	1.7E-7 (0.2%)	4.5E-3 (1.4%)	1.4E-5 (2.1%)	5.1E-4 (0.6%)	3.1E-7 (0.1%)	5.3E-7 (0.5%)	1.7E-6 (0.1%)
Large Mammal Ingestion	1.6E-4 (59.4%)	0.0E+0 (0.0%)	0.0E+0 (0.0%)	0.0E+0 (0.0%)	7.3E-2 (22.9%)	3.7E-4 (54.4%)	0.0E+0 (0.0%)	7.1E-5 (11.7%)	0.0E+0 (0.0%)	2.5E-4 (8.2%)
Fish Ingestion	6.0E-5 (22.5%)	1.6E-4 (3.5%)	1.7E-5 (83.7%)	1.7E-5 (24.1%)	1.2E-2 (3.8%)	1.7E-5 (2.5%)	4.0E-4 (0.5%)	5.3E-4 (87.3%)	8.5E-6 (7.4%)	2.5E-3 (83.6%)
Total	2.7E-4	4.5E-3	2.0E-5	7.0E-5	3.2E-1	6.8E-4	8.3E-2	6.1E-4	1.1E-4	3.0E-3

Table 3.3 Calculated Dose (mg/kg/day) and Percent of Total (Value in Parentheses) for All Routes of Exposure for the Toddler Receptor Under the Baseline Scenario

Pathway	As	Ba	Be	Cr	Fe	Pb	Mn	Hg	Mo	Se
Soil Ingestion	5.2E-5 (7.5%)	1.7E-5 (0.2%)	1.3E-8 (0.0%)	1.3E-8 (0.0%)	2.4E-1 (25.7%)	8.4E-5 (5.3%)	2.3E-4 (0.1%)	3.9E-7 (0.0%)	1.1E-5 (2.7%)	3.9E-6 (0.1%)
Particulate Inhalation	4.3E-8 (0.0%)	2.0E-7 (0.0%)	1.5E-9 (0.0%)	8.0E-10 (0.0%)	2.0E-4 (0.0%)	6.9E-8 (0.0%)	4.7E-6 (0.0%)	3.2E-10 (0.0%)	9.0E-9 (0.0%)	3.2E-9 (0.0%)
Soil Dermal Contact	1.3E-6 (0.2%)	2.1E-5 (0.2%)	1.5E-6 (3.2%)	8.3E-8 (0.0%)	2.0E-2 (2.2%)	7.2E-5 (4.6%)	4.9E-3 (2.6%)	3.3E-7 (0.0%)	9.3E-8 (0.0%)	3.3E-8 (0.0%)
Surface Water Ingestion	4.5E-5 (6.5%)	3.0E-4 (2.8%)	9.1E-6 (19.1%)	2.3E-4 (85.9%)	9.8E-2 (10.6%)	2.3E-5 (1.4%)	9.5E-3 (5.1%)	4.5E-6 (0.3%)	4.5E-5 (11.4%)	1.4E-4 (2.1%)
Berry Ingestion	7.9E-5 (11.3%)	4.7E-3 (43.8%)	1.1E-7 (0.2%)	3.1E-7 (0.1%)	1.1E-1 (12.3%)	5.3E-5 (3.4%)	7.7E-2 (41.0%)	4.7E-6 (0.4%)	2.3E-4 (57.1%)	3.1E-6 (0.0%)
Labrador Tea Ingestion	2.3E-5 (3.2%)	4.8E-3 (45.1%)	2.2E-7 (0.5%)	8.7E-8 (0.0%)	1.9E-1 (20.1%)	4.5E-5 (2.9%)	9.3E-2 (49.8%)	4.0E-6 (0.3%)	7.6E-5 (18.9%)	7.4E-7 (0.0%)
Game Bird Ingestion	1.5E-5 (2.1%)	4.0E-5 (0.4%)	2.3E-7 (0.5%)	3.5E-8 (0.0%)	7.1E-2 (7.7%)	4.0E-4 (25.7%)	7.4E-4 (0.4%)	3.1E-6 (0.2%)	2.0E-5 (5.0%)	4.6E-4 (7.0%)
Small Mammal Ingestion	9.5E-7 (0.1%)	4.8E-4 (4.5%)	3.6E-9 (0.0%)	3.6E-7 (0.1%)	9.8E-3 (1.1%)	3.1E-5 (1.9%)	1.1E-3 (0.6%)	6.6E-7 (0.1%)	1.1E-6 (0.3%)	3.6E-6 (0.1%)
Large Mammal Ingestion	3.5E-4 (50.6%)	0.0E+0 (0.0%)	0.0E+0 (0.0%)	0.0E+0 (0.0%)	1.6E-1 (17.5%)	8.2E-4 (52.5%)	0.0E+0 (0.0%)	1.6E-4 (12.0%)	0.0E+0 (0.0%)	5.5E-4 (8.4%)
Fish Ingestion	1.3E-4 (18.5%)	3.4E-4 (3.2%)	3.6E-5 (76.4%)	3.6E-5 (13.7%)	2.6E-2 (2.8%)	3.6E-5 (2.3%)	8.5E-4 (0.5%)	1.1E-3 (86.6%)	1.8E-5 (4.5%)	5.4E-3 (82.4%)
Total	7.0E-4	1.1E-2	4.8E-5	2.6E-4	9.3E-1	1.6E-3	1.9E-1	1.3E-3	4.0E-4	6.6E-3

3.1.2 Risk Characterization

Risks to human health as a result of multi-media exposure to contaminants of concern under baseline conditions are characterized using calculated hazard quotients and incremental lifetime cancer risks as described in Section 2.8. The following section provides calculated hazard quotients for threshold contaminant exposures (Section 3.1.2.1), locally acting chemicals (Section 3.1.2.2), and non-threshold carcinogenic substances (Section 3.1.2.3).

3.1.2.1 General Threshold Contaminant Risks

Calculated hazard quotients for threshold contaminant exposures are presented in Table 3.4 and Table 3.5 for adult and toddler receptors respectively.

Table 3.4 Calculated Hazard Quotients for Each Route of Exposure for the Adult Receptor Under the Baseline Scenario

PCOC	As	Ba	Be	Cr	Fe	Pb	Mn	Hg	Mo	Se
Soil Ingestion	1.0E-2	4.9E-6	3.7E-8	7.4E-7	2.0E-2	4.9E-3	8.5E-5	7.5E-5	2.3E-8	4.0E-8
Particulate Inhalation	3.4E-5	2.3E-7	1.7E-8	1.9E-7	6.6E-5	1.6E-5	7.1E-6	2.5E-7	7.5E-11	1.3E-10
Soil Dermal Contact	2.6E-3	6.0E-5	4.5E-5	4.8E-5	1.7E-2	4.2E-2	1.8E-2	6.5E-4	1.9E-9	3.4E-9
Surface Water Ingestion	3.5E-2	3.5E-4	1.1E-4	5.3E-2	3.3E-2	5.3E-3	1.4E-2	3.5E-3	3.8E-7	5.6E-6
Berry Ingestion	3.6E-2	3.2E-3	7.8E-7	4.2E-5	2.2E-2	7.3E-3	6.7E-2	2.1E-3	1.1E-6	7.5E-8
Labrador Tea Ingestion	5.3E-2	1.7E-2	7.6E-6	6.2E-5	1.9E-1	3.2E-2	**4.2E-1**	9.3E-3	1.9E-6	9.2E-8
Game Bird Ingestion	2.3E-2	9.4E-5	5.3E-6	1.6E-5	4.7E-2	1.9E-1	2.2E-3	4.8E-3	3.3E-7	3.8E-5
Small Mammal Ingestion	1.5E-3	1.1E-3	8.4E-8	1.7E-4	6.5E-3	1.4E-2	3.3E-3	1.0E-3	1.9E-8	2.9E-7
Large Mammal Ingestion	**5.3E-1**	0.0E+0	0.0E+0	0.0E+0	1.0E-1	**3.7E-1**	0.0E+0	**2.4E-1**	0.0E+0	4.3E-5
Fish Ingestion	**2.0E-1**	7.9E-4	8.5E-4	1.7E-2	1.7E-2	1.7E-2	2.5E-3	**1.8E+0**	3.0E-7	4.4E-4
Total	**8.9E-1**	2.3E-2	1.0E-3	7.0E-2	**4.6E-1**	**6.8E-1**	**5.3E-1**	**2.0E+0**	4.1E-6	5.3E-4

Table 3.5 Calculated Hazard Quotients for Each Route of Exposure for the Toddler Receptor Under the Baseline Scenario

PCOC	As	Ba	Be	Cr	Fe	Pb	Mn	Hg	Mo	Se
Soil Ingestion	1.7E-1	8.4E-5	6.3E-7	1.3E-5	**3.4E-1**	8.4E-2	1.7E-3	1.3E-3	4.7E-7	6.3E-7
Particulate Inhalation	1.4E-4	9.9E-7	7.4E-8	8.0E-7	2.8E-4	6.9E-5	3.5E-5	1.1E-6	3.9E-10	5.2E-10
Soil Dermal Contact	4.5E-3	1.0E-4	7.7E-5	8.3E-5	2.9E-2	7.2E-2	3.6E-2	1.1E-3	4.1E-9	5.4E-9
Surface Water Ingestion	1.5E-1	1.5E-3	4.5E-4	**2.3E-1**	1.4E-1	2.3E-2	7.0E-2	1.5E-2	2.0E-6	2.2E-5

PCOC	As	Ba	Be	Cr	Fe	Pb	Mn	Hg	Mo	Se
Berry Ingestion	**2.6E-1**	2.3E-2	5.7E-6	3.1E-4	1.6E-1	5.3E-2	**5.6E-1**	1.6E-2	9.9E-6	5.0E-7
Labrador Tea Ingestion	7.5E-2	2.4E-2	1.1E-5	8.7E-5	**2.7E-1**	4.5E-2	**6.8E-1**	1.3E-2	3.3E-6	1.2E-7
Game Bird Ingestion	4.8E-2	2.0E-4	1.1E-5	3.5E-5	1.0E-1	**4.0E-1**	5.5E-3	1.0E-2	8.7E-7	7.4E-5
Small Mammal Ingestion	3.2E-3	2.4E-3	1.8E-7	3.6E-4	1.4E-2	3.1E-2	8.0E-3	2.2E-3	4.9E-8	5.8E-7
Large Mammal Ingestion	**1.2E+0**	0.0E+0	0.0E+0	0.0E+0	**2.3E-1**	**8.2E-1**	0.0E+0	**5.3E-1**	0.0E+0	8.9E-5
Fish Ingestion	**4.3E-1**	1.7E-3	1.8E-3	3.6E-2	3.7E-2	3.6E-2	6.2E-3	**3.8E+0**	7.9E-7	8.7E-4
Total	**2.3E+0**	5.4E-2	2.4E-3	**2.6E-1**	**1.3E+0**	**1.6E+0**	**1.4E+0**	**4.4E+0**	1.7E-5	1.1E-3

3.1.2.2 Locally Acting Respiratory Risks

In the case of the Howse project, beryllium is the only PCOC for which a specific tolerable concentration (0.00002 mg/m^3) could be identified. The calculated respiratory hazard quotient as a result of baseline exposure to beryllium in airborne particulates is 7.4x10^{-5}, a value below the de minimis level of 0.2.

Risks to respiratory health as a result of baseline exposure to beryllium in airborne particulates are therefore considered to be negligible.

3.1.2.3 Non-Threshold Cancer Risk

When assessing risks posed by genotoxic carcinogenic substances it is assumed that any level of exposure carries an associated hypothetical cancer risk (i.e., cancer effects do not rely on exceeding some safe threshold dose).

Non-threshold contaminants assessed in the present HHRA include arsenic, beryllium and chromium (total). Cancer risks as a result of oral exposure (ingestion of soil, water, food + dermal contact with contaminated soil), as well as cancer risks as a result of exposure to arsenic, beryllium and chromium through inhalation of fugitive dust are presented in Table 3.6.

Table 3.6 Calculated Incremental Lifetime Cancer Risks from Non-threshold Contaminants Under Baseline Conditions

PCOC	Oral Cancer Risks	Inhalation Cancer Risks	Total
Arsenic	4.81E-04	2.72E-07	4.82E-04
Beryllium		2.54E-09	2.54E-09
Chromium		8.64E-09	8.64E-09

3.1.3 Summary of Baseline Scenario Assessment

Arsenic

- The calculated total daily dose of arsenic to human receptors is primarily influenced by consumption of fish and caribou.
    - Ingestion of caribou accounts for 59.4% and 50.6% of the total dose to adults and toddlers respectively
    - Ingestion of fish accounts for 22.5% and 18.5% of the total dose to adults and toddlers respectively
- Calculated hazard quotients for total daily dose of arsenic are 0.89 and 2.3 for adult and toddler receptors respectively and suggest risks are low and likely negligible given the conservative nature of the exposure scenario and quantitative assessment.
- The incremental lifetime cancer risk associated with oral exposure is calculated to be $4.8x10^{-4}$.
    - This value is driven primarily by fish and caribou ingestion.
    - This value exceeds the de minimis level of $1x10^{-5}$, however it is based on highly conservative assumptions and elevated detection limits which inflate the calculated exposure and risk estimates.
- The ILCR for exposure through inhalation of fugitive dust is calculated to be $2.7x10^{-7}$, a value well below the de minimis level of $1x10^{-5}$ (i.e., negligible risk). .

Human health risks as a result of arsenic exposure under baseline conditions are considered to be low and likely to be negligible.

Barium

- The calculated total daily dose of barium to human receptors is primarily influenced by consumption of Labrador tea and partridge berry.
    - Ingestion of Labrador tea accounts for 75% and 45% of the total dose to adults and toddlers respectively
    - Ingestion of partridge berry accounts for 14% and 44% of the total dose to adults and toddlers respectively
- Calculated hazard quotients for total daily dose of barium are 0.02 and 0.05 for adult and toddler receptors respectively and are deemed to be negligible.

Human health risks as a result of barium exposure under baseline conditions are considered to be negligible.

Beryllium

- The calculated total daily dose of beryllium to human receptors is primarily influenced by ingestion of fish and surface water ingestion.
    - Ingestion of fish accounts for 84% and 75% of the total dose to adults and toddlers respectively
    - Ingestion of surface water accounts for 11% and 19% of the total dose to adults and toddlers respectively
- Calculated hazard quotients for total daily dose of beryllium are 0.001 and 0.002 for adult and toddler receptors respectively and deemed to be negligible.
- The calculated hazard quotient for local beryllium respiratory toxicity is $7.4x10^{-5}$, and deemed to be negligible.
- The ILCR for exposure through inhalation of fugitive dust is calculated to be $2.5x10^{-9}$, a value well below the de minimis level of $1x10^{-5}$ (i.e., negligible risk).

Human health risks as a result of beryllium exposure under baseline conditions are considered to be negligible.

Chromium

- The calculated total daily dose of chromium to human receptors is primarily influenced by consumption of surface water and fish tissue.
    - Ingestion of surface water accounts for 75% and 86% of the total dose to adults and toddlers respectively
    - Ingestion of fish accounts for 24% and 14% of the total dose to adults and toddlers respectively
- Calculated hazard quotients for total daily dose of chromium are 0.07 and 0.26 for adult

and toddler receptors respectively and are deemed to be negligible.

- The ILCR for exposure through inhalation of fugitive dust is calculated to be $8.6x10^{-9}$, a value well below the de minimis level of $1x10^{-5}$ (i.e., negligible risk).

Human health risks as a result of chromium exposure under baseline conditions are considered to be negligible.

Iron

- The calculated total daily dose of iron to adult receptors is primarily influenced by ingestion of Labrador tea and caribou, accounting for 41% and 23% of the total dose respectively.
- The calculated total daily dose of iron to toddlers is primarily influenced by soil ingestion and ingestion of Labrador tea, accounting for 25% and 20% of the total dose respectively.
- Calculated hazard quotients for total daily dose of iron are 0.46 and 1.3 for adult and toddler receptors respectively and suggest risks are low and likely to be negligible given the highly conservative nature of the exposure scenario and quantitative assessment.

Human health risks as a result of iron exposure under baseline conditions are considered to be low and likely to be negligible.

Lead

- The calculated total daily dose of lead to human receptors is primarily influenced by ingestion of caribou and game fowl.
  - Ingestion of caribou accounts for 54% and 52% of the total dose to adults and toddlers respectively
  - Ingestion of game fowl accounts for 28% and 26% of the total dose to adults and toddlers respectively
- Calculated hazard quotients for total daily dose of lead are 0.68 and 1.6 for adult and toddler receptors respectively and suggest that risks are low and likely to be negligible given the highly conservative nature of the exposure scenario and quantitative assessment.

Human health risks as a result of lead exposure under baseline conditions are considered to be low and likely to be negligible.

Manganese

- The calculated total daily dose of manganese to human receptors is primarily influenced by consumption of Labrador tea and partridge berry.
  - Ingestion of Labrador tea accounts for 80% and 50% of the total dose to adults and toddlers respectively
  - Ingestion of partridge berry accounts for 13% and 41% of the total dose to adults and toddlers respectively
- Calculated hazard quotients for total daily dose of manganese are 0.5 and 1.4 for adult and toddler receptors respectively and suggest that risks are low and likely to be negligible given the highly conservative nature of the exposure scenario and quantitative assessment.

Human health risks as a result of manganese exposure under baseline conditions are considered to be low and likely to be negligible.

Mercury

- The calculated total daily dose of mercury to human receptors is primarily influenced by consumption of fish and caribou.
  - Ingestion of fish accounts for 87% of the total dose to adults and toddlers.
  - Ingestion of caribou accounts for 12% of the total dose to adults and toddlers.
- Calculated hazard quotients for total daily dose of mercury are 2.0 and 4.4 for adult and toddler receptors respectively and suggest that risks are low and likely to be negligible given the highly conservative nature of the exposure scenario and quantitative assessment.
  - 100% of fish collected from Howse property
  - Fish consumed daily

- Maximum measured concentration used as exposure point concentration

Human health risks as a result of mercury exposure under baseline conditions are considered to be low and likely to be negligible.

Molybdenum

- The calculated total daily dose of molybdenum to human receptors is primarily influenced by consumption of Labrador tea and partridge berry.
  - Ingestion of Labrador tea accounts for 47% and 19% of the total dose to adults and toddlers respectively
  - Ingestion of partridge berry accounts for 27% and 57% of the total dose to adults and toddlers respectively
- Calculated hazard quotients for total daily dose of molybdenum are $4.1x10^{-6}$ and $1.7x10^{-5}$ for adult and toddler receptors respectively (i.e., negligible risk).

Human health risks as a result of molybdenum exposure under baseline conditions are considered to be negligible.

Selenium

- The calculated total daily dose of selenium to human receptors is primarily influenced by consumption of fish and caribou.
  - Ingestion of fish accounts for 84% and 82% of the total dose to adults and toddlers respectively.
  - Ingestion of caribou accounts for 8% of the total dose to adults and toddlers.
- Calculated hazard quotients for total daily dose of selenium are 0.89 and 2.3 for adult and toddler receptors respectively and suggest that risks are low and likely to be negligible given the highly conservative nature of the exposure scenario and quantitative assessment.

Human health risks as a result of selenium exposure under baseline conditions are considered to be low and likely to be negligible.

3.2 Project Scenario

3.2.1 Exposure Assessment

Doses to adult and toddler human receptors were calculated based on receptor characteristics described in Table 2.2, as well as scenario specific exposure conditions described in Table 2.3. Exposure point concentrations carried forward into the quantitative exposure assessment are presented in Table 3.7.

Table 3.7 Concentrations of Assessed Metals in Abiotic and Biotic Media Carried Forward into the Quantitative Dose Estimates for the Project Scenario

PCOC	Soil (mg/kg dw)	Water (mg/L)	Particulate (mg/kg)	Berries (mg/kg dw)	Labrador Tea (mg/kg dw)	Fish (mg/kg ww)	Grouse (mg/kg ww)	Caribou (mg/kg ww)	Hare (mg/kg ww)
Arsenic	1.1E+1	5.0E-4	3.1E+1	3.9E-1	3.9E-1	3.6E-2	1.4E-2	6.0E-2	5.6E-4
Barium	5.0E+1	3.3E-3	1.1E+2	1.5E-1	7.4E+0	9.3E-2	3.6E-3	0.0E+0	3.5E-2
Beryllium	3.7E-1	1.0E-4	1.8E+0	5.6E-4	3.7E-3	1.0E-2	1.9E-4	0.0E+0	2.1E-6
Chromium	3.1E-1	2.5E-3	4.3E+1	2.3E-3	2.3E-3	1.0E-2	3.5E-5	0.0E+0	3.0E-4
Iron	5.0E+4	1.1E+0	3.7E+6	1.7E+2	6.4E+1	7.2E+0	5.7E+1	2.8E+1	3.1E+0
Lead	1.7E+1	2.5E-4	3.8E+1	2.6E-1	7.8E-1	1.0E-2	1.5E-2	1.4E-1	1.8E-2
Manganese	1.2E+3	1.0E-1	1.1E+3	2.7E+1	4.8E+2	2.3E-1	2.0E-2	0.0E+0	2.1E-1
Mercury	8.0E-2	5.0E-5	2.9E+1	2.3E-2	6.8E-2	3.2E-1	4.7E-5	2.7E-2	3.9E-4
Molybdenum	2.2E+0	5.0E-4	3.0E+0	1.1E+0	1.3E+0	5.0E-3	6.7E-3	0.0E+0	6.7E-4
Selenium	8.0E-1	1.5E-3	5.3E-1	1.5E-2	1.3E-2	1.5E+0	1.3E-2	9.4E-2	2.1E-3

3.2.1.1 Calculated Dose

The calculated daily doses (and relative contribution to the total) for each route of exposure for adult and toddler receptors in the project scenario are presented in Table 3.8 and Table 3.9 respectively.

Table 3.8 Calculated Dose (mg/kg/day) and Percent of Total (Value in Parentheses) for All Routes of Exposure for the Adult Receptor Under the Project Scenario

PCOC	As	Ba	Be	Cr	Fe	Pb	Mn	Hg	Mo	Se
Soil Ingestion	3.0E-6 (1.1%)	9.8E-7 (0.2%)	7.3E-10 (0.0%)	8.5E-10 (0.0%)	1.4E-2 (7.8%)	4.9E-6 (1.0%)	1.3E-5 (0.1%)	2.3E-8 (0.0%)	6.3E-7 (0.6%)	2.3E-7 (0.0%)
Particulate Inhalation	3.0E-8 (0.0%)	1.1E-7 (0.0%)	1.6E-9 (0.0%)	3.1E-8 (0.0%)	2.8E-3 (1.6%)	3.9E-8 (0.0%)	1.5E-6 (0.0%)	2.2E-8 (0.0%)	3.6E-9 (0.0%)	9.1E-10 (0.0%)
Soil Dermal Contact	7.8E-7 (0.3%)	1.2E-5 (2.1%)	9.0E-7 (4.4%)	5.6E-8 (0.1%)	1.2E-2 (6.7%)	4.2E-5 (8.3%)	2.9E-3 (10.8%)	1.9E-7 (0.0%)	5.4E-8 (0.0%)	1.9E-8 (0.0%)
Surface Water Ingestion	1.1E-5 (4.0%)	7.0E-5 (12.0%)	2.1E-6 (10.5%)	5.3E-5 (75.2%)	2.3E-2 (12.9%)	5.3E-6 (1.1%)	2.2E-3 (8.4%)	1.1E-6 (0.2%)	1.1E-5 (9.7%)	3.2E-5 (1.1%)
Berry Ingestion	1.1E-5 (4.0%)	4.2E-6 (0.7%)	1.6E-8 (0.1%)	6.4E-8 (0.1%)	4.8E-3 (2.7%)	7.3E-6 (1.4%)	7.6E-4 (2.9%)	6.4E-7 (0.1%)	3.1E-5 (28.8%)	4.3E-7 (0.0%)
Labrador Tea Ingestion	1.6E-5 (5.9%)	3.1E-4 (52.7%)	1.5E-7 (0.8%)	9.4E-8 (0.1%)	2.7E-3 (1.5%)	3.2E-5 (6.4%)	2.0E-2 (75.6%)	2.8E-6 (0.5%)	5.4E-5 (49.1%)	5.3E-7 (0.0%)
Game Bird Ingestion	7.7E-6 (2.9%)	2.0E-6 (0.3%)	1.1E-7 (0.5%)	2.0E-8 (0.0%)	3.1E-2 (17.6%)	8.5E-6 (1.7%)	1.1E-5 (0.0%)	2.6E-8 (0.0%)	3.7E-6 (3.4%)	7.0E-6 (0.2%)
Small Mammal Ingestion	4.5E-7 (0.2%)	2.8E-5 (4.7%)	1.7E-9 (0.0%)	2.4E-7 (0.3%)	2.4E-3 (1.4%)	1.4E-5 (2.8%)	1.7E-4 (0.6%)	3.1E-7 (0.1%)	5.3E-7 (0.5%)	1.7E-6 (0.1%)
Large Mammal Ingestion	1.6E-4 (59.1%)	0.0E+0 (0.0%)	0.0E+0 (0.0%)	0.0E+0 (0.0%)	7.3E-2 (41.0%)	3.7E-4 (73.9%)	0.0E+0 (0.0%)	7.1E-5 (11.7%)	0.0E+0 (0.0%)	2.5E-4 (8.8%)
Fish Ingestion	6.0E-5 (22.4%)	1.6E-4 (27.2%)	1.7E-5 (83.7%)	1.7E-5 (24.1%)	1.2E-2 (6.9%)	1.7E-5 (3.4%)	4.0E-4 (1.5%)	5.3E-4 (87.5%)	8.5E-6 (7.8%)	2.5E-3 (89.7%)
Total	2.7E-4	5.8E-4	2.0E-5	7.1E-5	1.8E-1	5.0E-4	2.6E-2	6.1E-4	1.1E-4	2.8E-3

Table 3.9 Calculated Dose (mg/kg/day) and Percent of Total (Value in Parentheses) for All Routes of Exposure for the Toddler Receptor Under the Project Scenario

Pathway	As	Ba	Be	Cr	Fe	Pb	Mn	Hg	Mo	Se
Soil Ingestion	5.2E-5 (7.4%)	1.7E-5 (1.4%)	1.3E-8 (0.0%)	1.5E-8 (0.0%)	2.4E-1 (35.7%)	8.4E-5 (7.1%)	2.3E-4 (0.5%)	3.9E-7 (0.0%)	1.1E-5 (2.8%)	3.9E-6 (0.1%)
Particulate Inhalation	1.3E-7 (0.0%)	4.8E-7 (0.0%)	6.8E-9 (0.0%)	1.3E-7 (0.1%)	1.2E-2 (1.8%)	1.7E-7 (0.0%)	6.6E-6 (0.0%)	9.2E-8 (0.0%)	1.6E-8 (0.0%)	3.9E-9 (0.0%)
Soil Dermal Contact	1.3E-6 (0.2%)	2.1E-5 (1.7%)	1.5E-6 (3.2%)	9.7E-8 (0.0%)	2.1E-2 (3.1%)	7.2E-5 (6.1%)	4.9E-3 (9.9%)	3.3E-7 (0.0%)	9.3E-8 (0.0%)	3.3E-8 (0.0%)
Surface Water Ingestion	4.5E-5 (6.5%)	3.0E-4 (24.9%)	9.1E-6 (19.1%)	2.3E-4 (85.8%)	9.8E-2 (14.7%)	2.3E-5 (1.9%)	9.5E-3 (19.1%)	4.5E-6 (0.3%)	4.5E-5 (11.7%)	1.4E-4 (2.2%)
Berry Ingestion	7.9E-5 (11.3%)	3.0E-5 (2.5%)	1.1E-7 (0.2%)	4.7E-7 (0.2%)	3.5E-2 (5.3%)	5.3E-5 (4.5%)	5.5E-3 (11.2%)	4.7E-6 (0.4%)	2.3E-4 (58.9%)	3.1E-6 (0.1%)
Labrador Tea Ingestion	2.3E-5 (3.2%)	4.3E-4 (36.0%)	2.2E-7 (0.5%)	1.3E-7 (0.1%)	3.7E-3 (0.6%)	4.5E-5 (3.8%)	2.8E-2 (56.8%)	4.0E-6 (0.3%)	7.6E-5 (19.5%)	7.5E-7 (0.0%)
Game Bird Ingestion	1.6E-5 (2.3%)	4.3E-6 (0.4%)	2.3E-7 (0.5%)	4.2E-8 (0.0%)	6.7E-2 (10.0%)	1.8E-5 (1.5%)	2.3E-5 (0.0%)	5.5E-8 (0.0%)	7.9E-6 (2.0%)	1.5E-5 (0.2%)
Small Mammal Ingestion	9.6E-7 (0.1%)	5.9E-5 (4.9%)	3.6E-9 (0.0%)	5.1E-7 (0.2%)	5.2E-3 (0.8%)	3.1E-5 (2.6%)	3.6E-4 (0.7%)	6.7E-7 (0.1%)	1.1E-6 (0.3%)	3.6E-6 (0.1%)
Large Mammal Ingestion	3.5E-4 (50.4%)	0.0E+0 (0.0%)	0.0E+0 (0.0%)	0.0E+0 (0.0%)	1.6E-1 (24.2%)	8.2E-4 (69.5%)	0.0E+0 (0.0%)	1.6E-4 (12.1%)	0.0E+0 (0.0%)	5.5E-4 (9.0%)
Fish Ingestion	1.3E-4 (18.4%)	3.4E-4 (28.1%)	3.6E-5 (76.4%)	3.6E-5 (13.7%)	2.6E-2 (3.9%)	3.6E-5 (3.1%)	8.5E-4 (1.7%)	1.1E-3 (86.8%)	1.8E-5 (4.7%)	5.4E-3 (88.4%)
Total	7.0E-4	1.2E-3	4.8E-5	2.7E-4	6.7E-1	1.2E-3	4.9E-2	1.3E-3	3.9E-4	6.1E-3

3.2.2 Risk Characterization

Risks to human health as a result of multi-media exposure to contaminants of concern under the project scenario are characterized using calculated hazard quotients and incremental lifetime cancer risks as described in Section 2.8. The following sections provides calculated hazard quotients for threshold contaminant exposures (Section 3.2.2.1), locally acting chemicals (Section 3.2.2.2), and non-threshold carcinogenic substances (Section 3.2.2.3).

3.2.2.1 General Threshold Contaminant Risks

Calculated hazard quotients, and percent increase from baseline (value in parentheses) for threshold contaminant exposures are presented in Table 3.10 and Table 3.11 for adult and toddler receptors respectively. Percent change from baseline is displayed only where calculated HQs exceed 0.2.

Table 3.10 Calculated Hazard Quotients (and Percent Change from Baseline Conditions) for Each Route of Exposure for the Adult Receptor Under the Project Scenario

Pathway	As	Ba	Be	Cr	Fe	Pb	Mn	Hg	Mo	Se
Soil Ingestion	1.0E-2	4.9E-6	3.7E-8	8.5E-7	2.0E-2	4.9E-3	8.5E-5	7.5E-5	2.3E-8	4.0E-8
Particulate Inhalation	9.9E-5	5.6E-7	7.9E-8	3.1E-5	3.9E-3	3.9E-5	9.9E-6	7.2E-5	1.3E-10	1.6E-10
Soil Dermal Contact	2.6E-3	6.0E-5	4.5E-5	5.6E-5	1.7E-2	4.2E-2	1.8E-2	6.5E-4	1.9E-9	3.4E-9

Pathway	As	Ba	Be	Cr	Fe	Pb	Mn	Hg	Mo	Se
Surface Water Ingestion	3.5E-2	3.5E-4	1.1E-4	5.3E-2	3.3E-2	5.3E-3	1.4E-2	3.5E-3	3.8E-7	5.6E-6
Berry Ingestion	3.6E-2	2.1E-5	7.8E-7	6.4E-5	6.9E-3	7.3E-3	4.9E-3	2.1E-3	1.1E-6	7.5E-8
Labrador Tea Ingestion	5.3E-2	1.5E-3	7.7E-6	9.4E-5	3.8E-3	3.2E-2	1.3E-1	9.3E-3	1.9E-6	9.2E-8
Game Bird Ingestion	2.6E-2	1.0E-5	5.3E-6	2.0E-5	4.5E-2	8.5E-3	6.9E-5	8.6E-5	1.3E-7	1.2E-6
Small Mammal Ingestion	1.5E-3	1.4E-4	8.5E-8	2.4E-4	3.5E-3	1.4E-2	1.1E-3	1.0E-3	1.9E-8	2.9E-7
Large Mammal Ingestion	**5.3E-1 (0.0%)**				1.0E-1	**3.7E-1 (0.0%)**		**2.4E-1 (0.0%)**		4.3E-5
Fish Ingestion	**2.0E-1 (0.0%)**	7.9E-4	8.5E-4	1.7E-2	1.7E-2	1.7E-2	2.5E-3	**1.8E+0 (0.0%)**	3.0E-7	4.4E-4
Total	**8.9E-1 (0.4%)**	2.9E-3	1.0E-3	7.1E-2	**2.5E-1 (-44.2%)**	**5.0E-1 (-26.3%)**	1.7E-1	**2.0E+0 (-0.2%)**	3.9E-6	4.9E-4

Table 3.11 Calculated Hazard Quotients (and Percent Change from Baseline Conditions) for Each Route of Exposure for the Toddler Receptor Under the Project Scenario

Pathway	As	Ba	Be	Cr	Fe	Pb	Mn	Hg	Mo	Se
Soil Ingestion	1.7E-1	8.4E-5	6.3E-7	1.5E-5	**3.4E-1 (0.3%)**	8.4E-2	1.7E-3	1.3E-3	4.7E-7	6.3E-7
Particulate Inhalation	4.2E-4	2.4E-6	3.4E-7	1.3E-4	1.7E-2	1.7E-4	4.9E-5	3.1E-4	6.8E-10	6.3E-10
Soil Dermal Contact	4.5E-3	1.0E-4	7.7E-5	9.7E-5	2.9E-2	7.2E-2	3.6E-2	1.1E-3	4.1E-9	5.4E-9
Surface Water Ingestion	1.5E-1	1.5E-3	4.5E-4	**2.3E-1 (0.0%)**	1.4E-1	2.3E-2	7.0E-2	1.5E-2	2.0E-6	2.2E-5
Berry Ingestion	**2.6E-1 (0.3%)**	1.5E-4	5.7E-6	4.7E-4	5.0E-2	5.3E-2	4.1E-2	1.6E-2	9.9E-6	5.0E-7
Labrador Tea Ingestion	7.5E-2	2.2E-3	1.1E-5	1.3E-4	5.4E-3	4.5E-2	**2.1E-1 (-69.8%)**	1.3E-2	3.3E-6	1.2E-7
Game Bird Ingestion	5.5E-2	2.1E-5	1.1E-5	4.2E-5	9.6E-2	1.8E-2	1.7E-4	1.8E-4	3.4E-7	2.4E-6
Small Mammal Ingestion	3.2E-3	3.0E-4	1.8E-7	5.1E-4	7.4E-3	3.1E-2	2.6E-3	2.2E-3	4.9E-8	5.8E-7
Large Mammal Ingestion	**1.2E+0 (0.0%)**				**2.3E-1 (0.0%)**	**8.2E-1 (0.0%)**		**5.3E-1 (0.0%)**		8.9E-5
Fish Ingestion	**4.3E-1 (0.0%)**	1.7E-3	1.8E-3	3.6E-2	3.7E-2	3.6E-2	6.2E-3	**3.8E+0 (0.0%)**	7.9E-7	8.7E-4
Total	**2.3E+0 (0.3%)**	6.0E-3	2.4E-3	**2.7E-1 (0.2%)**	**9.6E-1 (-27.8%)**	**1.2E+0 (-24.4%)**	**3.6E-1 (-73.5%)**	**4.4E+0 (-0.2%)**	1.7E-5	9.9E-4

3.2.2.2 Locally Acting Respiratory Risks

In the case of the Howe project, beryllium is the only PCOC for which a specific tolerable concentration (0.00002 mg/m^3) could be identified. The calculated respiratory hazard quotient as a result of beryllium in airborne particulates under the project activities scenario is 9.24×10^{-5}, a value below the de minimis minimum level of 0.2.

Risks to respiratory health as a result of beryllium exposure in airborne particulates as a result of project activities are therefore considered to be negligible.

3.2.2.3 Non-Threshold Cancer Risk

Non-threshold contaminants assessed in the present HHRA include arsenic, beryllium and chromium (total). Cancer risks as a result of oral exposure (ingestion of soil, water, food + dermal contact with contaminated soil), as well as cancer risks as a result of exposure to arsenic, beryllium and chromium through inhalation of fugitive dust are presented in Table 3.12.

Table 3.12 Calculated Incremental Lifetime Cancer Risks from Non-threshold Contaminants under Project Conditions

PCOC	Oral Cancer Risks	Inhalation Cancer Risks	Total
Arsenic	4.65E-04	7.98E-07	4.66E-04
Beryllium		1.15E-08	1.15E-08
Chromium		1.43E-06	1.43E-06

3.2.3 Summary of Project Risks

Arsenic

- The calculated total daily dose of arsenic to human receptors is primarily influenced by consumption of fish and caribou.
  - Ingestion of caribou accounts for 59.1% and 50.4% of the total dose to adults and toddlers respectively
  - Ingestion of fish accounts for 22.4% and 18.4% of the total dose to adults and toddlers respectively
- Calculated hazard quotients for total daily dose of arsenic are 0.89 and 2.3 for adult and toddler receptors respectively and both represent hazard quotient changes of <1% compared to baseline conditions. Given the conservative nature of the exposure scenario and quantitative assessment, this suggests risks are low and likely negligible.
- The incremental lifetime cancer risk associated with oral exposure is calculated to be $4.7x10^{-4}$.
  - This value is driven primarily by fish and caribou ingestion.
  - This value exceeds the de minimis level of $1x10^{-5}$, however it is based on highly conservative assumptions and elevated detection limits which inflate the calculated exposure and risk estimates.
- The ILCR for exposure through inhalation of fugitive dust is calculated to be $8.0x10^{-7}$, a value well below the de minimis level of $1x10^{-5}$ (i.e., negligible risk). .

Human health risks as a result of arsenic exposure under the project scenario are considered low and likely to be negligible. In addition, the project incremental risks are negligible because the marginal change in project risk relative to the baseline is <10%

Barium

- The calculated total daily dose of barium to human receptors is primarily influenced by consumption of Labrador tea and partridge berry.
  - Ingestion of Labrador tea accounts for 53% and 36% of the total dose to adults and toddlers respectively
  - Ingestion of partridge berry accounts for 0.7% and 2.5% of the total dose to adults and toddlers respectively

- Calculated hazard quotients for total daily dose of barium are 0.003 and 0.006 for adult and toddler receptors respectively and are deemed to be negligible.

Human health risks as a result of barium exposure under the project scenario are considered to be negligible. In addition, the project incremental risks are negligible because the marginal change in project risk relative to the baseline is <10%

Beryllium

- The calculated total daily dose of beryllium to human receptors is primarily influenced by ingestion of fish and surface water ingestion.
  - Ingestion of fish accounts for 84% and 76% of the total dose to adults and toddlers respectively
  - Ingestion of surface water accounts for 11% and 19% of the total dose to adults and toddlers respectively
- Calculated hazard quotients for total daily dose of beryllium are 0.001 and 0.002 for adult and toddler receptors respectively and deemed to be negligible.
- The calculated hazard quotient for local beryllium respiratory toxicity is 9.24×10^{-5}, and deemed to be negligible.
- The ILCR for exposure through inhalation of fugitive dust is calculated to be 1.15×10^{-8}, a value well below the de minimis level of 1×10^{-5} (i.e., negligible risk).

- *Human health risks as a result of beryllium exposure under the project scenario are considered to be negligible. In addition, the project incremental risks are negligible because the marginal change in project risk relative to the baseline is <10%*

Chromium

- The calculated total daily dose of chromium to human receptors is primarily influenced by consumption of surface water and fish tissue.
  - Ingestion of surface water accounts for 75% and 86% of the total dose to adults and toddlers respectively
  - Ingestion of fish accounts for 24% and 14% of the total dose to adults and toddlers respectively
- Calculated hazard quotients for total daily dose of chromium are 0.07 and 0.27 for adult and toddler receptors respectively and both represent hazard quotient changes of <1% compared to baseline conditions. This suggests that the risks are deemed to be negligible.
- The ILCR for exposure through inhalation of fugitive dust is calculated to be 1.4×10^{-6}, a value that is an order of magnitude below the de minimis level of 1×10^{-5} (i.e., negligible risk).

Human health risks as a result of chromium exposure under the project scenario are considered to be negligible. In addition, the project incremental risks are negligible because the marginal change in project risk relative to the baseline is <10%

Iron

- The calculated total daily dose of iron to adult receptors is primarily influenced by ingestion of caribou and spruce grouse, accounting for 41% and 18% of the total dose respectively.
- The calculated total daily dose of iron to toddlers is primarily influenced by soil ingestion and ingestion of caribou, accounting for 36% and 24% of the total dose respectively.
- Calculated hazard quotients for total daily dose of iron are 0.25 and 0.96 for adult and toddler receptors respectively. Both represent hazard quotient reductions compared to baseline conditions. This is a result of the soil to tissue transfer factors for the project scenario predicting a lower risk than the assumed detection limits from the baseline scenario.. Given the highly conservative nature of the exposure scenario and quantitative assessment the risks are low and likely to be negligible.

Human health risks as a result of iron exposure under the project scenario are considered to be low and likely to be negligible. In addition, the project *incremental risks are negligible because the marginal change in project risk relative to the baseline is <10%*

Lead

- The calculated total daily dose of lead to adult receptors is primarily influenced by ingestion of caribou and soil dermal contact accounting for 74% and 8%, respectively, of the total dose to adults.
- The calculated total daily dose of lead to toddler receptors is primarily influenced by ingestion of caribou and soil ingestion accounting for 70% and 7%, respectively, of the total dose to toddlers.
- Calculated hazard quotients for total daily dose of lead are 0.5 and 1.0 for adult and toddler receptors respectively. Both represent hazard quotient reductions compared to baseline conditions. This is a result of the soil to tissue transfer factors for the project scenario predicting a lower risk than the assumed detection limits from the baseline scenario. Given the highly conservative nature of the exposure scenario and quantitative assessment the risks are low and likely to be negligible..

Human health risks as a result of lead exposure under the project scenario are considered low and likely to be negligible. In addition, the project incremental risks are negligible because the marginal change in project risk relative to the baseline is <10%

Manganese

- The calculated total daily dose of manganese to human receptors is primarily influenced by consumption of Labrador tea (both adults and toddlers), soil dermal contact (adults), and partridge berry.(toddlers)
  - Ingestion of Labrador tea and soil dermal contact accounts for 76% and 11% of the total dose, respectively. to
  - Ingestion of Labrador tea accounts for 57% and partridge berry accounts for 41% of the total dose to toddlers.
- Calculated hazard quotients for total daily dose of manganese are 0.2 and 0.4 for adult and toddler receptors respectively. For toddlers this represents a hazard quotient reduction compared to baseline conditions. This is a result of the soil to tissue transfer factors for the project scenario predicting a lower risk than the assumed detection limits from the baseline scenario. Given the highly conservative nature of the exposure scenario and quantitative assessment the risks are low and likely to be negligible.

Human health risks as a result of manganese exposure under the project scenario are considered to be low and likely to be negligible. In addition, the project incremental risks are negligible because the marginal change in project risk relative to the baseline is <10%.

Mercury

- The calculated total daily dose of mercury to human receptors is primarily influenced by consumption of fish and caribou.
  - Ingestion of fish accounts for 87% of the total dose to adults and toddlers.
  - Ingestion of caribou accounts for 12% of the total dose to adults and toddlers.
- Calculated hazard quotients for total daily dose of mercury are 2.0 and 4.4 for adult and toddler receptors respectively and both represent hazard quotient changes of <1% compared to baseline conditions and suggest that risks are low and likely to be negligible given the highly conservative nature of the exposure scenario and quantitative assessment.
  - 100% of fish collected from Howse property
  - Fish consumed daily
  - Maximum measured concentration used as exposure point concentration

Human health risks as a result of mercury exposure under the project scenario are considered to be low and likely to be negligible. In addition, the project incremental risks are negligible because the marginal change in project risk relative to the baseline is <10%.

Molybdenum

- The calculated total daily dose of molybdenum to human receptors is primarily influenced by consumption of Labrador tea and partridge berry.

- Ingestion of Labrador tea accounts for 49% and 20% of the total dose to adults and toddlers respectively
- Ingestion of partridge berry accounts for 29% and 59% of the total dose to adults and toddlers respectively
- Calculated hazard quotients for total daily dose of molybdenum are 3.9×10^{-6} and 1.7×10^{-5} for adult and toddler receptors respectively (i.e., negligible risk).

Human health risks as a result of molybdenum exposure under the project scenario are considered to be negligible. In addition, the project incremental risks are negligible because the marginal change in project risk relative to the baseline is <10%

Selenium

- The calculated total daily dose of selenium to human receptors is primarily influenced by consumption of fish and caribou.
  - Ingestion of fish accounts for 90% and 88% of the total dose to adults and toddlers respectively.
  - Ingestion of caribou accounts for 9% of the total dose to adults and toddlers.
- Calculated hazard quotients for total daily dose of selenium are 4.9×10^{-4} and 9.9×10^{-4} for adult and toddler receptors respectively and suggest that risks are low and likely to be negligible given the highly conservative nature of the exposure scenario and quantitative assessment.

Human health risks as a result of selenium exposure under the project scenario are considered to be negligible. In addition, the project incremental risks are negligible because the marginal change in project risk relative to the baseline is <10%

3.3 Cumulative Scenario

3.3.1 Deterministic Exposure Assessment

Doses to adult and toddler human receptors were calculated based on receptor characteristics described in Table 2.2, as well as scenario specific exposure conditions described in Table 2.3. Exposure point concentrations carried forward into the quantitative exposure assessment are presented Table 3.13.

Table 3.13 Concentrations of Assessed Metals in Abiotic and Biotic Media Carried Forward into the Quantitative Dose Estimates for the Cumulative Scenario

PCOC	Soil (mg/kg dw)	Water (mg/L)	Particulate (mg/kg)	Berries (mg/kg dw)	Labrador Tea (mg/kg dw)	Fish (mg/kg ww)	Grouse (mg/kg ww)	Caribou (mg/kg ww)	Hare (mg/kg ww)
Arsenic	1.1E+1	5.0E-4	3.1E+1	3.9E-1	3.9E-1	3.6E-2	1.4E-2	6.0E-2	5.7E-4
Barium	5.0E+1	3.3E-3	1.1E+2	1.5E-1	7.6E+0	9.3E-2	3.7E-3	0.0E+0	3.5E-2
Beryllium	3.8E-1	1.0E-4	1.8E+0	5.6E-4	3.8E-3	1.0E-2	2.0E-4	0.0E+0	2.2E-6
Chromium	5.4E-1	2.5E-3	4.3E+1	4.0E-3	4.0E-3	1.0E-2	4.7E-5	0.0E+0	4.9E-4
Iron	5.0E+4	1.1E+0	3.7E+6	1.8E+2	6.6E+1	7.2E+0	5.8E+1	2.8E+1	3.1E+0
Lead	1.7E+1	2.5E-4	3.8E+1	2.6E-1	7.8E-1	1.0E-2	1.6E-2	1.4E-1	1.8E-2
Manganese	1.2E+3	1.0E-1	1.1E+3	2.7E+1	4.8E+2	2.3E-1	2.0E-2	0.0E+0	2.1E-1
Mercury	8.0E-2	5.0E-5	2.9E+1	2.3E-2	6.8E-2	3.2E-1	4.7E-5	2.7E-2	3.9E-4

PCOC	Soil (mg/kg dw)	Water (mg/L)	Particulate (mg/kg)	Berries (mg/kg dw)	Labrador Tea (mg/kg dw)	Fish (mg/kg ww)	Grouse (mg/kg ww)	Caribou (mg/kg ww)	Hare (mg/kg ww)
Molybdenum	2.3E+0	5.0E-4	3.0E+0	1.1E+0	1.3E+0	5.0E-3	6.7E-3	0.0E+0	6.7E-4
Selenium	8.0E-1	1.5E-3	5.3E-1	1.5E-2	1.3E-2	1.5E+0	1.3E-2	9.4E-2	2.1E-3

3.3.1.1 Calculated Dose

The calculated daily doses (and % contribution to the total) for each route of exposure for adult and toddler receptors in the baseline scenario are presented in Table 3.14 and Table 3.15 respectively.

Table 3.14 Calculated Dose (mg/kg/day) and Percent of Total (Value in Parentheses) Dose for All Routes of Exposure for the Adult Receptor Under the Cumulative Scenario

PCOC	As	Ba	Be	Cr	Fe	Pb	Mn	Hg	Mo	Se
Soil Ingestion	3.0E-6 (1.1%)	9.8E-7 (0.2%)	7.4E-10 (0.0%)	1.1E-9 (0.0%)	1.4E-2 (7.6%)	4.9E-6 (1.0%)	1.3E-5 (0.1%)	2.3E-8 (0.0%)	6.3E-7 (0.6%)	2.3E-7 (0.0%)
Particulate Inhalation	7.7E-8 (0.0%)	2.8E-7 (0.0%)	4.4E-9 (0.0%)	9.7E-8 (0.1%)	8.5E-3 (4.6%)	9.8E-8 (0.0%)	3.2E-6 (0.0%)	6.7E-8 (0.0%)	8.3E-9 (0.0%)	1.7E-9 (0.0%)
Soil Dermal Contact	7.8E-7 (0.3%)	1.2E-5 (2.0%)	9.0E-7 (4.4%)	7.4E-8 (0.1%)	1.2E-2 (6.5%)	4.2E-5 (8.3%)	2.9E-3 (10.8%)	1.9E-7 (0.0%)	5.4E-8 (0.0%)	1.9E-8 (0.0%)
Surface Water Ingestion	1.1E-5 (3.9%)	7.0E-5 (11.9%)	2.1E-6 (10.5%)	5.3E-5 (74.8%)	2.3E-2 (12.4%)	5.3E-6 (1.1%)	2.2E-3 (8.4%)	1.1E-6 (0.2%)	1.1E-5 (9.7%)	3.2E-5 (1.1%)
Berry Ingestion	1.1E-5 (4.1%)	4.2E-6 (0.7%)	1.6E-8 (0.1%)	1.1E-7 (0.2%)	4.9E-3 (2.7%)	7.3E-6 (1.5%)	7.6E-4 (2.9%)	6.4E-7 (0.1%)	3.2E-5 (28.8%)	4.3E-7 (0.0%)
Labrador Tea Ingestion	1.6E-5 (6.0%)	3.1E-4 (53.1%)	1.5E-7 (0.8%)	1.7E-7 (0.2%)	2.7E-3 (1.5%)	3.2E-5 (6.4%)	2.0E-2 (75.7%)	2.8E-6 (0.5%)	5.4E-5 (49.2%)	5.3E-7 (0.0%)
Game Bird Ingestion	7.7E-6 (2.9%)	2.0E-6 (0.3%)	1.1E-7 (0.5%)	2.6E-8 (0.0%)	3.2E-2 (17.3%)	8.6E-6 (1.7%)	1.1E-5 (0.0%)	2.6E-8 (0.0%)	3.7E-6 (3.4%)	7.0E-6 (0.2%)
Small Mammal Ingestion	4.5E-7 (0.2%)	2.8E-5 (4.8%)	1.7E-9 (0.0%)	3.9E-7 (0.5%)	2.5E-3 (1.3%)	1.4E-5 (2.9%)	1.7E-4 (0.6%)	3.1E-7 (0.1%)	5.3E-7 (0.5%)	1.7E-6 (0.1%)
Large Mammal Ingestion	1.6E-4 (59.1%)	0.0E+0 (0.0%)	0.0E+0 (0.0%)	0.0E+0 (0.0%)	7.3E-2 (39.5%)	3.7E-4 (73.8%)	0.0E+0 (0.0%)	7.1E-5 (11.7%)	0.0E+0 (0.0%)	2.5E-4 (8.8%)
Fish Ingestion	6.0E-5 (22.4%)	1.6E-4 (26.9%)	1.7E-5 (83.7%)	1.7E-5 (23.9%)	1.2E-2 (6.6%)	1.7E-5 (3.4%)	4.0E-4 (1.5%)	5.3E-4 (87.5%)	8.5E-6 (7.8%)	2.5E-3 (89.7%)
Total	2.7E-4	5.9E-4	2.0E-5	7.1E-5	1.8E-1	5.0E-4	2.6E-2	6.1E-4	1.1E-4	2.8E-3

Table 3.15 Calculated Dose (mg/kg/day) and Percent of Total (Value in Parentheses) for All Routes of Exposure for the Toddler receptor Under the Cumulative Scenario

Pathway	As	Ba	Be	Cr	Fe	Pb	Mn	Hg	Mo	Se
Soil Ingestion	5.2E-5 (7.4%)	1.7E-5 (1.4%)	1.3E-8 (0.0%)	1.9E-8 (0.0%)	2.4E-1 (34.4%)	8.4E-5 (7.1%)	2.3E-4 (0.5%)	3.9E-7 (0.0%)	1.1E-5 (2.8%)	3.9E-6 (0.1%)
Particulate Inhalation	3.3E-7 (0.0%)	1.2E-6 (0.1%)	1.9E-8 (0.0%)	4.2E-7 (0.2%)	3.7E-2 (5.2%)	4.2E-7 (0.0%)	1.4E-5 (0.0%)	2.9E-7 (0.0%)	3.5E-8 (0.0%)	7.4E-9 (0.0%)
Soil Dermal Contact	1.3E-6 (0.2%)	2.1E-5 (1.7%)	1.6E-6 (3.3%)	1.3E-7 (0.0%)	2.1E-2 (3.0%)	7.2E-5 (6.1%)	4.9E-3 (9.9%)	3.3E-7 (0.0%)	9.4E-8 (0.0%)	3.3E-8 (0.0%)
Surface Water Ingestion	4.5E-5 (6.5%)	3.0E-4 (24.7%)	9.1E-6 (19.1%)	2.3E-4 (85.4%)	9.8E-2 (14.1%)	2.3E-5 (1.9%)	9.5E-3 (19.1%)	4.5E-6 (0.3%)	4.5E-5 (11.7%)	1.4E-4 (2.2%)

Pathway	As	Ba	Be	Cr	Fe	Pb	Mn	Hg	Mo	Se
Berry Ingestion	8.0E-5 (11.4%)	3.1E-5 (2.5%)	1.2E-7 (0.2%)	8.2E-7 (0.3%)	3.6E-2 (5.1%)	5.3E-5 (4.5%)	5.5E-3 (11.2%)	4.7E-6 (0.4%)	2.3E-4 (59.0%)	3.1E-6 (0.1%)
Labrador Tea Ingestion	2.3E-5 (3.2%)	4.4E-4 (36.3%)	2.2E-7 (0.5%)	2.3E-7 (0.1%)	3.8E-3 (0.5%)	4.6E-5 (3.8%)	2.8E-2 (56.9%)	4.0E-6 (0.3%)	7.6E-5 (19.5%)	7.5E-7 (0.0%)
Game Bird Ingestion	1.7E-5 (2.4%)	4.4E-6 (0.4%)	2.3E-7 (0.5%)	5.6E-8 (0.0%)	6.8E-2 (9.8%)	1.8E-5 (1.5%)	2.3E-5 (0.0%)	5.5E-8 (0.0%)	7.9E-6 (2.0%)	1.5E-5 (0.2%)
Small Mammal Ingestion	9.6E-7 (0.1%)	6.0E-5 (5.0%)	3.7E-9 (0.0%)	8.3E-7 (0.3%)	5.3E-3 (0.8%)	3.1E-5 (2.6%)	3.6E-4 (0.7%)	6.7E-7 (0.1%)	1.1E-6 (0.3%)	3.6E-6 (0.1%)
Large Mammal Ingestion	3.5E-4 (50.4%)	0.0E+0 (0.0%)	0.0E+0 (0.0%)	0.0E+0 (0.0%)	1.6E-1 (23.3%)	8.2E-4 (69.4%)	0.0E+0 (0.0%)	1.6E-4 (12.1%)	0.0E+0 (0.0%)	5.5E-4 (9.0%)
Fish Ingestion	1.3E-4 (18.4%)	3.4E-4 (27.9%)	3.6E-5 (76.4%)	3.6E-5 (13.7%)	2.6E-2 (3.8%)	3.6E-5 (3.1%)	8.5E-4 (1.7%)	1.1E-3 (86.8%)	1.8E-5 (4.7%)	5.4E-3 (88.4%)
Total	7.0E-4	1.2E-3	4.8E-5	2.7E-4	7.0E-1	1.2E-3	5.0E-2	1.3E-3	3.9E-4	6.1E-3

3.3.2 Risk Characterization

Risks to human health as a result of multi-media exposure to contaminants of concern under project conditions are characterized using calculated hazard quotients and incremental lifetime cancer risks as described in Section 2.8. The following sections provides calculated hazard quotients for threshold contaminant exposures (Section 3.3.2.1), locally acting chemicals (Section 3.3.2.2), and non-threshold carcinogenic substances (Section 3.3.2.3).

3.3.2.1 General Threshold Contaminant Risks

Calculated hazard quotients, and percent increase from baseline (value in parentheses) for threshold contaminant exposures are presented Table 3.16 and Table 3.17 for adult and toddler receptors respectively. Percent change from baseline is displayed only where calculated HQs exceed 0.2.

Table 3.16 Calculated Hazard Quotients (and Percent Change from Baseline Conditions) for Each Route of Exposure for the Adult Receptor Under the Cumulative Scenario

PCOC	As	Ba	Be	Cr	Fe	Pb	Mn	Hg	Mo	Se
Soil Ingestion	1.0E-2	4.9E-6	3.7E-8	1.1E-6	2.0E-2	4.9E-3	8.5E-5	7.5E-5	2.3E-8	4.0E-8
Particulate Inhalation	2.6E-4	1.4E-6	2.2E-7	9.7E-5	1.2E-2	9.8E-5	2.0E-5	2.2E-4	3.0E-10	3.0E-10
Soil Dermal Contact	2.6E-3	6.0E-5	4.5E-5	7.4E-5	1.7E-2	4.2E-2	1.8E-2	6.5E-4	1.9E-9	3.4E-9
Surface Water Ingestion	3.5E-2	3.5E-4	1.1E-4	5.3E-2	3.3E-2	5.3E-3	1.4E-2	3.5E-3	3.8E-7	5.6E-6
Berry Ingestion	3.6E-2	2.1E-5	7.9E-7	1.1E-4	7.0E-3	7.3E-3	4.9E-3	2.1E-3	1.1E-6	7.5E-8
Labrador Tea Ingestion	5.4E-2	1.6E-3	7.7E-6	1.7E-4	3.9E-3	3.2E-2	1.3E-1	9.3E-3	1.9E-6	9.3E-8
Game Bird Ingestion	2.6E-2	1.0E-5	5.4E-6	2.6E-5	4.6E-2	8.6E-3	7.0E-5	8.6E-5	1.3E-7	1.2E-6
Small Mammal Ingestion	1.5E-3	1.4E-4	8.5E-8	3.9E-4	3.5E-3	1.4E-2	1.1E-3	1.0E-3	1.9E-8	2.9E-7
Large Mammal Ingestion	**5.3E-1 (0.0%)**				1.0E-1	**3.7E-1 (0.0%)**		**2.4E-1 (0.0%)**		4.3E-5

PCOC	As	Ba	Be	Cr	Fe	Pb	Mn	Hg	Mo	Se
Fish Ingestion	**2.0E-1 (0.0%)**	7.9E-4	8.5E-4	1.7E-2	1.7E-2	1.7E-2	2.5E-3	**1.8E+0 (0.0%)**	3.0E-7	4.4E-4
Total	**9.0E-1 (0.5%)**	2.9E-3	1.0E-3	7.1E-2	**2.6E-1 (-42.1%)**	**5.0E-1 (-26.2%)**	1.7E-1	**2.0E+0 (-0.2%)**	3.9E-6	4.9E-4

Table 3.17 Calculated Hazard Quotients (and Percent Change from Baseline Conditions) for Each Route of Exposure for the Toddler Receptor Under the Cumulative Scenario

PCOC	As	Ba	Be	Cr	Fe	Pb	Mn	Hg	Mo	Se
Soil Ingestion	1.7E-1	8.4E-5	6.3E-7	1.9E-5	**3.4E-1 (0.8%)**	8.4E-2	1.7E-3	1.3E-3	4.7E-7	6.3E-7
Particulate Inhalation	1.1E-3	6.0E-6	9.4E-7	4.2E-4	5.2E-2	4.2E-4	1.0E-4	9.6E-4	1.5E-9	1.2E-9
Soil Dermal Contact	4.5E-3	1.0E-4	7.8E-5	1.3E-4	3.0E-2	7.2E-2	3.6E-2	1.1E-3	4.1E-9	5.4E-9
Surface Water Ingestion	1.5E-1	1.5E-3	4.5E-4	**2.3E-1 (0.0%)**	1.4E-1	2.3E-2	7.0E-2	1.5E-2	2.0E-6	2.2E-5
Berry Ingestion	**2.7E-1 (1.1%)**	1.5E-4	5.8E-6	8.2E-4	5.1E-2	5.3E-2	4.1E-2	1.6E-2	1.0E-5	5.0E-7
Labrador Tea Ingestion	7.6E-2	2.2E-3	1.1E-5	2.3E-4	5.5E-3	4.6E-2	**2.1E-1 (-69.7%)**	1.3E-2	3.3E-6	1.2E-7
Game Bird Ingestion	5.5E-2	2.2E-5	1.2E-5	5.6E-5	9.8E-2	1.8E-2	1.7E-4	1.8E-4	3.4E-7	2.4E-6
Small Mammal Ingestion	3.2E-3	3.0E-4	1.8E-7	8.3E-4	7.6E-3	3.1E-2	2.7E-3	2.2E-3	4.9E-8	5.8E-7
Large Mammal Ingestion	**1.2E+0 (0.0%)**				**2.3E-1 (0.0%)**	**8.2E-1 (0.0%)**		**5.3E-1 (0.0%)**		8.9E-5
Fish Ingestion	**4.3E-1 (0.0%)**	1.7E-3	1.8E-3	3.6E-2	3.7E-2	3.6E-2	6.2E-3	**3.8E+0 (0.0%)**	7.9E-7	8.7E-4
Total	**2.3E+0 (0.5%)**	6.1E-3	2.4E-3	**2.7E-1 (0.6%)**	**1.0E+0 (-24.7%)**	**1.2E+0 (-24.3%)**	**3.6E-1 (-73.5%)**	**4.4E+0 (-0.2%)**	1.7E-5	9.9E-4

3.3.2.2 Locally Acting Respiratory Risks

In the case of the Howe project, beryllium is the only PCOC for which a specific tolerable concentration (0.00002 mg/m^3) could be identified. The calculated respiratory hazard quotient as a result of beryllium in airborne particulates under the cumulative activities scenario is 2.88x10^{-5}, a value below the de minimis level of 0.2.

Risks to respiratory health as a result of beryllium exposure in airborne particulates as a result of cumulative activities are therefore considered to be negligible.

3.3.2.3 Non-Threshold Cancer Risk

Non-threshold contaminants assessed in the present HHRA include arsenic, beryllium and chromium (total). Cancer risks as a result of oral exposure (ingestion of soil, water, food + dermal contact with contaminated soil), as well as cancer risks as a result of exposure to arsenic, beryllium and chromium through inhalation of fugitive dust are presented in Table 3.18.

Table 3.18 Calculated Incremental Lifetime Cancer Risks from Non-threshold Contaminants Under Cumulative Conditions

PCOC	Oral Cancer Risks	Inhalation Cancer Risks	Total
Arsenic	4.66E-04	2.09E-06	4.68E-04
Beryllium		3.22E-08	3.22E-08
Chromium		4.46E-06	4.46E-06

3.3.3 Summary of Deterministic Cumulative Risks Estimates

Arsenic

- The calculated total daily dose of arsenic to human receptors is primarily influenced by consumption of fish and caribou.
  - Ingestion of caribou accounts for 59.1% and 50.4% of the total dose to adults and toddlers respectively and both represent hazard quotient changes of <1% compared to baseline conditions.
  - Ingestion of fish accounts for 22.4% and 18.4% of the total dose to adults and toddlers respectively
- Calculated hazard quotients for total daily dose of arsenic are 0.9 and 2.3 for adult and toddler receptors respectively and both represent changes of ‘1% compared to baseline conflations. Given the conservative nature of the exposure scenario and quantitative assessment this suggests risks are low and likely negligible.
- The incremental lifetime cancer risk associated with oral exposure is calculated to be 4.7×10^{-4}.
  - This value is driven primarily by fish and caribou ingestion.
  - This value exceeds the de minimis level of 1×10^{-5}, however it is based on highly conservative assumptions and elevated detection limits which inflate the calculated exposure and risk estimates.
- The ILCR for exposure through inhalation of fugitive dust is calculated to be 2.1×10^{-6}, a value well below the de minimis level of 1×10^{-5} (i.e., negligible risk).

Human health risks as a result of arsenic exposure under the cumulative scenario are considered to be low and likely to be negligible. In addition, the project incremental risks are negligible because the marginal change in project risk relative to the baseline is <10%.

Barium

- The calculated total daily dose of barium to human receptors is primarily influenced by consumption of Labrador tea and fish ingestion.
  - Ingestion of Labrador tea accounts for 53% and 36% of the total dose to adults and toddlers respectively
  - Fish ingestion accounts for 27% and 28% of the total dose to adults and toddlers respectively
- Calculated hazard quotients for total daily dose of barium are 0.003 and 0.006 for adult and toddler receptors respectively and are deemed to be negligible.

Human health risks as a result of barium exposure under the cumulative scenario are considered to be negligible. In addition, the project incremental risks are negligible because the marginal change in project risk relative to the baseline is <10%.

Beryllium

- The calculated total daily dose of beryllium to human receptors is primarily influenced by ingestion of fish and surface water ingestion.
  - Ingestion of fish accounts for 84% and 76% of the total dose to adults and toddlers respectively
  - Ingestion of surface water accounts for 11% and 19% of the total dose to adults and toddlers respectively

- Calculated hazard quotients for total daily dose of beryllium are 0.001 and 0.002 for adult and toddler receptors respectively and deemed to be negligible.
- The calculated hazard quotient for local beryllium respiratory toxicity is $2.9x10^{-5}$, and deemed to be negligible.
- The ILCR for exposure through inhalation of fugitive dust is calculated to be $3.2x10^{-8}$, a value well below the de minimis level of $1x10^{-5}$ (i.e., negligible risk).

Human health risks as a result of beryllium exposure under the cumulative scenario are considered to be negligible. In addition, the project incremental risks are negligible because the marginal change in project risk relative to the baseline is <10%.

Chromium

- The calculated total daily dose of chromium to human receptors is primarily influenced by consumption of surface water and fish tissue.
    - Ingestion of surface water accounts for 75% and 85% of the total dose to adults and toddlers respectively
    - Ingestion of fish accounts for 24% and 14% of the total dose to adults and toddlers respectively
- Calculated hazard quotients for total daily dose of chromium are 0.07 and 0.27 for adult and toddler receptors respectively. For toddlers the hazard quotient changes by <1% compared to baseline conditions. This suggests that the risks are deemed to be negligible.
- The ILCR for exposure through inhalation of fugitive dust is calculated to be $4.5x10^{-6}$, a value well below the de minimis level of $1x10^{-5}$ (i.e., negligible risk).

Human health risks as a result of chromium exposure under the cumulative scenario are considered to be negligible. In addition, the project incremental risks are negligible because the marginal change in project risk relative to the baseline is <10%.

Iron

- The calculated total daily dose of iron to adult receptors is primarily influenced by ingestion of caribou and spruce grouse, accounting for 40% and 17% of the total dose respectively.
- The calculated total daily dose of iron to toddlers is primarily influenced by soil ingestion and ingestion of caribou, accounting for 34% and 23% of the total dose respectively.
- Calculated hazard quotients for total daily dose of iron are 0.26 and 1.0 for adult and toddler receptors respectively. Both represent hazard quotient reductions compared to baseline conditions. This is a result of the soil to tissue transfer factors for the project scenario predicting a lower risk than the assumed detection limits from the baseline scenario. Given the highly conservative nature of the exposure scenario and quantitative assessment the risks are low and likely to be negligible.

Human health risks as a result of iron exposure under the cumulative scenario are considered to be low and likely to be negligible. In addition, the project incremental risks are negligible because the marginal change in project risk relative to the baseline is <10%.

Lead

- The calculated total daily dose of lead to adult receptors is primarily influenced by ingestion of caribou and soil dermal contact accounting for 74% and 8%, respectively, of the total dose to adults.
- The calculated total daily dose of lead to toddler receptors is primarily influenced by ingestion of caribou and soil ingestion accounting for 69% and 7%, respectively, of the total dose to toddlers.

  Calculated hazard quotients for total daily dose of lead are 0.5 and 1.2 for adult and toddler receptors, respectively. Both represent hazard quotient reductions compared to baseline conditions. This is a result of the soil to tissue transfer factors for the project scenario predicting a lower risk than the assumed detection limits from the baseline scenario. Given the highly conservative nature of the exposure scenario and quantitative assessment the risks are low and likely to be negligible.

Human health risks as a result of lead exposure under the cumulative scenario are considered to be low and likely to be negligible. In addition, the project incremental risks are negligible because the marginal change in project risk relative to the baseline is <10%.

Manganese

- The calculated total daily dose of manganese to human receptors is primarily influenced by consumption of Labrador tea (both adults and toddlers), soil dermal contact (adults), and surface water ingestion (toddlers).
  - For adults the ingestion of Labrador tea accounts for 76% of the total dose and soil dermal contact accounts for 11% of the total dose of manganese.
  - For toddlers the ingestion of Labrador tea accounts for 57% of the total dose and surface water ingestion accounts for 19% of the total dose.
- Calculated hazard quotients for total daily dose of manganese are 0.2 and 0.4 for adult and toddler receptors respectively. For toddlers this represents a hazard quotient reduction compared to baseline conditions. This is a result of the soil to tissue transfer factors for the project scenario predicting a lower risk than the assumed detection limits from the baseline scenario. Given the highly conservative nature of the exposure scenario and quantitative assessment the risks are low and likely to be negligible.

Human health risks as a result of manganese exposure under the cumulative scenario are considered to be low and likely to be negligible. In addition, the project incremental risks are negligible because the marginal change in project risk relative to the baseline is <10%.

Mercury

- The calculated total daily dose of mercury to human receptors is primarily influenced by consumption of fish and caribou.
  - Ingestion of fish accounts for 87% of the total dose to adults and toddlers.
  - Ingestion of caribou accounts for 12% of the total dose to adults and toddlers.
- Calculated hazard quotients for total daily dose of mercury are 2.0 and 4.4 for adult and toddler receptors respectively and suggest that risks are low and likely to be negligible given the highly conservative nature of the exposure scenario and quantitative assessment.
  - 100% of fish collected from Howse property
  - Fish consumed daily
  - Maximum measured concentration used as exposure point concentration

Human health risks as a result of mercury exposure under the cumulative scenario are considered to be low and likely to be negligible. In addition, the project incremental risks are negligible because the marginal change in project risk relative to the baseline is <10%.

Molybdenum

- The calculated total daily dose of molybdenum to human receptors is primarily influenced by consumption of Labrador tea and partridge berry.
  - Ingestion of Labrador tea accounts for 49% and 20% of the total dose to adults and toddlers respectively
  - Ingestion of partridge berry accounts for 29% and 59% of the total dose to adults and toddlers respectively
- Calculated hazard quotients for total daily dose of molybdenum are 3.9×10^{-6} and 1.7×10^{-5} for adult and toddler receptors respectively (i.e., negligible risk).

Human health risks as a result of molybdenum exposure under the cumulative scenario are considered to be negligible. In addition, the project incremental risks are negligible because the marginal change in project risk relative to the baseline is <10%.

Selenium

- The calculated total daily dose of selenium to human receptors is primarily influenced by consumption of fish and caribou.
  - Ingestion of fish accounts for 90% and 88% of the total dose to adults and toddlers respectively.

- Ingestion of caribou accounts for 9% of the total dose to adults and toddlers.

Calculated hazard quotients for total daily dose of selenium are 4.9x10^{-4} and 9.9 x10^{-4} for adult and toddler receptors respectively and suggest that risks are low and likely to be negligible given the highly conservative nature of the exposure scenario and quantitative assessment.

Human health risks as a result of selenium exposure under the cumulative scenario are considered to be low and likely to be negligible. In addition, the project incremental risks are negligible because the marginal change in project risk relative to the baseline is <10%.

3.3.4 Probabilistic Assessment of Cumulative Inhalation Risks

The deterministic risk assessment presented above indicates that fugitive dust is a key uncontrolled release associated with project or cumulative activities. In consideration of this fact, and the fact that fugitive dust can disperse large distances, a probabilistic risk assessment was conducted to examine the stochastic nature of human health risks from fugitive dust as a result of cumulative mineral extraction activities.

Deterministic quantitative HHRA relies on assignment of point estimates for a variety of input exposure parameters to derive quantitative estimates of risk. Although these input parameter values may be selected with some knowledge of their variability or uncertainty, a deterministic risk assessment provides no information on the variability of the resulting risk estimates.

In comparison, probabilistic risk assessment uses probability distributions to characterize stochastic (natural) variability and uncertainty in key input parameters, and produces a probability distribution of the resulting risk estimates. This provides not only a description of the variability in the calculated risk estimates, but also a basis for selecting a risk estimate whose likelihood of exceedance can be quantified for decision-making purposes.

3.3.4.1 Simulation Methods

The GoldSim® modeling platform was used to develop a spatially explicit inhalation exposure model of the project area using Monte-Carlo simulation (Appendix D2). GoldSim is a graphically oriented, programming platform for modelling dynamic, probabilistic simulations and is particularly well suited to quantitatively address the inherent uncertainty which is present in real-world systems. GoldSim uses Monte Carlo Simulation to propagate uncertainties in model inputs into uncertainties in model outputs. The variability/uncertainty associated with the probability functions from which the data are drawn is propagated through the model by the multiple resampling/recalculation of the Monte Carlo Simulation. In this case, the Monte-Carlo simulation was conducted with 2000 iterations. This type of simulation explicitly and quantitatively addresses uncertainties.

3.3.4.2 Exposure Assessment

Dose and associated risks from inhalation of fugitive dust were modelled using the standard Health Canada (2010a) guidance for detailed quantitative risk assessment for those contaminants for which a specific inhalation toxicity effect has been documented (i.e., arsenic, beryllium, and chromium).

Review of the deterministic risk assessment identified four model elements related to fugitive dust for which sufficient data exists to assign probability distributions. The stochastic elements used in the probabilistic risk assessment, their assigned distributions, and the rationale for their use are provided in Table 3.19 below.

Table 3.19 Stochastic Elements, Probability Distributions and Rationale Supporting Assignment of Specific Distributions Considered in the Probabilistic Risk Assessment on Inhalation of Fugitive Arsenic, Beryllium and Chromium Particulate Matter

Parameter	Distribution	Rationale
PM_{10} During Blasting Conditions (μg/m^3)	The probability distribution for concentration of airborne particulates during blasting conditions was developed as a cumulative distribution specific for each geographic receptor location based on predicted hourly particulate concentrations for a period of 5 years. The dataset used to create the cumulative distribution consists of 43,848 predicted concentrations. Predicted concentration incorporate variability in meteorological conditions responsible for fugitive dust dispersion.	
PM_{10} During Non-Blasting Conditions (μg/m^3)	The probability distribution for concentration of airborne particulates during non-blasting conditions was developed as a cumulative distribution specific for each geographic receptor location based on predicted hourly particulate concentrations for a period of 5 years. The dataset used to create the cumulative distribution consists of 43,848 predicted concentrations. Predicted concentration incorporate variability in meteorological conditions responsible for fugitive dust dispersion.	
Inhalation Rate	Log-normal distribution with a mean (± Std.Dev.) of 16.6 (± 4.1) and 7.9 (± 2.2) for adult and toddler receptors respectively.	Inhalation rates and assumed log-normal distributions were sourced from the 2013 Canadian Exposure Factors Handbook (Richardson & SCL, 2013).
C_Particulate (Concentration of PCOC in PM_{10} (mg/kg))	Log-Normal Distribution Arsenic: Mean= 26.09 Std.Dev.=±18.51 Beryllium: Mean= 1.538 Std.Dev.= ± 0.895 Chromium: Mean= 23.32 Std.Dev.= ± 18.44	Rock chemistry from the drill core dataset (n=39) was examined to determine statistical distribution of the contaminants of potential concern. Log-normal distributions were confirmed using ProUCL version 5.0 statistical software to conduct Shapiro-Wilk tests to a confidence level of 95%. (i.e., p-value<0.05). All distributions truncated at a minimum value of 0 mg/kg.

Receptors Assessed

The probabilistic risk assessment of cumulative fugitive dust impacts to human health specifically addressed adult human receptors at specific geographic locations. The toddler was excluded from the probabilistic assessment on the basis that the inhalation effects of interest are primarily carcinogenic endpoints which are assessed based on a lifetime-amortized dose and not applicable to specific age classes. One exception to this is the respiratory risks posed by beryllium, which is based on a chronic reference concentration. The reference concentration is analogous to an oral reference dose in that it represents a tolerable daily exposure concentration to the human population (with the inclusion of sensitive sub-groups) over a lifetime of exposure. However, it is expressed as a concentration, not a dose and is not specific to a particular age group. Beryllium was therefore assessed for adult receptors only.

Receptor Locations and Exposure Duration

The framework of the detailed probabilistic risk assessment has allowed for a spatially explicit assessment of potential health risks. A total of 13 critical receptors, and 4 grid receptors were selected from the Air Quality assessment for inclusion in the probabilistic assessment of inhalation risks. These receptors were selected to represent either (i) the worst-case scenario (as is the case with the off-property maximum locations), (ii) areas of the RSA having a high potential for seasonal human occupation (e.g., traditional food harvesting/hunting locations), or (iii) areas of potential full time residence (towns, worker camp). The specific geographic locations assessed are described in Table 3.20 and presented on Figure 7 and Figure 9.

Inhalation exposures were assessed assuming full-time occupancy of the receptor locations (i.e., 52 weeks per year) assuming one blasting day per week. This is a highly conservative assumption; it is unlikely individuals would be occupying hunting/gathering locations for 52 weeks per year, and mine workers are likely to occupy the worker camp on a rotation schedule. Additionally, information presented in the air modelling chapter indicate a planned blasting schedule of one blast day per week during the summer months, but only one blast day per month in winter months.

Table 3.20 Critical and Grid Receptors Assessed as Part of the Probabilistic Inhalation Assessment

Receptor ID	Receptor Class	Name
147	Grid Receptor	Location of off-property maximum particulate concentration during blasting events
156	Grid Receptor	Location of off-property maximum particulate concentration during blasting events
59	Grid Receptor	Location of off-property maximum particulate concentration without blasting
387	Grid Receptor	Location of off-property maximum particulate concentration without blasting
5	Critical Receptor	Innu Camp
9	Critical Receptor	Young Naskapi Camp (Pinette Lake)
11	Critical Receptor	Young Naskapi Trailer tent (Triangle Lake)
13	Critical Receptor	Uashat people's camp 2
15	Critical Receptor	Young Naskapi Camp (Howells River)
19	Critical Receptor	Naskapi Cabin
31	Critical Receptor	Innu Cabin
34	Critical Receptor	Naskapi Cabin
36	Critical Receptor	Kawawachikamak (Town)
37	Critical Receptor	Lac John (Town)
38	Critical Receptor	Matimekush (Town)
39	Critical Receptor	Schefferville (Town)
40	Critical Receptor	Workers' Camp

3.3.4.3 Results

Results of the probabilistic risk assessment are presented in Table 3.21 below. Displayed results include the probability of exceeding the de minimis risk level (0.2 for threshold respiratory effects of beryllium and 1E-5 for non-threshold carcinogenic effects). In addition, the probabilistic model estimates the most likely risk estimate should the regulatory benchmarks be exceeded. This is quantified by calculating a conditional tail expectation (CTE), a measure of central tendency of all model realizations greater than a specific probability.

Table 3.21 Probability of Exceeding de minimis levels, and Conditional Tail Expectation for Threshold and Non-threshold Endpoints for Arsenic, Beryllium and Chromium Inhalation

Receptor ID	Beryllium Threshold Respiratory Risks		Lifetime Incremental Cancer Risk via Inhalation				
			Arsenic		Beryllium	Chromium	
	Prob. HQ>0.2	CTE	Prob. ILCR>1e-5	CTE	Prob. ILCR>1e-5	Prob. ILCR>1e-5	CTE
147	0.003	0.29	0.044	3.2E-5	0.000	0.053	4.1E-5
156	0.007	0.26	0.052	3.1E-5	0.000	0.060	4.1E-5
59	0.000	na	0.028	2.2E-5	0.000	0.044	3.1E-5
387	0.001	0.24	0.050	2.5E-5	0.000	0.067	3.5E-5
5	0.000	na	0.000	na	0.000	0.002	1.3E-5

Receptor ID	Beryllium Threshold Respiratory Risks		Lifetime Incremental Cancer Risk via Inhalation				
			Arsenic		Beryllium	Chromium	
	Prob. HQ>0.2	CTE	Prob. ILCR>1e-5	CTE	Prob. ILCR>1e-5	Prob. ILCR>1e-5	CTE
9	0.000	na	0.009	1.8E-5	0.000	0.021	1.9E-5
11	0.000	na	0.002	1.2E-5	0.000	0.005	1.5E-5
13	0.000	na	0.013	1.7E-5	0.000	0.024	2.2E-5
15	0.000	na	0.000	na	0.000	0.000	Na
19	0.000	na	0.000	na	0.000	0.000	Na
31	0.000	na	0.000	na	0.000	0.000	Na
34	0.000	na	0.000	na	0.000	0.005	1.06E-5
36	0.000	na	0.000	na	0.000	0.000	Na
37	0.000	na	0.000	na	0.000	0.000	Na
38	0.000	na	0.000	na	0.000	0.000	Na
39	0.000	na	0.000	na	0.000	0.000	Na
40	0.0003	0.21	0.041	2.5E-5	0.000	0.056	3.2E-5

Notes: The conditional tail expectation (CTE) is the expected value of the output given that it lies above a specified Cumulative Probability. That is, it represents the mean of the worst 100(1 - α)% of outcomes, where α is the specified Cumulative Probability. For example, in the case of arsenic ILCRs at receptor 147, the CTE is the average of all values that lie above the cumulative probability of 0.956.

For the case of potential beryllium respiratory effects, the tabulated results indicate the probability of a significant incremental human health risk(i.e., HQ > 0.2) from cumulative resource extraction activities in the LSA is very low (typically less than 0.1% (i.e., probability <0.001). This is clearly evident in the complementary cumulative distribution functions (CCDF) of predicted HQs for beryllium threshold effects at off property maximal locations (Figure 7). The extremely low probability of HQ > 0.2 is predicted despite the highly conservative assumption of 52 weeks per year exposure and provides confidence that the health risk is negligible. Additionally, in the theoretical scenario where maximum hourly PM_{10} concentrations persist for the chronic exposure duration (a condition not supported by meteorological data) the likely predicted HQ based on the CTE ranges between 0.21 and 0.29 (Table 3.21) a negligible value in light of conservative assumptions.

For the case of cancer risks, in the theoretical scenario where maximum hourly PM_{10} concentrations persist for the chronic exposure duration (a condition not supported by meteorological data) the probability of exceeding the de minimis level is very low (typically <1%). Grid receptor 147 was selected for display (Figure 8) because it is an off-property maximal location during blasting conditions and also has the highest calculated likely ILCRs (CTE). The risk to other receptor locations is inferred to be lower than for grid receptor 147. Figure 9 shows the probability of exceeding the de minimis level of 1E-5 for the three inhalation carcinogens assessed. This figure, clearly indicates that the probability of instantaneous climatic conditions yielding PM_{10}-derived doses equating to ILCRs>1E-5 is unlikely (~5% chance of this occurring). Furthermore, the CTEs provided in Table 3.21 indicate that should this rare condition occur; the likely predicted ILCRs remain between 1E-5 and 1E-4, and are not associated with lifetime exposure. Given the conservative assumptions surrounding exposure duration, these results are considered low and likely to be negligible.

A sensitivity analysis of the predicted ILCRs indicates that P_Air_Blast (the concentration of airborne PM_{10} during blasting conditions) as the greatest contributor to the variance of the predicted ILCRs (Importance measure = 0.376). The predicted hourly P_Air concentrations are modelled based on climate data. Therefore, weather conditions are the driving factor in determining an instantaneous dose.

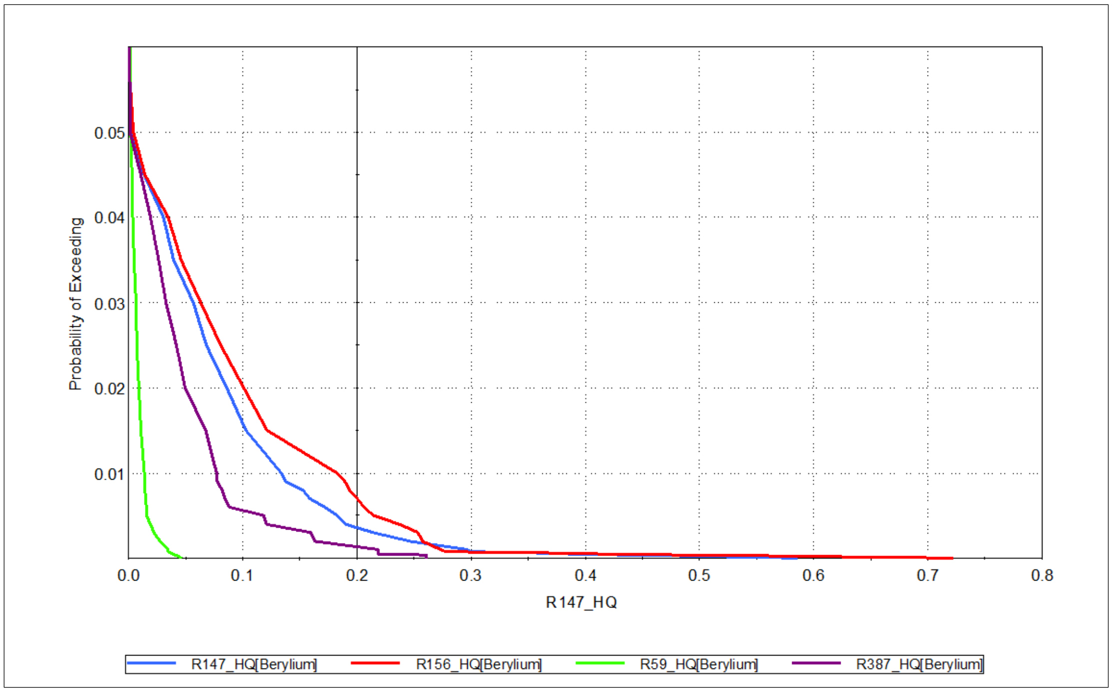


Figure 7 Complementary Cumulative Distribution Function (i.e., Probability of Exceeding a Decision Level) at Off-property Maximum Locations for Threshold Respiratory Effects as a Result of Exposure to Beryllium in PM_{10}, Assuming 52 Weeks Exposure

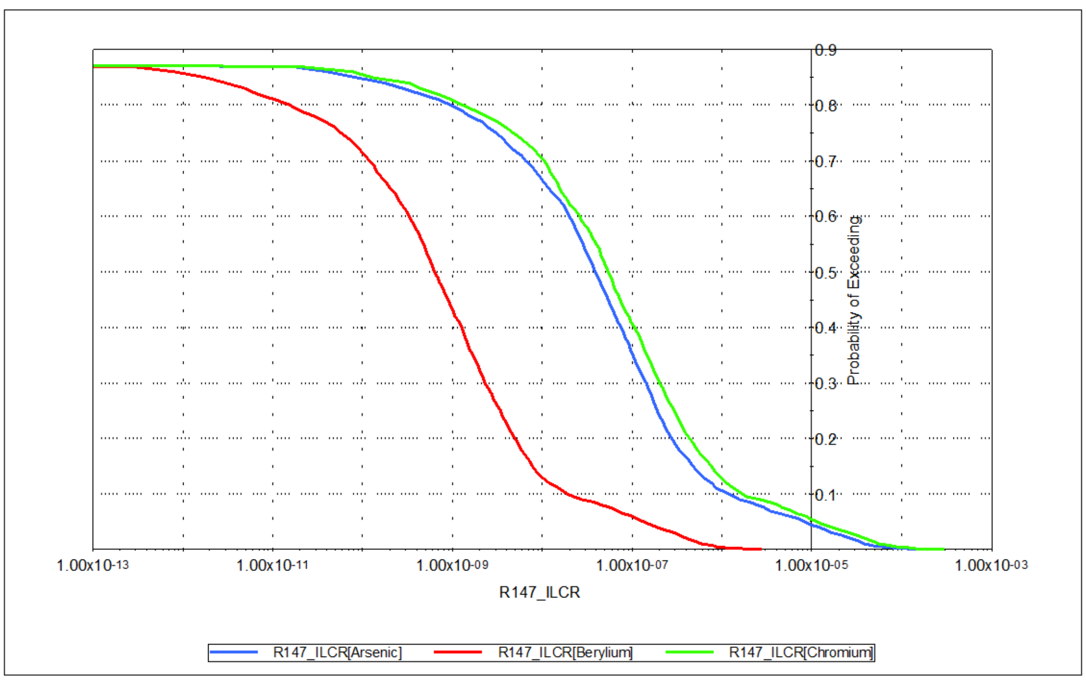


Figure 8 Complementary Cumulative Distribution Function (i.e., Probability of Exceeding a Decision Level) at Off-property Maximum Location 147 for Non-threshold Cancer Risks as a Result of Exposure to Arsenic, Beryllium, and Chromium in PM_{10}, Assuming 52 Weeks Exposure

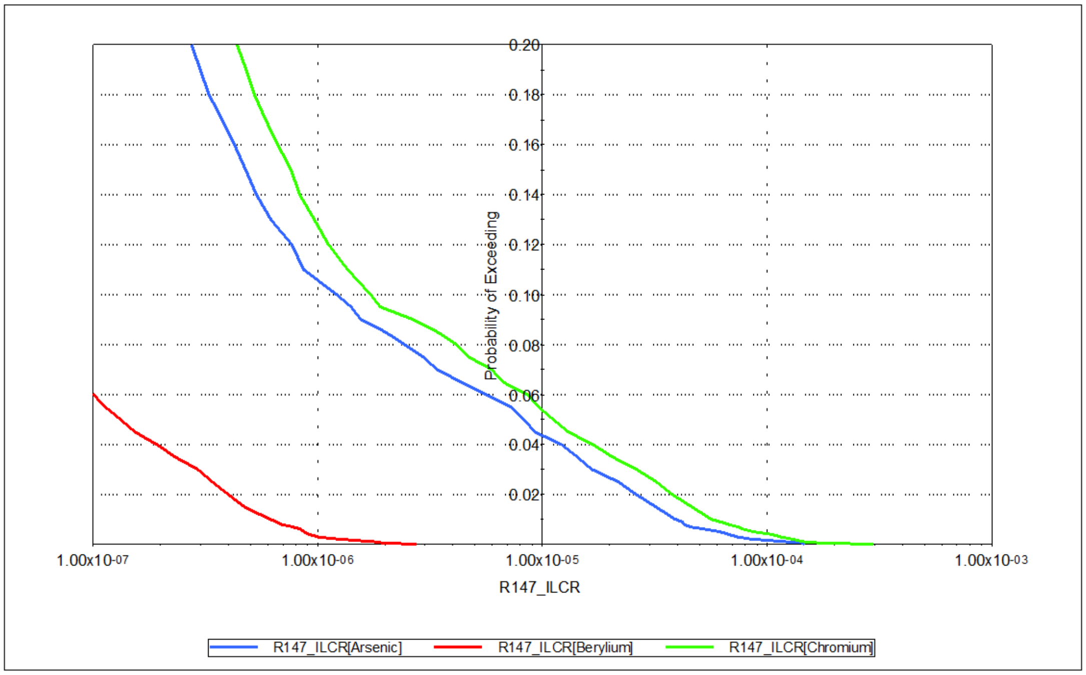


Figure 9 Detailed View of Complementary Cumulative Distribution Function Showing the Probability of Exceeding the de Minimis level at Off-property Maximum Location 147 for Non-threshold Cancer Risks as a Result of Exposure to Arsenic, Beryllium, and Chromium in PM_{10}, Assuming 52 Weeks Exposure

To summarise, the stochastic analysis of fugitive dust exposure and associate health risk indicates:

- Uncontrolled emissions of fugitive dust as a result of cumulative resource extraction activities in the LSA are predicted to have a low probability of resulting in adverse human health effects.
  - Probability threshold risk estimates exceeding the de minimis level are 0.7% for threshold respiratory effects of beryllium.
  - The probability of predicting an ILCR that exceeds 1E-5 ranges from 0 to a maximum of 6.7%
- The magnitude of the most likely predicted risk estimates in the event that meteorological conditions result in exceedance of the de minimis levels remain at levels which are considered to be low and likely to be negligible (i.e., 0.2<HQ<1 and 1E-5<ILCR<1E-4).
- The concentration of PM_{10} during blasting is the primary driver of the probabilistic risk estimates. Site specific monitoring of fugitive dust (PM_{10}) will have the greatest impact of reducing uncertainty around the inhalation risk estimates.

4. Uncertainty Analysis

Throughout the conduct of a quantitative human health risk assessment, the assessor is faced with choices required to calculate exposure estimates and characterize potential risks. These choices relate to assumed exposure point concentrations, exposure duration and frequency, intake rates for human receptors accessing the site, and the toxicity reference values that are used to characterize the risks associated with a certain level of exposure. Details of these uncertainties are presented in Appendix F. Key sources of uncertainty that influence the present risk assessment are discussed briefly below.

Exposure Assessment

The assessment of exposure carries inherent uncertainty that is generally offset by the application of conservative assumptions. The ingestion rates for soil, water and airborne particulates were based on conservative behaviours and human characteristics provided by Health Canada (2010). Ingestion of country food was assumed to be equal to a reasonable upper bound based on literature and project specific data. Highly conservative assumptions concerning site use duration and frequency were applied. No adjustments were made for the bioavailability of PCOCs for uptake through the gastrointestinal tract for environmental media. The above assumptions tend to overestimate exposure, and therefore err on the side of conservatism.

Concentration of Airborne Particulates

The assessment assumes visitors to the LSA are exposed to the 90^{th} percentile of maximum predicted 24-hour PM_{10} concentrations blended between blasting and non-blasting conditions. It is assumed that blasting will occur one day per week throughout the year. The use of the 90^{th} percentile equates to placing a human receptor in very close proximity to the site boundary for a period of 16 weeks per year. Additionally, information in the EIS suggests that reduced frequency of blasting will occur during winter months. All of the above assumptions have the potential to result in an overestimation of inhalation exposure, and therefore err on the side of conservatism.

AECOM have attempted to quantify the uncertainty and variation in expected risk estimates through the use of a probabilistic risk assessment for exposure to airborne particulates under the cumulative activity scenario. The concentration of PM_{10} is the primary driver in dose and risk estimates as a result of inhalation of fugitive dust. The predicted PM_{10} concentrations are based on retrospective weather data, indicating that meteorological conditions at the time of blast are the primary controlling factor for instantaneous dose via particulate inhalation.

Dataset Suitability

Analytical uncertainty is present in every human health risk assessment. The chances of false positive or false negative results are greatest when concentrations in environmental media are close to reportable detection limits. Generally, the overall laboratory dataset is considered to be valid for soil characterization. The datasets for surface water, and particularly plant and wildlife tissues contain a high proportion of values below analytical limits of detection. In these instances, food web models were used to estimate tissue concentrations. This approach, while preferable to arbitrary substitution, carries with it its own uncertainties.

Food Chain Modelling

Directly measured concentrations of contaminants of potential concern were not available for use as exposure point concentrations for all game species considered likely to be consumed under baseline conditions. As well, human health risk estimates in the future project activity and cumulative activity scenarios rely on prediction of tissue quality through food web modeling. Concentrations in tissues were modelled using standard intake equations and receptor characteristics, as well as literature derived transfer factors. The food chain models introduce uncertainty in the risk assessment. The influence of the food web models on the total dose of the human receptors is large. The uncertainty associated with the food web models is compounded by the uncertainty associated with contaminant transfer factors used to estimate the proportion of ingested contaminant that is absorbed and ultimately assimilated into the animal's tissues. This is potentially the largest source of uncertainty to the risk assessment for the predicted future scenarios.

5. Conclusions

Conclusions of the HHRA are drawn based on providing sufficient evidence to answer the key questions developed at the outset of the risk assessment (Section 2.4). Based on the information provided in additional documentation in the EIS (refer to section 1.2) and the quantitative assessment contained herein, the following conclusions can be made.

HH1: What effect will project releases have on water and subsequently human health?

- Under both the Project Operations Scenario and the Cumulative Operations Scenario there is no predicted change in water quality because the mine operation is committed to minimal water discharges with water quality that complies with applicable guidelines. Therefore, there is no anticipated effect on surface water quality or associated health risk from water consumption during traditional land use activities.

HH2: What effect will project releases have on air quality and subsequently human health?

- Under both the Project Operations Scenario and the Cumulative Operations Scenario uncontrolled releases of airborne particulates extending past the property line are predicted to exceed air quality assessment criteria (regulatory guidelines) for short durations, with very limited frequency (<1% of time), and generally only at locations in close proximity to the boundary of the project footprint. The effect on air quality is predicted to yield negligible health risks to aboriginal peoples though both the direct inhalation pathway of dust and indirectly through traditional land uses in the project area.

HH3: What effect will project releases have on soil quality and subsequently human health?

- Under both the Project Operations Scenario and the Cumulative Operations Scenario the predicted effect of releases from the project are likely to yield negligible, or low and likely to be negligible health risk to aboriginal people from incidental soil ingestion during traditional land use activities in the project area. This is based on modelled uptake of soil from the project area influenced by air deposition.

HH4: What effect will project releases have on food quality and subsequently human health?

- Under both the Project Operations Scenario and the Cumulative Operations Scenario, the predicted effect on food quality is likely to yield negligible, or low and likely to be negligible health risk to aboriginal people that consume a large component of traditional country food. This is based on modelled uptake of substances from air deposition into food items such as berries, medicinal tea, and small game. No changes are anticipated in fish or caribou quality, or associated health risk from their consumption, due to (i) minimal water discharges that are managed to comply with water standards, and (ii) a minimal interaction time and diet derived from the mine or surrounding area by caribou.

HH5: What will be the collective effect of changes to water, air, soil and food on human health?

- Under both the Project Operations Scenario and the Cumulative Operations Scenario, the collective effect of predicted changes to water, air, soil, and food are likely to yield negligible, or low and likely to be negligible health risk to aboriginal people visiting the site for traditional land use. This is based on a multi-media exposure assessment for various key substances of interest and the summation of the associated health risks.

Applicability and Inference of Conclusions

- Construction Phase of Project:
  Based on the industrial activities, the evaluated exposure scenarios, and the level of conservatism employed, the predicted health risks summarized above are expected to also apply to the construction phase of the project.
- Decommissioned Project (far future):
  Based on the reduced far future activities following mine decommissioning, evaluated exposure scenarios, and level of conservatism employed, the predicted health risks summarized above are expected to also apply to the far future decommissioned phase of the project.

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Appendix A

Screening for Substances of Interest

Appendix A
Screening of Substances of Interest to Human Health Risk Assessment, Howse Property Project

This document provides the objectives and outcome of a qualitative screening of Substances of Interest (SOI) that may be nominated for further study and input into the Human Health Risk Assessment for Tata Steel Minerals Canada Limited proposed Howse Property Project.

1. Objectives

The specific objective of the screening is to create a broad and inclusive framework for the identification of substances of interest (SOI), defined as substances that meet one of two criteria as follows:

- Substances present in environmental media under baseline conditions at concentrations that are unusual (locally elevated), or;
- Substances with the potential to be present in any compartment of the mine process or lifecycle that may have the ability to alter the current baseline conditions of environmental media by a significant degree.

2. Screening Framework

A broad screening framework (depicted in Figure 1 below) was used to identify substances of interest. The screening framework consists of three broad tracks as follows:

1. Substances whose maximum measured concentration in site media exceed applicable guidelines for metals (Canadian Counsellors of the Ministry of the Environment (CCME), Health Canada Guidelines, or Quebec) and hydrocarbons (CCME and The Atlantic Partners in Risk-Based Corrective Action (RBCA) will be retained as substances of interest. Substances which are in compliance with the aforementioned EQGs will not be retained as substances of interest.
2. A lack of federal or provincial EQGs does not preclude risks to human health. As such, substances for which there are no EQGs will be screened based on site specific background concentrations. Substances whose maximum measured concentration in site media exceed site specific background concentrations will be retained as substances of interest. Substances which are in compliance with site specific background concentrations will not be retained as substances of interest.
3. If no suitable EQG or background data is available, further qualitative assessment based on professional judgement and the precautionary principle is required. Substances will be retained as a SOI if appropriate regulatory bodies (such as Health Canada, US EPA, World Health Organization or others) indicate toxicity, and suitable toxicological data exists upon which to base an assessment. If such information does not exist, and there is concern over magnitude of impact or potential for toxicity additional research may be required.

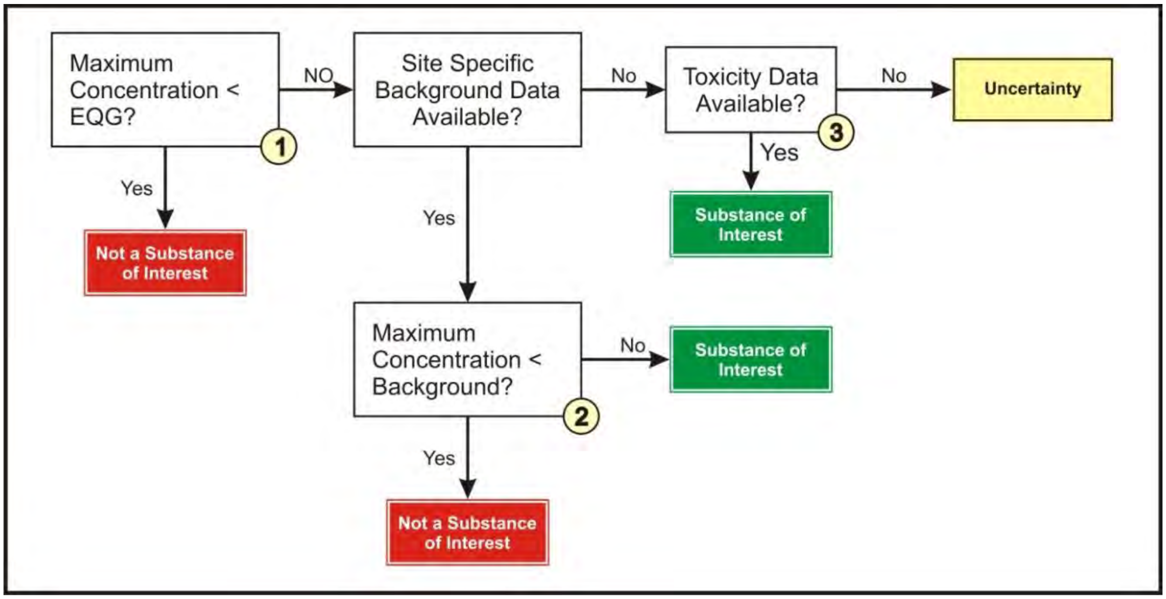

Figure 1 Screening Framework for Identification of Substances of Interest

In order to satisfy the specific objectives of the screening, as stated above, a two phased approach was necessary.

1. Maximum concentrations of elements and hydrocarbons measured in site matrices including soil and surface water were examined. Examination of these baseline matrices will inform the first component of the objective, to identify substances which are at unusual concentration under baseline conditions.
   a. Concentrations of metals measured in soil samples were compared to applicable CCME and Quebec MDDEFP soil quality guidelines.
   b. Concentrations of metals measured in surface water samples were compared to applicable Health Canada and Quebec Drinking Water Guidelines.
2. In order to identify substances which have a potential to alter baseline conditions during the lifecycle of the proposed development, the raw materials that will be introduced to the process will be considered. Concentrations of metals measured in samples of ore, waste rock, and overburden from the Howse property were compared to applicable CCME and Quebec MDDEFP soil quality guidelines. Substances with concentration in ore or waste rock in exceedance of the soil quality guidelines are considered to have the potential to impact baseline conditions for environmental media during the lifecycle of the mine development; and will be retained as substances of interest.
3. The air quality substance of interest screening was conducted by comparing air quality samples for metals and VOCs to air quality standards from Newfoundland/Labrador and Quebec.

3. Substances of Interest

3.1 Soil

The screening framework described above identified 3 substances of interest based on unusual concentrations in the baseline soil dataset. In addition, iron has been nominated due to local enrichment that has made this area the focus of iron mine developments. Contaminants of potential concern based on the soil data therefore include:

- Arsenic
- Mercury
- Manganese
- Iron

3.2 Surface Water

No substances of interest were identified[1] based on the concentrations reported in the baseline surface water data for the study area.

3.3 Ore, Waste Rock and Overburden

In addition, the concentrations of metals in samples of ore and waste rock compared to applicable soil standards identified 10 substances which have the potential to alter baseline conditions, resulting in 7 additional nominated substances of interest. These are:

- Barium
- Beryllium
- Chromium
- Lead
- Molybdenum
- Selenium

It's worth noting that iron was not nominated as a SOI during the above referenced screening despite its natural enrichment in the local area. This is due to its low toxicity, it's an essential trace element for biological activity, and as a consequence it has a correspondingly high soil standard. There are no CCME or Quebec MDDEFP soil quality guidelines for iron; however, iron has been included due to local enrichment that has made this area the focus of iron mine developments. Tabulated maximum concentrations of metals compared to applicable environmental quality guidelines are presented in Table 1 to Table 3.

At the request of CEAA an air quality screening was conducted to applicable air standards which identified 5 additional substances of interest which have the potential to alter baseline conditions. These are:

- Acrolein
- Acetaldehyde
- Benzene
- 1,3-Butadiene
- Formaldehyde

However, the based on the results of the air analysis (Air Dispersion Modeling Report; Appendix 3) these SOI's were compliant with applicable standards and therefore were not nominated for quantitative evaluation in the HHRA.

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[1] *Uranium in Pinette Lake was reported on one occasion at 24 µg/L, however all other values reported from Pinette Lake were below limits of detection (<1.0 µg/L). This is an outlier value, and was not considered relevant. Uranium has been stricken as a substance of interest based on surface water baseline data.*

4. Closure

AECOMs screening has identified a total of 16 metals as substances of interest. The screening is designed to provide a broad assessment of substances which warrant more careful study or consideration as the large project unfolds. A substances designation as being “of interest” in no way identifies the probability or magnitude of exposure to any environmental media or potential receptor. These determinations will be made later as part of the formal Human Health Risk Assessment (HHRA).

Table 1. Maximum Concentrations of Metals Measured in Soil from the Howse Property Project Area, as Compared to Applicable Environmental Quality Guidelines

Contaminant	Max. Concentration (mg/kg)	Quebec Soil Standards (mg/kg)			CCME Soil Quality Guidelines (mg/kg)	
		Level A	Level B	Level C	PL	IL
Aluminum	9800	-	-	-	-	-
Antimony	0.5	-	-	-	20	40
Arsenic	17	10	30	50	12	12
Barium	150	245	500	2,000	500	2,000
Beryllium	0.6	-	-	-	4	8
Boron	<2	-	-	-	-	-
Cadmium	0.2	1.5	5	20	10	22
Calcium	<20	-	-	-	-	-
Chromium	22	80	250	800	64	87
Cobalt	9	25	50	300	50	300
Copper	13	100	100	500	63	91
Iron	62000	-	-	-	-	-
Lead	17	30	500	1,000	140	600
Magnesium	2800	-	-	-	-	-
Manganese	1900	1000	1,000	2,200	-	-
Mercury	0.24	0.2	2	10	6.6	50
Molybdenum	3.1	6	10	40	10	40
Nickel	13	100	100	500	50	50
Phosphorus	620					
Potassium	290	-	-	-	-	-
Selenium	0.8	1	3	10	1	3
Silicon	<0.5	-	-	-	-	-
Silver	1	2	20	40	20	40
Sodium	40	-	-	-	-	-
Thallium	<0.1				1	1
Titanium	240	-	-	-	-	-
Thorium	<4					
Tin	<1	5	50	300	50	300
Uranium	NA				23	300
Vanadium	52	-	-	-	130	130
Zinc	47	230	500	1,500	200[a]	360

Quebec Soil Standards: A = Residential/Commercial background levels for inorganic parameters in the Labrador Trough Region. B= Maximum acceptable limit residential, recreational land use. C=Maximum acceptable limit for Non-residential Commercial or Industrial.

CCME Soil Quality Guidelines; PL= = Residential/Park Land, IL = Industrial Lands

a – PL guideline of 200 mg/kg is based on the 1991 interim soil quality criterion. Default value of 500 mg/kg was based on eco contact.

Table 2. Maximum Concentrations of Metals Measured in Surface Water from the Howse Property Project Area, as Compared to Applicable Drinking Water Guidelines*

	Max. Concentration (µg/L)	*MDDELCC (ug/L)	**Health Canada (ug/L)
Aluminum	358	NG	NG
Antimony		6	6
Arsenic	<1	10	10
Barium		1000	1000
Bismuth		NG	NG
Boron		5000	5000
Cadmium	0.152	5	5
Chromium		50	50
Cobalt		NG	NG
Copper	9	1000	NG
Iron	1640	NG	NG
Lead	2	10	10
Lithium		NG	NG
Manganese	135	NG	NG
Mercury	0.04	1	1
Molybdenum	1	NG	NG
Nickel	3.5	NG	NG
Selenium	2	10	50
Silicon		NG	NG
Silver		NG	NG
Sodium	1490	NG	NG
Strontium		NG	NG
Thallium		NG	NG
Titanium		NG	NG
Tin		NG	NG
Uranium	<20	20	20
Vanadium		NG	NG
Zinc	25	NG	NG
Radium (RA 226)	0.018	NG	NG

** Quebec Drinking Water Guidelines - Ministre du Développement durable, de l'Environnement et de la Lutte contre les changements climatiques (MDDELCC). Quebec Drinking Water Guidelines exceeded are highlighted in Bold.*

*** Health Canada Drinking Water Guidelines (Maximum Allowable Concentration) exceeded are highlighted with grey shading.*

**** Uranium in Pinette Lake was reported on one occasion at 24 µg/L, however all other values reported from Pinette Lake were below limits of detection (<1.0 µg/L). This is n outlier value, and was not considered relevant. Uranium has been stricken as a substance of interest based on surface water baseline data.*

Table 3. Maximum Concentrations of Metals Measured in Potentially Minable Materials (Ore and Waste Rock), as Compared to Applicable Soil Quality Guidelines*

Substance	Max. Concentration	*Quebec Criteria (Labrador Trough)	**CCME Soil Quality Guideline (PL)
Antimony	1		20
Arsenic	108	10	12
Barium	586	245	500
Berylium	4.6		4
Cadmium	0.4	1.5	10
Cerium	209		
Cesium	3.75		
Chromium	171	80	64
Cobalt	18.9	25	50
Copper	33.1	100	63
Iron (%)	49.5		
Lead	287	30	140
Manganese	3880	1000	
Mercury	100	0.2	6.6
Molybdenum	9.65	6	10
Nickel	39.4	100	50
Selenium	1.3	1	1
Silver	1.34***	0.8	20
Strontium	1600		
Thallium	0.74		1
Tin	2	5	50
Uranium	3.9		23
Vanadium	106		130
Zinc	103	230	200

** Quebec criteria exceedances are highlighted with bold.*

*** CCME Guidelines exceeded are highlighted with grey shading.*

**** Single Outlier Data Point among non detect data. Value not used.*

a – PL guideline of 200 mg/kg is based on the 1991 interim soil quality criterion. Default value of 500 mg/kg was based on eco contact.

Appendix B

Exposure Parameters

- B1: Selection of Dietary Ingestion Rates
- B2: Literature Derived Caribou Tissue Concentrations
- B3: Deterministic Air Particulates (PM_{10}) Estimates

B1. Selection of Dietary Ingestion Rates

Appendix B1
Selection of Country Food Ingestion Rates

Adult Country Food Ingestion Rates

Collection and consumption of traditional country foods is an important cultural and social component of the lives of northern peoples. In addition, country food ingestion can be an important driver in the exposure to environmental contaminants. In consideration of this, AECOM have assessed risks to human health using literature derived country food ingestion rates for northern populations, in conjunction with information gathered through a limited dietary intake survey conducted for the Howse Project (Table 1).

Country food ingestion rates obtained from literature sources were compiled along with estimates made from the dietary intake study. The Naskapi and other northern peoples rely heavily on caribou as a preferred game species. AECOM have elected to ascribe 80% of the game ingestion rate to caribou, and the remaining 20% to small mammals assumed to be collected from the LSA. For adult receptors, the 90th percentile ingestion rate was selected as a reasonable approximation of country food ingestion rates for fish, game and birds.

The available data for berries and Labrador tea was considered insufficient for the calculation of a meaningful 90th percentile; therefore the maximum reported value was used. It is assumed that berries are consumed for 4 months per year. Ingestion of Labrador tea has been assumed to be 0.25 L/day (this is equivalent to ingesting, on average, one cup of tea daily) for adult receptors. It is assumed that 2.91 grams of dry vegetation is required per cup of tea.

Estimation of Country Food Ingestion by Toddlers

The ingestion rates for toddlers of fish, game and birds is assumed to be 50% of the adult ingestion rates as determined from Table 1. These values are in contrast to the standard toddler ingestion rate of wild game (0.085 kg/day) as recommended by health Canada (HC, 2010). The rationale for this adjustment is as follows:

- Per capita ingestion rates were sourced from the U.S. EPA analysis of 2003−2006 NHANES dataset, as reported in Table 11-3 of the US EAP Exposure Factors Handbook (EPA, 2011).
- Based on mean per capita ingestion (g/kg bw/day) of meat, dairy and total fat in edible portions equivalent age groups to health Canada's toddler and adult receptors were calculated to ingest 66 g/day and 134 g/day respectively. Assuming mean per capita ingestion rates, toddlers are seen to consume 49% of the total meat intake relative to an adult receptor.
- Based on the 90th percentile per capita ingestion (g/kg bw/day) of meat, dairy and total fat in edible portions toddler and adult receptors were calculated to ingest 128 and 240 g/day respectively, with toddlers consuming 53% of the total meat intake relative to an adult receptor.

The ingestion rate for berries was scaled in a similar fashion. Per capita ingestion rates of fruit from the NHANES dataset indicate that toddlers consume fruit at a rate that is 1.7 times that of adults. The berry ingestion rate from Table 1 has been scaled accordingly, and converted to dry weight assuming moisture content of 81%. It is assumed that berries are consumed for 4 months per year.

AECOM have assumed that toddlers ingest 1/3 cup of Labrador tea daily.

Table 1. Adult Traditional Food Ingestion Rates (kg/day) and Summary Statistics Used in the Quantitative Human Health Risk Assessment

Source	Community	Fish	Game	Birds	Berries	Vegetation
Health Canada, 2010			0.27			
Richardson, 1997		0.220				
Health Canada, 2007		0.040				
Dewailly et al., 2003	Southern Québecois	0.013				
	James Bay Cree	0.060				
	Nunavik Inuit	0.131				
Godin et al., 2003	Montreal Angers	0.041				
	James Bay Anglers	0.087				
Blanchet & Rochette, 2008	Nunavik Inuit	0.055	0.053	0.028	0.014	
Batal et al., 2005	Denendeh	0.094	0.200	0.019	0.011	0.011
	Yukon	0.093	0.193	0.008	0.011	0.011
Lawn & Harvey, 2004	Kangiqsujuaq, 2002	0.053	0.005	0.054		
Lawn & Harvey, 2003	Kugaaruk,	0.990	0.041			
Lawn & Harvey, 2001	Repulse Bay 1992	0.015	0.188			
	Repulse Bay 1997	0.037	0.097			
	Pond Inlet 1992	0.024	0.241			
	Pond Inlet 1993	0.022	0.202			
	Pond Inlet 1997	0.040	0.171	0.015		
	Repulse Bay 1992	0.031	0.160	0.001		
	Repulse Bay 1997	0.043	0.096	0.000		
	Pond Inlet 1992	0.044	0.246	0.004		
	Pond Inlet 1993	0.017	0.142	0.001		
	Pond Inlet 1997	0.037	0.154	0.001		
Duhaime et al., 2002	Nunavik Inuit	0.038	0.055	0.040	0.017	
Tata Steel	LSA	0.049 [a]	0.02 [b]	0.032 [c]	0.043 [d]	
	Mean	0.095	0.141	0.017	0.019	0.011
	Median	0.042	0.157	0.011	0.014	0.011
	Min.	0.013	0.005	0.000	0.011	0.011
	Max.	0.990	0.270	0.054	**0.043**	**0.011**
	90th %ile	**0.120**	**0.243**	**0.039**	na	na

Notes:

a. . Ingestion rate (kg/day) of game fowl calculated from maximum reported ingestion rate from baseline country food survey results. Country food survey results reported as meals per month. Ingestion rate converted from meals per month to kg/day assuming 150 g/serving from Health Canada (2007) Human Health Risk Assessment of Mercury in Fish and Health Benefits of Fish Consumption. Available at: http://www.hc-sc.gc.ca/fn-an/pubs/mercur/merc_fish_poisson-eng.php#appd

b. Ingestion rate (kg/day) of game fowl calculated from maximum reported ingestion rate from baseline country food survey results. Country food survey results reported as meals per month. Conversion to kg/day assumed 0.163 kg/serving based on EPA (2011) Beef Steak Portion Size (average for men >20 years of age) from Table 11-21.

c. Ingestion rate (kg/day) of game fowl calculated from maximum reported ingestion rate from baseline country food survey results. Country food survey results reported as meals per month. Conversion to kg/day assumed 0.103 kg/serving based on EPA (2011) Chicken and Turkey Portion Size (average for men >20 years of age) from Table 11-21.

d Ingestion rate converted from cups per months (based on maximum reported consumption in the Howse - Baseline Country Food Survey) to kg/day assuming 0.1 kg berry per cup.

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B2. Literature Derived Caribou Tissue Concentrations

Appendix B2
Literature Derived Caribou Tissue Concentrations

Two Aboriginal communities, the Naskapi and the Innu, use the land in the vicinity of the Howse Property for hunting and gathering and both groups place great importance on the health of the caribou herds that visit this area. Based on the analysis conducted for the HHRA caribou tissue concentrations are not likely to be influenced to a large degree by Howse Project Property. Table 1 summarizes findings of the literature review conducted for tissue concentrations of metals in North American caribou herds. The HHRA assumed the majority of the diet to be sourced from caribou muscle tissue and the consumption of organs such as kidneys and liver to represent a small percentage of the diet. Therefore the caribou concentrations brought forward into the HHRA were based on the maximum muscle tissue concentrations of metals found in Table 1.

Table 1. Literature Based Metals Concentrations in Caribou Tissue

Source	Location	Tissue	Pb	Hg	Se	As	Fe
Elkin and Bethke 1995	Nunavut (Bathurst caribou herd)	Kidneys	0.032 (0.01)[a]	0.52 (0.04)[a]			
	Nunavut (Arviat caribou herd)	Kidneys	0.029 (0.01)[a]	2.93 (0.21)[a]			
	Nunavut (Southampton Island caribou herd)	Kidneys	0.0957 (0.02)[a]	2.22 (0.13)[a]			
	Nunavut (Cape Dorset caribou herd)	Kidneys	0.1218 (0.02)[a]	1.25 (0.05)[a]			
	Nunavut (Lake Harbour caribou herd)	Kidneys	0.1363 (0.03)[a]	2.56 (0.25)[a]			
Larter and Nagy 2000	Northwest Territories (Banks Island Peary caribou)	Kidneys	0.2842 (0.18)[a]	1.5747 (0.09)[a]			
	Northwest Territories (Bluenose caribou herd)	Kidneys	0.0609 (0)[a]	3.0305 (0.25)[a]			
Robillard et al. 2002	Northern Quebec (Leaf River Region)	Muscle	0.033 (0.16)[b]	**0.027** (0.01)[b]			
		Kidneys	0.28 (0.09)[b]	1.39 (0.91)[b]			
		Liver	0.89 (0.57)[b]	0.7 (0.41)[b]			
	Northern Quebec (George River - Torngat Mountains Region)	Muscle	0.014 (0.02)[b]	0.019 (0.01)[b]			
		Kidneys	0.2 (0.05)[b]	0.56 (0.19)[b]			
		Liver	0.89 (0.53)[b]	0.38 (0.15)[b]			
O-Hare et al. 2003	Northern Alaska (Point Hope and Cape Thompson)	Liver	0.32 (0.2)[b]			0.07 (0.09)[b]	243.34 (246.04)[b]
	Northern Alaska (Point Hope and Cape Thompson)	Kidneys	0.76 (4.55)[b]			0.12 (0.19)[b]	51.77 (95.87)[b]
	Northern Alaska (Point Hope and Cape Thompson)	Muscle	**0.14** (0.14)[b]			**0.06** (0.06)[b]	**27.55** (62.81)[b]
Aastrup et al. 2000	Greenland (Kangerlussuaq, Akia)	Muscle	0.0045 (0.001)[b]	0.0135 (0.01)[b]	**0.0935** (0.068)[b]		
	Greenland (Kangerlussuaq, Akia)	Liver	0.4255 (0.39)[b]	0.1225 (0.1)[b]	0.21825 (0.16)[b]		
Pollock et al. 2009	Labrador (George River caribou herd)	Kidneys	0.09 (0.06-0.13)[c]	0.66 (0.58-0.75)[c]	1.2 (0.9-1.5)[c]		

Source	Location	Tissue	Pb	Hg	Se	As	Fe
Schuster et al. 2011	Old Crow, Yukon (Porcupine caribou herd)	Muscle		0.003 (0.002)[b]			
		Kidneys		0.36 (0.12)[b]			
		Liver		0.12 (0.07)[b]			

Notes:

a = Standard Error

b= Standard Deviation

c = 95% Confidence Interval

References

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B3. Deterministic Air Particulates (PM_{10}) Estimates

Appendix B3
Deterministic Air Particulates (PM_{10}) Estimates

The predicted intake of contaminants via the halation of fugitive particulates in HHRA is calculated using the standard human exposure equation:

$$Dose_{Particulates} = \frac{C_{particulate} \times P_{Air} \times RAF_{Inh.} \times ET}{BW}$$

which incorporates a measure of the concertation of contaminants (expressed as mg/kg) associated with the particulates of interest ($C_{particulate}$); the concentration of particulate matter (in this case PM10 expressed as kg/m^3) in a volume of air (P_{Air}); the relative absorption factor of inhaled contaminants ($RAF_{Inh.}$), an exposure term (ET), and body weight (BW in kg).

The air particulate concentrations (P_{Air}) selected for the deterministic HHRA are single point estimates. In order to calculate a reasonable upper bound for particulate concentrations within the LSA the predicted maximum 24 hour PM10 concentrations for critical air modeling receptors and off property maximum grid receptors were compiled from the air quality technical report for blast and no-blast conditions under both project and cumulative scenarios.

The deterministic PM10 concentration for project and cumulative scenarios was calculated independently as the blended concentration using the 90^{th} percentile PM_{10} concentration for blast and no-blast conditions assuming blasting occurs one day per week (1/7 = 0.14) as follows:

$$P_{Air} = \left((90th\ \%ile\ PM10_{Blast}\ \times\ (0.14)) + (90th\ \%ile\ \mathrm{PM}_{10_{\mathrm{No\ Blast}}} \times (0.86)\ ) \right)$$

Where:

PAir	=	Reasonable upper bound point estimate of PM10 concentration in air (kg/m^3)
90th %ile $PM_{10\ (Blast)}$	=	Concentration of particulate matter less than 10 µm, in the Blast scenario (kg/m^3)
90th %ile $PM_{10\ (No\ Blast)}$	=	Concentration of Particulate matter less than 10 µm, in the No Blast scenario (kg/m^3)

Cumulative distributions and 90^{th} percentile PM10 concentrations for the blast and no-blast conditions under the project and cumulative scenarios are presented in Figures 1 through 2.

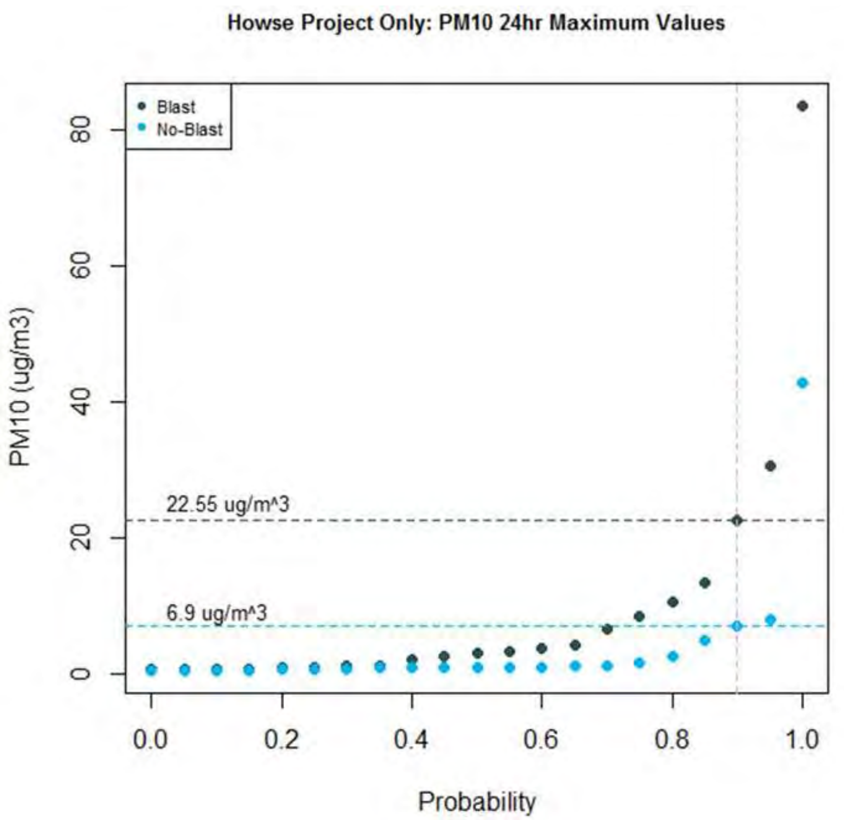

Figure 1. Probability Distribution for PM_{10} under Blast and No-blast Conditions in the Project Scenario

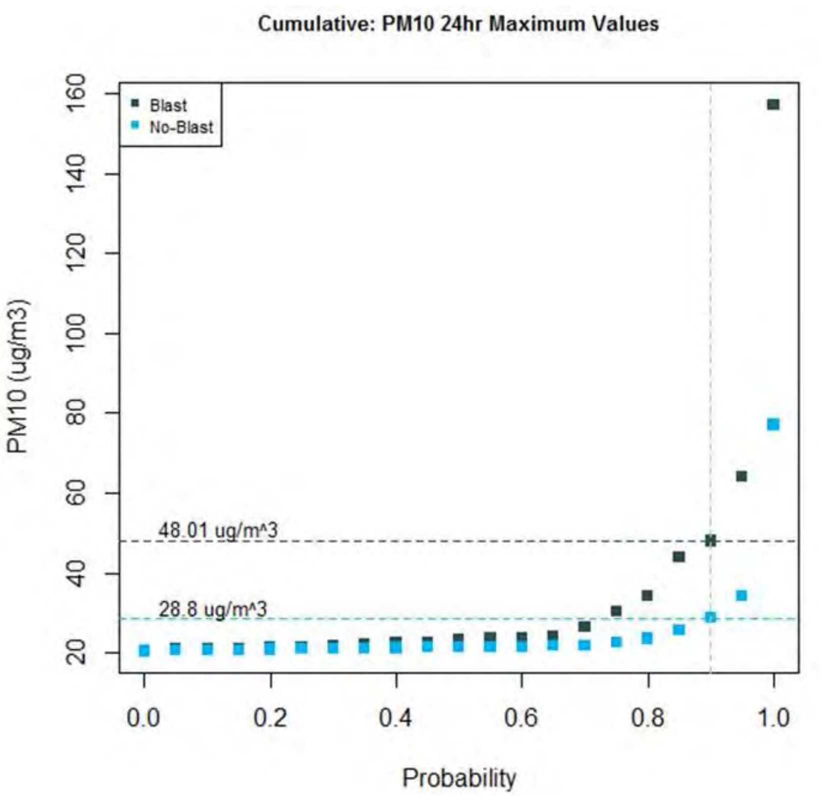

Figure 2. Probability Distribution for PM_{10} under Blast and No-blast Conditions in the Cumulative Scenario

Appendix C

Toxicity Reference Value Summary

Appendix C
Toxicity Reference Value Summary

1. Human Toxicity Reference Values

In accordance CEAA, human health toxicological reference values (TRVs) have been selected primarily from Health Canada (2010). However, in the absence of Health Canada numbers TRVs will be selected from US EPA IRIS. The following brief discussion of the carcinogenic classifications and threshold toxicological effects is required to provide sufficient rationale for the selection of TRVs and method of assessing risk characterization. Individual metal toxicants (Section 1.1) and the inhalation risks from volatile organic carbons (Section 1.2) are discussed separately.

1.1 Metals

Arsenic

Arsenic is a known human carcinogen by both the inhalation and oral exposure routes (CCME 2001, ATSDR 2007a). Increased rates of lung cancer, respiratory irritation, nausea, skin effects, and neurological effects have been reported following inhalation exposure (ATSDR 2007a). Increased lung cancer mortality was observed in multiple human populations (primarily smelter workers) exposed primarily through inhalation. Also, increased mortality from multiple internal organ cancers (liver, kidney, lung, and bladder) and an increased incidence of skin cancer were observed in populations consuming drinking water high in inorganic arsenic. The following non-carcinogenic TRV's were identified for this study:

- Health Canada (2010b) provides oral and inhalation cancer slope factors for arsenic of **1.80** and **27 (per (mg/kg/day))** respectively.
- Health Canada does not provide a non-carcinogenic TRV whereas the US EPA recognizes arsenic as a threshold non-carcinogenic contaminant and recommends an oral RfD of **0.0003 (mg/kg/day).**

Health Canada does provide the following carcinogenic TRV's:

- Provides and oral slope factor of **1.8 mg/kg bw/day.**
- Provides an inhalation slope factor of **27 mg/kg bw/day.**
- Provides an inhalation unit risk of **6.4 mg/m^3.**

The RfD is based primarily on epidemiological studies (applicable to chronic, sub-chronic, and acute exposures) of a Taiwanese population conducted by Tseng 1977 and Tseng et al. 1968, whose drinking water contained elevated concentration of arsenic (0.4-0.6 ppm). The critical effects studied included hyperkeratosis, hyperpigmentation and possible vascular complications. The general symptoms of chronic arsenic poisoning were reported by Hindmarsh and McCurdy 1986 as are weakness, general debility and lassitude, loss of appetite and energy, loss of hair, hoarseness of the voice, loss of weight, and mental abnormalities. Following long-term exposures the most common effects observed include skin, neurological, and vascular disorders.

Following absorption arsenic is initially accumulated in the liver, kidney, lung, spleen, aorta, and skin. With the exception of the skin, clearance from these organs is rapid (ASTDR 2007). The primary target organs for oral and inhalation exposures are the nervous system, skin, cardiovascular system, blood, liver, G.I. System, respiratory system. Typical disorders caused by arsenic exposure include: hyperpigmentation, hyperkeratosis), neurotoxicity, to the central and peripheral nervous system, cardiovascular system disorders, blood disorders such as anemia, leucopenia, liver swelling, gastroenteritis, respiratory system disorders such as rhinitis, laryngitis, tracheobronchitis, pulmonary insufficiency, and nasal septum perforation.

The complex chemistry of arsenic has made it difficult to characterize from a toxicological perspective. Casarett and Doull's (1991) noted no specific interaction between arsenic and other heavy metals. Chronic exposure to arsenic results in neurotoxicity, to the central and peripheral nervous system. Tin has similar target organs/effects, however the dose required to elicit toxicity as a result of tin exposure is extremely high. The interaction between arsenic and tin has therefore been considered insignificant. Arsenic, while having effects on the liver is not recognized as a specific nephrotoxin (Casarett and Doull's, 1991).

Barium

Health Canada (2010b) provides a TDI for Barium of **0.2 mg/kg bw/day.** The USEPA classifies Barium as a Group D compound, not classifiable as to human carcinogenicity. Therefore Health Canada (2010b) does not provide a toxicity reference value for carcinogenic effects.

Human exposure primarily occurs via drinking water, food and air. Chemical related nephropathy, hypertension, reproductive effects have been identified in rat and mice studies (ATSDR 2007b). Barium toxicity depends on the type of barium compound and the solubility of that compound. The solubility of the barium compound a receptor is exposed to is an important factor affecting the potential for absorption and thus development of adverse health effects in humans. However, during dietary exposure the levels of barium absorption may be affected by concentrations of calcium and other minerals in the diet.

The RfD for barium is based primarily on a drinking water study conducted on mice that measured chemical-related nephropathy data which provided the best evidence of a dose-response relationship. The most sensitive target organ resulting from repeated ingestion of soluble barium salts appears to be the kidney. A study by NTP (1994) of chronic and sub chronic drinking water exposures to barium chloride observed mild to severe cases of renal toxicity in F-344/N rats and B6C3F1 mice following. The RfD value provided above was derived using the lower 95% confidence limit for the dose estimated to affect 5% of the population and an uncertainty factor of 300. The uncertainty factor of 300 accounts for variation in susceptibility among humans, the uncertainty associated with extrapolation from laboratory animals to humans, and the uncertainty resulting from limitations in the data base. The overall confidence in the data base used to derive the TRV is medium because it lacks human data that define an adverse effect level but contains adequate dose response information for chronic and sub chronic animal studies conducted in more than one species.

Beryllium

Health Canada (2010b) does not provide a toxicity reference value for Beryllium. The toxicity of inhaled beryllium is well-documented. The acute condition known as berylliosis is caused by inhalation of large doses of beryllium compounds (Constantinidis, 1978). This disease usually develops shortly after exposure and is characterized by rhinitis, pharyngitis, and/or tracheobronchitis, and may progress to severe pulmonary symptoms. Occupational exposure studies have identified that the disease could develop at levels ranging from approximately 2-1000 µg Be/m^3 and therefore the disease is now rarely observed in the United States because of improved industrial hygiene (Zorn et al., 1988; Kriebel et al., 1988b).

The oral toxicity of beryllium is considered to be low. A no-adverse-effect level (NOAEL) for mice was noted in a lifetime bioassay by (Schroeder and Mitchener, 1975a, 1975b) to be 5 ppm beryllium in the drinking water. The NOAEL was converted to 0.54 mg/kg bw/day to derive the USEPA's chronic oral RfD for beryllium of 0.005 mg/kg/day (U.S. EPA, 1991).

Based on sufficient evidence for animals (lung cancer in monkeys and lung tumours in rats) and inadequate evidence for humans exposed to airborne beryllium (lung cancer), beryllium has been classified by the USEPA as (B2) a probable human carcinogen (U.S. EPA, 1991). The USEPA's non threshold TRV's include:

- The unit risk value for inhalation exposure is **0.0024 µg/m^3**
- The inhalation slope factor is **8.4 mg/kg bw/day**
- The unit risk value for oral exposure is **0.00012 µg/L**
- The oral slope factor is **4.3 mg/kg bw/day**

Chromium

Health Canada (2010b) provides a TDI for chromium of **0.001 mg/kg bw/day.** Health Canada has determined that studies conducted on inhalation exposure to chromium and certain chromium compounds provide sufficient evidence for carcinogenicity in humans and animals which includes the following carcinogenic TRV's:

- An inhalation slope factor of **46 mg/kg bw/day**
- Provides an inhalation unit risk of **11 mg/m^3**

Chromium (III) is considered an essential element and therefore trivalent chromium is considered non-toxic. The known harmful effects of chromium to humans are attributed primarily to the hexavalent form which leads to critical health effects such as hepatotoxicity, gastrointestinal irritation or corrosion, and encephalitis. The Health Canada's oral TRV's is based on a weight of evidence approach from drinking water studies of hexavalent chromium ingestion that did not use uncertainty factors. The inhalation cancer slope factor provided by Health Canada was based on a tolerable concentration derived from human epidemiological studies focused on chronic occupational exposure to chromium. The duration of the studies used to derive the inhalation unit risk were reportedly in the range of one to eight years.

Iron

Health Canada does not provide a TRV for iron. The USEPA does not provide an inhalation RfC for iron. Iron is considered an essential trace element; it is an important component of several proteins including enzymes, hemoglobin, and the myoglobin of muscle tissue and in enzymes necessary for oxidative metabolism. Acute iron toxicity effects are well documented, but it is difficult to obtain acute oral toxic doses because they are generally estimated from clinical history in overdose situations. The symptoms of acute iron toxicity include cardiovascular, metabolic, neurological and hepatic alterations as well as gastrointestinal distress. There has been no association between adverse developmental effects and the ingestion of supplemental iron intake during pregnancy. Chronic toxicity of iron has been observed in people with disorders that result in excessive iron absorption, hemoglobin synthesis abnormalities, anemia or frequent blood transfusions.

The USEPA PPTRV does provide an **RfD of 0.7 mg/kg-day** in their Regional Screening Level Summary Table (June, 2015). This value was determined based on a Tolerable Upper Intake Level (UL) for iron of 45 mg Fe/d which is based on gastrointestinal distress as an endpoint in Swedish males and females who were taking an iron supplement (US NAS 2002). The study identified a LOAEL of 60 mg/kg but no NOAEL. A LOAEL of total iron intake (the iron supplement and other sources including diet) was calculated by adding the LOAEL determined in the Swedish study (60 mg/d) to the estimated daily intake of iron from food for Scandinavian men and women (11 mg/d), resulting in a LOAEL of 70 mg/d. This evaluation used an uncertainty factor of 1.5 for extrapolation from a LOAEL to a NOAEL resulting in an upper intake level of 45 mg/d. With an assumed body weight of 70 kg an RfD of 0.64 mg/kg/d was calculated. The resulting US EPA PPTRV was set at 0.7 mg/kg/d.

No classification of iron carcinogenicity could be identified for Health Canada or the USEPA.

Lead

Neither Health Canada nor the US EPA provides TRVs for lead. AECOM has elected to assess inorganic lead based on Wilson and Richardson's (2012) "TDI-equivalent" TRV of **0.0013 mg/kg bw/day**. Wilson and Richardson's TDI-equivalent is based on the observation that a daily lead intake circa 1.3 µg/kg BW/day would be associated with a corresponding 1 mmHg increase in systolic blood pressure, the critical effect in adult receptors. This value is also protective of neurotoxic effects in children as it represents a correlative dose for lead in which is predicted to elicit a blood lead concentration of ~1.4 µg/dL, which is the endpoint used to derive CCME Soils Quality Guidelines for lead protective of human health.

The use of Wilson and Richardson's (2012) TDI-equivalent is further supported by its use in developing the current Director's Interim Standards in British Columbia: Industrial Land Use, Human Health Protection – Intake of Contaminated Soil Standard for Lead, and subsequent adoption following BC CSR Stage 9 Amendments to the Contaminated Sites Regulation (dated January 30, 2014).

Molybdenum

Health Canada (2010b) does not provide a toxicity reference value for carcinogenic effects. The US EPA classification for Molybdenum carcinogenicity is (D) "not classifiable as to carcinogenicity in human" on the basis that existing studies are inadequate to assess the carcinogenicity of molybdenum or molybdenum compounds. The chronic oral Reference Dose (RfD) for molybdenum and molybdenum compounds is **0.005 mg/kg/day**, based on biochemical indices in humans (U.S. EPA IRIS).

Molybdenum is considered an essential trace element. Molybdenum is an important component of the flavoprotein xanthine oxidase, an enzyme involved in the breakdown of purines to uric acid. Increased serum ceruloplasmin and urinary excretion of copper observed associated with increased molybdenum exposure in human studies indicates that high levels of ingested molybdenum may be associated with potential mineral imbalance (EPA IRIS). Excretion of sufficient quantities of this element may put individuals at risk for the hypochromic microcytic anemia associated with a dietary copper deficiency.

AECOM have assessed molybdenum independently for threshold non-carcinogenic risks only. Considering the absence of evidence for direct injury to obvious target organs/tissues, and molybdenum's antagonistic relationship with copper no assumption of additivity has been made (Casarett and Doull's, 1991).

Manganese

Manganese is considered an essential trace element but Health Canada (2010b) does not consider it to be carcinogenic to humans. However, exposure to elevated concentrations of manganese has been linked with a Parkinson-like neurotoxicity. Health Canada (2010b) provides life stage/body weight specific TRV's for infants to adults based on a Tolerable Daily Intake value derived from human epidemiological studies on food and water ingestion. The following TRV values were selected by AECOM for the risk assessment:

- Adults (0.156 mg/kg/day)

The TRV for manganese was derived using the weight of evidence from human epidemiological and experimental studies. A No Observable Adverse Effects Level (NOAEL) for food ingestion of 11 mg/kg per day was derived in response to parkinsonian-like neurotoxicity and no uncertainty factors were employed for this human test. Age and weight specific TRV's were derived using adjustments to the calculated tolerable upper limits based on life stage and body weight.

Mercury

Health Canada defines a threshold oral TDI for inorganic mercury of **0.0003 mg/kg/day**. This value is based on more than one rat study of oral and subcutaneous exposures looking at nephrotoxicity that indicated a lowest observable adverse effects limit (LOAEL) of 0.3 mg Hg/kg body weight per day. This value had an uncertainty factor of 1000 applied (10 times for use of sub chronic studies, 10 times for interspecies variability, and 10 times for using the LOAEL).

Selenium

Selenium is considered an essential trace element but Health Canada (2010b) does not consider it to be carcinogenic to humans and the USEPA considers it unclassifiable as to human carcinogenicity. Health Canada (2010b) provides life stage/body weight specific TRV's for infants to adults based on a NOAEL value derived from epidemiological studies on diet for infants and children. The adult TRV value for arsenic selected by AECOM for the risk assessment was **0.0057 mg/kg/day.**

The adult TDI provided by Health Canada for selenium is based on biochemical alterations associated with clinical selenosis (EPA IRIS). This is based on epidemiological studies by Yang and Zhou, 1994 and Shearer and Hadjimarkos, 1975. These human dietary studies indicated a NOAEL for adults of 800 µg/day with and uncertainty factor of 2. The NOAEL of 7 µg/kg-d that was derived for children was derived without the use of uncertainty factors. Common clinical and biochemical signs of selenium intoxication included the characteristic "garlic odor" of excess selenium excretion in the breath and urine, thickened and brittle nails, hair and nail loss, lowered hemoglobin levels, mottled teeth, skin lesions and CNS abnormalities.

Health Canada (2010b) does not provide a slope factor for carcinogenic effects. The US EPA classification for selenium carcinogenicity is (D) “not classifiable as to carcinogenicity in humans” based on inadequate human data and inadequate evidence of carcinogenicity in animals.

AECOM have assessed selenium for threshold non-carcinogenic risks only. Selenium forms many insoluble complexes with silver, copper, cadmium and mercury (Casarett and Doull's, 1991). The mechanisms for these interactions are only partially understood, and an assumption of additivity would not be based on verified toxicological understanding. AECOM have therefore assessed selenium independently, with no assumed additivity with other COCs.

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Appendix D

Specific Numerical Modeling

- D1: Soil Deposition and Food Web Modeling
- D2: GoldSim® Multimedia Exposure Model

D1. Soil Deposition and Food Web Modeling

Appendix D1
Soil Deposition and Food Web Modeling

1. Soil Deposition Model

Fugitive dust has been identified as the priority uncontrolled release related to mineral resource extraction activities. Deposition of particulate matter over the lifespan of the proposed project is expected to result in an incremental increase in the concentration of particular elements in surficial soils. In order to predict doses to human receptors via direct soil ingestion, as well as through food web uptake from the soil, the concentrations of COPCs following at the conclusion of the project must be modelled.

Incremental soil concentrations were calculated using protocols provided in the Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities[1]. The incremental change in soil concentrations was calculated as follows:

$$ISC\left(\frac{mg}{kg}\right) = \frac{(Dyd) \times tD}{Zs \times BD}$$

where:
Dyd = dry deposition (mg COPC/m^2/year)
tD = deposition time (16 years)
Zs – soil mixing depth (0.02 m)
BD = bulk density (1500 kg/m^3)

Dry deposition rate for dust (mg TPM/m^2/year) was calculated for blasting and non-blasting conditions using the air dispersion modelling platform CALPUFF (refer to Air Quality Technical Report) for 40 critical receptors located within the LSA and off property grid receptors. Dust fall was multiplied by COPC concentration in dust (mg COPC/kg dust) to estimate dry deposition rate for each COPC.

Soil concentrations were estimated for blast and non-blast conditions, and a weighted average was calculated assuming one day of blasting per week (1/7 $\approx$ 0.14) throughout the year, and non-blasting conditions for the remaining 6 days per week (6/7$\approx$0.86). This is a conservative simplification of the actual operation in which weekly blasting occurs only in summer, with blasting frequency during winter months reduced to one event per month. Therefore, the incremental soil concentration is calculated as follows:

$$ISC\left(\frac{mg}{kg}\right) = \frac{[(Dyd_{Blast} \times 0.14) + (Dyd_{No-Blast} \times 0.86)] \times tD}{Zs \times BD}$$

where:
Dyd = dry deposition (mg COPC/m^2/year)
tD = deposition time (16 years)
Zs – soil mixing depth (0.02 m)
BD = bulk density (1500 kg/m^3)

The incremental soil concentration for the LSA was assumed to be the 95% Upper tolerance limit of the predicted incremental soil concentrations for the 40 critical receptors plus the off-property maximum location. A tolerance

[1] US EPA. 2005. Human health risk assessment protocol for hazardous waste combustion facilities, Chapter 5: Estimating media concentrations. Office of Solid Waste and Emergency Response. EPA530-05-006.

interval is a statistical interval within which, with some confidence level, a specified proportion of a sampled population falls. In this case ACOM have calculated a 95% Upper Tolerance Limit with 90% coverage. That is, a value which will encompass 90% of the population with 95% confidence.

Incremental soil concentrations carried forward into the HHRA for the project and cumulative scenarios are presented in Table 1. Calculated incremental soil concentrations for individual receptor locations are presented in Tables 5 and 6 (located at the back of this appendix).

Table 1. Incremental and Predicted Soil Concentrations (mg/kg) For the Project and Cumulative Scenarios

COPC	Baseline	[COPC] in TPM	Project		Cumulative	
			Incremental	Total	Incremental	Total
Arsenic	10.74	4.8E+1	0.036	10.78	0.115	10.86
Barium	49.26	5.1E+2	0.380	49.6	1.213	50.47
Beryllium	0.37	2.6E+0	0.002	0.372	0.006	0.376
Chromium	0.2	1.4E+2	0.105	0.305	0.337	0.537
Iron	49148	5.5E+5	413.4	49561.4	1319	50467
Lead	17.26	7.4E+1	0.056	17.32	0.177	17.44
Manganese	1177	1.7E+3	1.262	1178.3	4.027	1181
Mercury	0.08	7.0E-2	0.0001	0.0801	0.0002	0.0802
Molybdenum	2.24	4.3E+0	0.0032	2.24	0.0102	2.25
Selenium	0.8	8.0E-1	0.0006	0.801	0.0019	0.802

2. Food Web Modeling

The HHRA requires food web modeling of metals concentrations plant and animal tissues. The equations and detailed inputs for these calculations are provided Sections 1.1 and 1.2, respectively. The HHRA used site specific metals concentrations, However, some environmental data was limited and additional modeling of vegetation (Labrador tea and partridge berry), soil invertebrates, and fish for select metals was also required using soil concentrations and literature derived transfer factors.

2.1 Modeled Concentrations in Hare Tissue

Estimated concentrations of COPCs in the tissue of the Hare were calculated using the following equation:

$$C_{Hare} = \left(C_{\text{water}} \times IR_{\text{water}} + C_{\text{ter.veg}} \times IR_{\text{ter.veg}} + C_{\text{soil.}} \times IR_{\text{soil}}\right) \times TF$$

Where:

C_{Hare}	=	Concentration of contaminant in Hare tissue (mg/kg dw)
IR_{water}	=	Water ingestion rate (0.13 L/day)
C_{water}	=	Measured water concentration (mg/L)
IR_{tveg}	=	Ingestion rate of terrestrial vegetation (Labrador Tea) (0.078 kg dw/day)
C_{tveg}	=	Concentration of COPC in terrestrial vegetation (mg/kg dw)
IR_{soil}	=	Soil ingestion rate (0.005 kg/day)
C_{soil}	=	Soil concentration (mg/kg dw)

TF = Feed to Hare Transfer Factor (d/kg (ww)) (See Table 2)

Table 2. Feed to Hare Transfer Factors (d/kg (ww))

Element	Transfer Factor	Source
Arsenic	0.0067	Sample, B. E., et al. "Development and validation of bioaccumulation models for small mammals." Prepared for the US Department of Energy. February (1998).
Barium	0.0451	
Chromium	0.1468	
Iron	0.0121	
Lead	0.1258	
Manganese	0.0053	IAEA, E. Quantification of Radionuclide Transfer in Terrestrial and Freshwater Environments for Radiological Assessments. IAEA-TECDOC-1616, IAEA, Vienna, Austria, 2009.
Mercury	0.0731	Sample, B. E., et al. "Development and validation of bioaccumulation models for small mammals." Prepared for the US Department of Energy. February (1998).
Selenium	0.4047	Sample, B. E., et al. "Development and validation of bioaccumulation models for small mammals." Prepared for the US Department of Energy. February (1998).
Beryllium	0.001	Baes, C. F., III, et al, 1984, A Review and Analysis of Parameters for Assessing Transport of Environmentally Released Radionuclides Through Agriculture, ORNL-5786, US. Department of Energy, Oak Ridge National Laboratory, Oak Ridge, TN
Molybdenum	0.006	

2.2 Modeled Concentrations in Spruce Grouse Tissue

Estimated concentrations of COPCs in the tissue of Spruce Grouse were calculated using the following:

$$C_{grouse} = \left(C_{water} \times IR_{water} + \left[(D1 \times C_{Labtea} \times IR_{Total}) + (D2 \times C_{berry} \times IR_{Total}) + (D3 \times C_{Invert} \times IR_{Total})\right]\right) \times TF$$

Where:

C_{grouse} = Concentration of contaminant in bird flesh (mg/kg ww)
IR_{water} = Water ingestion rate (0.039 L/day)
C_{water} = Measured water concentration (mg/L)
IR_{food} = Ingestion rate of food (0.033 kg dw/day)
C_{food} = Concentration of COPC in food items (Labrador tea, partridge berry, and soil invertebrates) (mg/kg dw)
D1 = Percentage of diet consumed as Labrador tea (50%)
D2 = Percentage of diet consumed as partridge berry (30%)
D3 = Percentage of diet consumed as soil invertebrates (15%)
$TF_{feed\text{-}to\text{-}grouse}$ = Feed to grouse transfer factor (d/kg (ww)) - (See Table 3)

Table 3. Feed-to-Spruce Grouse Transfer Factors (d/kg (ww))

Element	Transfer Factor	Source
Barium	0.019	IAEA, E. Quantification of Radionuclide Transfer in Terrestrial and Freshwater Environments for Radiological Assessments. IAEA-TECDOC-1616, IAEA, Vienna, Austria, 2009.
Manganese	0.019	
Selenium	9.7	

Arsenic	0.83	Recommended Parameter Values for GENII Modeling of Radionuclides in Routine Air and Water Releases. PNNL-21950: Pacific Northwest National Laboratory, 2013.
Beryllium	0.4	
Chromium	0.2	
Iron	1	
Lead	0.8	
Mercury	0.03	
Molybdenum	0.18	

2.3 Calculation of Tissue Concentrations Using Soil and Water Transfer Factors

Additional modeling of vegetation (Labrador tea and partridge berry), soil invertebrates, and fish tissue concentrations were conducted for select metals using the following equations and transfer factors (Table 4).

$$C_{Labrador\ Tea} = \left(C_{\mathrm{Soil}} \times TF_{Veg}\right)$$

$$C_{Partridge\ Berry} = \left(C_{\mathrm{Soil}} \times TF_{berry}\right)$$

$$C_{Invertebrates} = \left(C_{\mathrm{Soil}} \times TF_{Invertebrates}\right)$$

$$C_{fish} = \left(C_{\mathrm{Water}} \times TF_{Fish}\right)$$

Where:

C_{biota}	=	Concentration of contaminant in modeled tissue (mg/kg dw)
$TF_{soil\text{-}to\text{-}tissue}$	=	Soil to terrestrial biota tissue transfer factor (Labrador tea, partridge berry, soil invertebrates)
$TF_{water\text{-}to\text{-}tissue}$	=	Water to fish tissue transfer factor

Table 4. Transfer Factors used for Estimating Tissue Concentrations in Partridge Berry, Labrador Tea, Soil Invertebrates, and Fish

Element	Transfer Factor	Source
Soil-to-Partridge Berry ((mg/kg (ww))/(mg/kg (dw))		
Arsenic	0.036	Appendix C: Screening Level Ecological Risk Assessment Protocol (SLERAP) for Hazardous Waste Combustion Facilities Source: U.S. EPA, 530-D-99-001A - August 1999
Chromium	0.0075	
Barium	0.003	U.S. NRC. Transfer Factors for Contaminant Uptake by Fruit and Nut Trees. PNNL-22975, 2013
Beryllium	0.0015	
Manganese	0.023	
Mercury	0.285	
Lead	0.015	IAEA, E. Quantification of Radionuclide Transfer in Terrestrial and Freshwater Environments for Radiological Assessments. IAEA-TECDOC-1616, IAEA, Vienna, Austria, 2009.
Molybdenum	0.5	
Selenium	0.019	
Iron	0.0035	Site specific soil to partridge berry ratio calculated from 2015 collocated soil and vegetation data.
Soil-to-Labrador Tea ((mg/kg (ww))/(mg/kg (dw))		
Arsenic	0.036	Appendix C: Screening Level Ecological Risk Assessment Protocol (SLERAP) for Hazardous Waste Combustion Facilities Source: U.S. EPA, 530-D-99-001A - August 1999
Barium	0.15	
Beryllium	0.01	
Chromium	0.0075	
Lead	0.045	
Selenium	0.016	
Iron	0.0013	IAEA, E. Quantification of Radionuclide Transfer in Terrestrial and Freshwater Environments for Radiological Assessments. IAEA-TECDOC-1616, IAEA, Vienna, Austria, 2009.
Manganese	0.41	
Molybdenum	0.58	
Mercury	0.85	Recommended Parameter Values for GENII Modeling of Radionuclides in Routine Air and Water Releases. PNNL-21950: Pacific Northwest National Laboratory, 2013.
Soil-to-Soil Invertebrates ((mg/kg (ww))/(mg/kg (dw))		
Arsenic	0.11	Appendix C: Screening Level Ecological Risk Assessment Protocol (SLERAP) for Hazardous Waste Combustion Facilities Source: U.S. EPA, 530-D-99-001A - August 1999.
Barium	0.22	
Beryllium	0.22	
Chromium	0.01	
Lead	0.03	
Selenium	0.22	
Iron	0.22	Recommended Parameter Values for GENII Modeling of Radionuclides in Routine Air and Water Releases. PNNL-21950: Pacific Northwest National Laboratory, 2013.
Manganese	0.22	
Molybdenum	0.22	
Mercury	0.22	
Water-to-Fish ((mg/kg (ww))/(mg/L))		
Beryllium	10	Appendix C: Screening Level Ecological Risk Assessment Protocol (SLERAP) for Hazardous Waste Combustion Facilities Source: U.S. EPA, 530-D-99-001A - August 1999.
Chromium	4	
Molybdenum	10	A Compendium of Transfer Factors for Agricultural and Animal Products. PNNL-13421: Pacific Northwest National Laboratory, 2003.

Table 5: Incremental Soil Concentrations (mg/kg soil) for 'Howse Only' Scenario

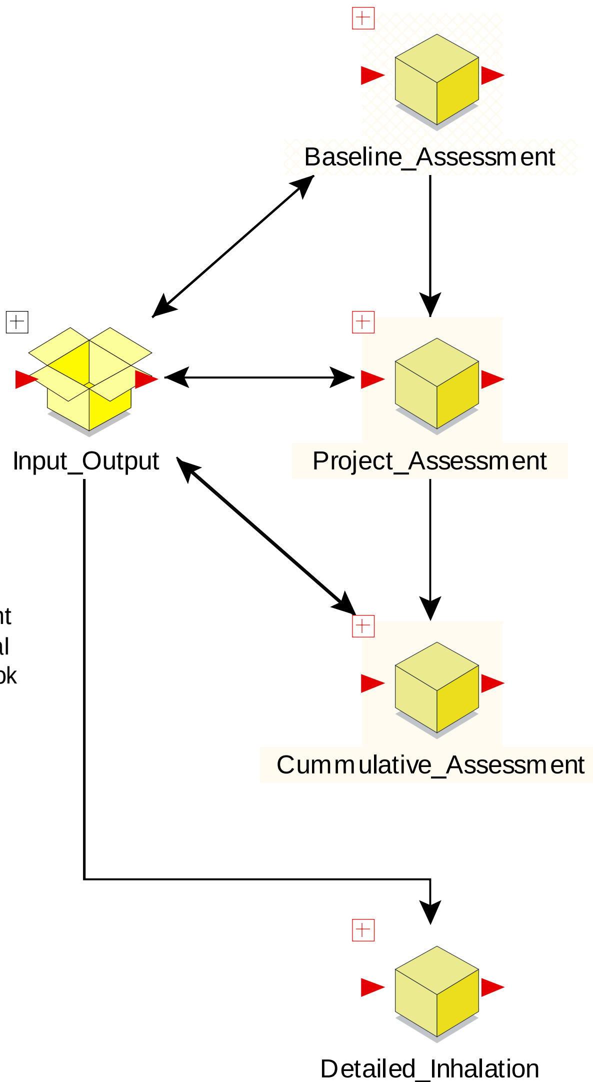
Receptor ID	Location	Dustfall (mg/m2.year)		Arsenic (As) 48.08 (mg/kg dust)			Barium (Ba) 508.72 (mg/kg dust)			Beryllium (Be) 2.62 (mg/kg dust)			Chromium (Cr) 141.16 (mg/kg dust)			Iron (Fe) 553329.46 (mg/kg dust)			Lead (Pb) 74.31 (mg/kg dust)			Manganese (Mn) 1689 (mg/kg dust)			Mercury (Hg) 0.07 (mg/kg dust)			Molybdenum (Mo) 4.28 (mg/kg dust)			Selenium (Se) 0.8 (mg/kg dust)		
		Blast	No-Balst	Blast Dyd	No-Blast Dyd	Total	Blast Dyd	No-Blast Dyd	Total	Blast Dyd	No-Blast Dyd	Total	Blast Dyd	No-Blast Dyd	Total	Blast Dyd	No-Blast Dyd	Total	Blast Dyd	No-Blast Dyd	Total	Blast Dyd	No-Blast Dyd	Total	Blast Dyd	No-Blast Dyd	Total	Blast Dyd	No-Blast Dyd	Total	Blast Dyd	No-Blast Dyd	Total
1	Young Naskapi Camp	92.4	68.6	0.0024	0.0018	0.00185	0.025	0.019	0.020	1.3E-04	9.6E-05	1.0E-04	0.0069541	0.0051619	0.0054307	51.1	20.2	21.3	0.0036608	0.0027173	0.0028588	0.083	0.062	0.065	3.4E-06	2.6E-06	2.7E-06	2.1E-04	1.6E-04	1.6E-04	3.9E-05	2.9E-05	3.1E-05
2	Young Naskapi Camp	88.5	66.0	0.0023	0.0017	0.00178	0.024	0.018	0.019	1.2E-04	9.2E-05	9.7E-05	0.0066652	0.0049708	0.0052249	49.0	19.5	20.5	0.0035087	0.0026167	0.0027505	0.080	0.059	0.063	3.3E-06	2.5E-06	2.6E-06	2.0E-04	1.5E-04	1.6E-04	3.8E-05	2.8E-05	3.0E-05
3	Innu Camp	102.5	76.2	0.0026	0.0020	0.00205	0.028	0.021	0.022	1.4E-04	1.1E-04	1.1E-04	0.00772	0.0057333	0.0060313	56.7	22.5	23.6	0.004064	0.0030182	0.003175	0.092	0.069	0.072	3.8E-06	2.8E-06	3.0E-06	2.3E-04	1.7E-04	1.8E-04	4.4E-05	3.2E-05	3.4E-05
4	Innu Camp	93.4	74.3	0.0024	0.0019	0.00198	0.025	0.020	0.021	1.3E-04	1.0E-04	1.1E-04	0.007028	0.0055925	0.0058079	51.7	21.9	22.8	0.0036997	0.002944	0.0030574	0.084	0.067	0.069	3.5E-06	2.8E-06	2.9E-06	2.1E-04	1.7E-04	1.8E-04	4.0E-05	3.2E-05	3.3E-05
5	Innu Camp	69.8	56.4	0.0018	0.0014	0.00150	0.019	0.015	0.016	9.7E-05	7.9E-05	8.1E-05	0.0052571	0.0042424	0.0043946	38.6	16.6	17.2	0.0027674	0.0022333	0.0023134	0.063	0.051	0.053	2.6E-06	2.1E-06	2.2E-06	1.6E-04	1.3E-04	1.3E-04	3.0E-05	2.4E-05	2.5E-05
6	Innu Camp	72.0	54.3	0.0018	0.0014	0.00146	0.020	0.015	0.015	1.0E-04	7.6E-05	7.9E-05	0.0054202	0.0040878	0.0042877	39.8	16.0	16.8	0.0028533	0.0021519	0.0022571	0.065	0.049	0.051	2.7E-06	2.0E-06	2.1E-06	1.6E-04	1.2E-04	1.3E-04	3.1E-05	2.3E-05	2.4E-05
7	Innu Tent	106.3	81.8	0.0027	0.0021	0.00219	0.029	0.022	0.023	1.5E-04	1.1E-04	1.2E-04	0.0080016	0.0061559	0.0064328	58.8	24.1	25.2	0.0042122	0.0032406	0.0033864	0.096	0.074	0.077	4.0E-06	3.1E-06	3.2E-06	2.4E-04	1.9E-04	2.0E-04	4.5E-05	3.5E-05	3.6E-05
8	Innu Tent	44.2	34.6	0.0011	0.0009	0.00092	0.012	0.009	0.010	6.2E-05	4.8E-05	5.0E-05	0.003329	0.0026016	0.0027107	24.5	10.2	10.6	0.0017525	0.0013695	0.001427	0.040	0.031	0.032	1.7E-06	1.3E-06	1.3E-06	1.0E-04	7.9E-05	8.2E-05	1.9E-05	1.5E-05	1.5E-05
9	Young Naskapi Camp (Pinette Lake)	831.1	669.2	0.0213	0.0172	0.01778	0.225	0.182	0.188	1.2E-03	9.3E-04	9.7E-04	0.0625683	0.0503818	0.0522098	459.9	197.5	204.7	0.0329373	0.0265221	0.0274844	0.749	0.603	0.625	3.1E-05	2.5E-05	2.6E-05	1.9E-03	1.5E-03	1.6E-03	3.5E-04	2.9E-04	3.0E-04
10	Young Naskapi Camp	679.6	506.7	0.0174	0.0130	0.01366	0.184	0.137	0.145	9.5E-04	7.1E-04	7.4E-04	0.0511629	0.0381431	0.040096	376.0	149.5	157.2	0.0269333	0.0200794	0.0211074	0.612	0.456	0.480	2.5E-05	1.9E-05	2.0E-05	1.6E-03	1.2E-03	1.2E-03	2.9E-04	2.2E-04	2.3E-04
11	Young Naskapi Trailer tent (Triangle Lake)	477.6	369.4	0.0122	0.0095	0.00989	0.130	0.100	0.105	6.7E-04	5.2E-04	5.4E-04	0.0359541	0.0278084	0.0290302	264.3	109.0	113.8	0.018927	0.014639	0.0152822	0.430	0.333	0.347	1.8E-05	1.4E-05	1.4E-05	1.1E-03	8.4E-04	8.8E-04	2.0E-04	1.6E-04	1.6E-04
12	Young Naskapi Camp	277.4	249.3	0.0071	0.0064	0.00650	0.075	0.068	0.069	3.9E-04	3.5E-04	3.5E-04	0.0208847	0.0187714	0.0190884	153.5	73.6	74.8	0.0109942	0.0098817	0.0100486	0.250	0.225	0.228	1.0E-05	9.3E-06	9.5E-06	6.3E-04	5.7E-04	5.8E-04	1.2E-04	1.1E-04	1.1E-04
13	Uashat people's camp 2	505.5	392.1	0.0130	0.0101	0.01049	0.137	0.106	0.111	7.1E-04	5.5E-04	5.7E-04	0.0380552	0.0295202	0.0308004	279.7	115.7	120.7	0.0200331	0.0155401	0.016214	0.455	0.353	0.369	1.9E-05	1.5E-05	1.5E-05	1.2E-03	9.0E-04	9.3E-04	2.2E-04	1.7E-04	1.7E-04
14	Young Naskapi Camp	31.7	25.8	0.0008	0.0007	0.00068	0.009	0.007	0.007	4.4E-05	3.6E-05	3.7E-05	0.0023855	0.0019428	0.0020092	17.5	7.6	7.9	0.0012558	0.0010227	0.0010577	0.029	0.023	0.024	1.2E-06	9.6E-07	1.0E-06	7.2E-05	5.9E-05	6.1E-05	1.4E-05	1.1E-05	1.1E-05
15	Young Naskapi Camp (Howells River)	67.5	61.7	0.0017	0.0016	0.00160	0.018	0.017	0.017	9.4E-05	8.6E-05	8.7E-05	0.0050793	0.0046424	0.0047079	37.3	18.2	18.5	0.0026738	0.0024439	0.0024784	0.061	0.056	0.056	2.5E-06	2.3E-06	2.3E-06	1.5E-04	1.4E-04	1.4E-04	2.9E-05	2.6E-05	2.7E-05
16	Uashat - Mani-Utenam Camp	353.0	300.6	0.0090	0.0077	0.00791	0.096	0.082	0.084	4.9E-04	4.2E-04	4.3E-04	0.0265715	0.0226313	0.0232223	195.3	88.7	91.0	0.0139878	0.0119136	0.0122248	0.318	0.271	0.278	1.3E-05	1.1E-05	1.2E-05	8.1E-04	6.9E-04	7.0E-04	1.5E-04	1.3E-04	1.3E-04
17	Uashat - Mani-Utenam Camp	190.2	149.7	0.0049	0.0038	0.00399	0.052	0.041	0.042	2.7E-04	2.1E-04	2.2E-04	0.0143194	0.011271	0.0117283	105.2	44.2	46.0	0.0075381	0.0059333	0.006174	0.171	0.135	0.140	7.1E-06	5.6E-06	5.8E-06	4.3E-04	3.4E-04	3.6E-04	8.1E-05	6.4E-05	6.6E-05
18	Uashat - Mani-Utenam Camp (Inukshuk Lake)	699.9	669.2	0.0179	0.0172	0.01728	0.190	0.182	0.183	9.8E-04	9.3E-04	9.4E-04	0.0526895	0.0503794	0.0507259	387.3	197.5	198.8	0.0277369	0.0265208	0.0267033	0.630	0.603	0.607	2.6E-05	2.5E-05	2.5E-05	1.6E-03	1.5E-03	1.5E-03	3.0E-04	2.9E-04	2.9E-04
19	Naskapi Cabin	47.4	40.4	0.0012	0.0010	0.00106	0.013	0.011	0.011	6.6E-05	5.6E-05	5.8E-05	0.0035714	0.0030437	0.0031228	26.2	11.9	12.2	0.0018801	0.0016022	0.0016439	0.043	0.036	0.037	1.8E-06	1.5E-06	1.5E-06	1.1E-04	9.2E-05	9.5E-05	2.0E-05	1.7E-05	1.8E-05
20	Naskapi Cabin	57.5	48.6	0.0015	0.0012	0.00128	0.016	0.013	0.014	8.0E-05	6.8E-05	7.0E-05	0.0043304	0.0036576	0.0037585	31.8	14.3	14.7	0.0022796	0.0019254	0.0019786	0.052	0.044	0.045	2.1E-06	1.8E-06	1.9E-06	1.3E-04	1.1E-04	1.1E-04	2.5E-05	2.1E-05	2.1E-05
21	Bustard - Observation and hunting site	37.5	32.2	0.0010	0.0008	0.00085	0.010	0.009	0.009	5.2E-05	4.5E-05	4.6E-05	0.0028207	0.0024264	0.0024855	20.7	9.5	9.7	0.0014849	0.0012773	0.0013084	0.034	0.029	0.030	1.4E-06	1.2E-06	1.2E-06	8.6E-05	7.4E-05	7.5E-05	1.6E-05	1.4E-05	1.4E-05
22	Bustard - Observation and hunting site	89.5	66.3	0.0023	0.0017	0.00179	0.024	0.018	0.019	1.2E-04	9.2E-05	9.7E-05	0.0067347	0.004989	0.0052509	49.5	19.6	20.6	0.0035453	0.0026263	0.0027642	0.081	0.060	0.063	3.3E-06	2.5E-06	2.6E-06	2.0E-04	1.5E-04	1.6E-04	3.8E-05	2.8E-05	3.0E-05
23	Picking site (berries / tea)	239.2	204.0	0.0061	0.0052	0.00537	0.065	0.055	0.057	3.3E-04	2.8E-04	2.9E-04	0.0180108	0.0153574	0.0157554	132.4	60.2	61.8	0.0094813	0.0080845	0.008294	0.216	0.184	0.189	8.9E-06	7.6E-06	7.8E-06	5.5E-04	4.7E-04	4.8E-04	1.0E-04	8.7E-05	8.9E-05
24	Irony Mountain	395.5	319.8	0.0101	0.0082	0.00849	0.107	0.087	0.090	5.5E-04	4.5E-04	4.6E-04	0.0297742	0.0240739	0.0249289	218.8	94.4	97.7	0.0156738	0.012673	0.0131231	0.356	0.288	0.298	1.5E-05	1.2E-05	1.2E-05	9.0E-04	7.3E-04	7.6E-04	1.7E-04	1.4E-04	1.4E-04
25	Innu Cabin	47.3	41.4	0.0012	0.0011	0.00108	0.013	0.011	0.011	6.6E-05	5.8E-05	5.9E-05	0.0035577	0.0031175	0.0031835	26.1	12.2	12.5	0.0018728	0.0016411	0.0016759	0.043	0.037	0.038	1.8E-06	1.5E-06	1.6E-06	1.1E-04	9.5E-05	9.7E-05	2.0E-05	1.8E-05	1.8E-05
26	Innu Cabin	39.3	33.5	0.0010	0.0009	0.00088	0.011	0.009	0.009	5.5E-05	4.7E-05	4.8E-05	0.0029563	0.0025249	0.0025896	21.7	9.9	10.2	0.0015563	0.0013292	0.0013632	0.035	0.030	0.031	1.5E-06	1.3E-06	1.3E-06	9.0E-05	7.7E-05	7.9E-05	1.7E-05	1.4E-05	1.5E-05
27	Innu Cabin	33.9	28.1	0.0009	0.0007	0.00074	0.009	0.008	0.008	4.7E-05	3.9E-05	4.0E-05	0.002551	0.0021128	0.0021785	18.7	8.3	8.5	0.0013429	0.0011122	0.0011468	0.031	0.025	0.026	1.3E-06	1.0E-06	1.1E-06	7.7E-05	6.4E-05	6.6E-05	1.4E-05	1.2E-05	1.2E-05
28	Innu Cabin	31.1	24.7	0.0008	0.0006	0.00066	0.008	0.007	0.007	4.3E-05	3.4E-05	3.6E-05	0.0023417	0.0018579	0.0019305	17.2	7.3	7.6	0.0012327	0.0009781	0.0010163	0.028	0.022	0.023	1.2E-06	9.2E-07	9.6E-07	7.1E-05	5.6E-05	5.9E-05	1.3E-05	1.1E-05	1.1E-05
29	Innu Cabin	33.8	26.5	0.0009	0.0007	0.00071	0.009	0.007	0.007	4.7E-05	3.7E-05	3.8E-05	0.0025479	0.0019919	0.0020753	18.7	7.8	8.1	0.0013413	0.0010486	0.0010925	0.030	0.024	0.025	1.3E-06	9.9E-07	1.0E-06	7.7E-05	6.0E-05	6.3E-05	1.4E-05	1.1E-05	1.2E-05
30	Innu Cabin	28.7	22.2	0.0007	0.0006	0.00059	0.008	0.006	0.006	4.0E-05	3.1E-05	3.2E-05	0.0021576	0.0016713	0.0017442	15.9	6.6	6.8	0.0011358	0.0008798	0.0009182	0.026	0.020	0.021	1.1E-06	8.3E-07	8.6E-07	6.5E-05	5.1E-05	5.3E-05	1.2E-05	9.5E-06	9.9E-06
31	Innu Cabin	33.4	27.1	0.0009	0.0007	0.00072	0.009	0.007	0.008	4.7E-05	3.8E-05	3.9E-05	0.0025145	0.0020402	0.0021113	18.5	8.0	8.3	0.0013237	0.001074	0.0011115	0.030	0.024	0.025	1.2E-06	1.0E-06	1.0E-06	7.6E-05	6.2E-05	6.4E-05	1.4E-05	1.2E-05	1.2E-05
32	Innu Cabin	24.6	21.7	0.0006	0.0006	0.00057	0.007	0.006	0.006	3.4E-05	3.0E-05	3.1E-05	0.001853	0.0016342	0.0016671	13.6	6.4	6.5	0.0009755	0.0008603	0.0008776	0.022	0.020	0.020	9.2E-07	8.1E-07	8.3E-07	5.6E-05	5.0E-05	5.1E-05	1.1E-05	9.3E-06	9.4E-06
33	Naskapi Cabin	56.8	44.5	0.0015	0.0011	0.00119	0.015	0.012	0.013	7.9E-05	6.2E-05	6.5E-05	0.004273	0.0033509	0.0034892	31.4	13.1	13.7	0.0022494	0.001764	0.0018368	0.051	0.040	0.042	2.1E-06	1.7E-06	1.7E-06	1.3E-04	1.0E-04	1.1E-04	2.4E-05	1.9E-05	2.0E-05
34	Naskapi Cabin	109.0	85.0	0.0028	0.0022	0.00227	0.030	0.023	0.024	1.5E-04	1.2E-04	1.2E-04	0.0082032	0.0063983	0.0066691	60.3	25.1	26.1	0.0043183	0.0033682	0.0035107	0.098	0.077	0.080	4.1E-06	3.2E-06	3.3E-06	2.5E-04	1.9E-04	2.0E-04	4.6E-05	3.6E-05	3.8E-05
35	Naskapi Cabin	77.4	55.5	0.0020	0.0014	0.00151	0.021	0.015	0.016	1.1E-04	7.7E-05	8.2E-05	0.0058278	0.0041778	0.0044253	42.8	16.4	17.3	0.0030679	0.0021993	0.0023296	0.070	0.050	0.053	2.9E-06	2.1E-06	2.2E-06	1.8E-04	1.3E-04	1.3E-04	3.3E-05	2.4E-05	2.5E-05
36	Kawawachikamak (Town)	7.8	6.6	0.0002	0.0002	0.00017	0.002	0.002	0.002	1.1E-05	9.2E-06	9.4E-06	0.0005835	0.0004952	0.0005084	4.3	1.9	2.0	0.0003072	0.0002607	0.0002676	0.007	0.006	0.006	2.9E-07	2.5E-07	2.5E-07	1.8E-05	1.5E-05	1.5E-05	3.3E-06	2.8E-06	2.9E-06
37	Lac John (Town)	8.7	7.2	0.0002	0.0002	0.00019	0.002	0.002	0.002	1.2E-05	1.0E-05	1.0E-05	0.0006537	0.0005436	0.0005601	4.8	2.1	2.2	0.0003441	0.0002862	0.0002949	0.008	0.007	0.007	3.2E-07	2.7E-07	2.8E-07	2.0E-05	1.6E-05	1.7E-05	3.7E-06	3.1E-06	3.2E-06
38	Matimekush (Town)	11.2	9.6	0.0003	0.0002	0.00025	0.003	0.003	0.003	1.6E-05	1.3E-05	1.4E-05	0.0008423	0.0007202	0.0007385	6.2	2.8	2.9	0.0004434	0.0003791	0.0003888	0.010	0.009	0.009	4.2E-07	3.6E-07	3.7E-07	2.6E-05	2.2E-05	2.2E-05	4.8E-06	4.1E-06	4.2E-06
39	Schefferville (Town)	12.6	10.7	0.0003	0.0003	0.00028	0.003	0.003	0.003	1.8E-05	1.5E-05	1.5E-05	0.0009491	0.0008058	0.0008273	7.0	3.2	3.2	0.0004996	0.0004242	0.0004355	0.011	0.010	0.010	4.7E-07	4.0E-07	4.1E-07	2.9E-05	2.4E-05	2.5E-05	5.4E-06	4.6E-06	4.7E-06
40	Workers' Camp	993.9	978.3	0.0255	0.0251	0.02514	0.270	0.265	0.266	1.4E-03	1.4E-03	1.4E-03	0.0748236	0.0736532	0.0738287	549.9	288.7	289.4	0.0393888	0.0387727	0.0388651	0.895	0.881	0.883	3.7E-05	3.7E-05	3.7E-05	2.3E-03	2.2E-03	2.2E-03	4.2E-04	4.2E-04	4.2E-04
	"Off-Property Limit" Maximum	3191.4	2743.9	0.0818	0.0704	0.07207	0.866	0.744	0.763	4.5E-03	3.8E-03	3.9E-03	0.2402637	0.2065675	0.2116219	1765.9	809.7	829.5	0.1264802	0.1087417	0.1114025	2.875	2.472	2.532	1.2E-04	1.0E-04	1.0E-04	7.3E-03	6.3E-03	6.4E-03	1.4E-03	1.2E-03	1.2E-03

Table 6: Incremental Soil Concentrations (mg/kg soil) for the Cumulative Scenario

Receptor ID	Location	Dustfall (mg/m2.year)		Arsenic (As) 48.08 (mg/kg dust)			Barium (Ba) 508.72 (mg/kg dust)			Beryllium (Be) 2.62 (mg/kg dust)			Chromium (Cr) 141.16 (mg/kg dust)			Iron (Fe) 553329.46 (mg/kg dust)			Lead (Pb) 74.31 (mg/kg dust)			Manganese (Mn) 1689 (mg/kg dust)			Mercury (Hg) 0.07 (mg/kg dust)			Molybdenum (Mo) 4.28 (mg/kg dust)			Selenium (Se) 0.8 (mg/kg dust)		
		Blast	No-Balst	Blast Dyd	No-Blast Dyd	Total	Blast Dyd	No-Blast Dyd	Total	Blast Dyd	No-Blast Dyd	Total	Blast Dyd	No-Blast Dyd	Total	Blast Dyd	No-Blast Dyd	Total	Blast Dyd	No-Blast Dyd	Total	Blast Dyd	No-Blast Dyd	Total	Blast Dyd	No-Blast Dyd	Total	Blast Dyd	No-Blast Dyd	Total	Blast Dyd	No-Blast Dyd	Total
1	Young Naskapi Camp	2445	2418	0.0627	0.0620	0.06210	0.663	0.656	0.657	3.4E-03	3.4E-03	3.4E-03	0.18407	0.18204	0.18234	1352.9	713.6	714.8	0.0969	0.09583	0.09599	2.202	2.178	2.182	9.1E-05	9.0E-05	9.0E-05	5.6E-03	5.5E-03	5.5E-03	1.0E-03	1.0E-03	1.0E-03
2	Young Naskapi Camp	2440	2414	0.0626	0.0619	0.06200	0.662	0.655	0.656	3.4E-03	3.4E-03	3.4E-03	0.1837	0.18177	0.18206	1350.2	712.5	713.6	0.0967	0.09569	0.09584	2.198	2.175	2.178	9.1E-05	9.0E-05	9.0E-05	5.6E-03	5.5E-03	5.5E-03	1.0E-03	1.0E-03	1.0E-03
3	Innu Camp	2459	2430	0.0631	0.0623	0.06241	0.667	0.659	0.660	3.4E-03	3.4E-03	3.4E-03	0.18514	0.18291	0.18324	1360.8	717.0	718.3	0.09746	0.09629	0.09646	2.215	2.189	2.193	9.2E-05	9.1E-05	9.1E-05	5.6E-03	5.5E-03	5.6E-03	1.0E-03	1.0E-03	1.0E-03
4	Innu Camp	2452	2430	0.0629	0.0623	0.06239	0.665	0.659	0.660	3.4E-03	3.4E-03	3.4E-03	0.1846	0.18293	0.18318	1356.8	717.1	718.1	0.09718	0.0963	0.09643	2.209	2.189	2.192	9.2E-05	9.1E-05	9.1E-05	5.6E-03	5.5E-03	5.6E-03	1.0E-03	1.0E-03	1.0E-03
5	Innu Camp	2424	2408	0.0621	0.0617	0.06179	0.658	0.653	0.654	3.4E-03	3.4E-03	3.4E-03	0.18246	0.18125	0.18143	1341.1	710.5	711.2	0.09605	0.09541	0.09551	2.183	2.169	2.171	9.0E-05	9.0E-05	9.0E-05	5.5E-03	5.5E-03	5.5E-03	1.0E-03	1.0E-03	1.0E-03
6	Innu Camp	2419	2398	0.0620	0.0615	0.06158	0.656	0.651	0.652	3.4E-03	3.3E-03	3.4E-03	0.18211	0.18057	0.1808	1338.5	707.8	708.7	0.09587	0.09505	0.09518	2.179	2.161	2.163	9.0E-05	9.0E-05	9.0E-05	5.5E-03	5.5E-03	5.5E-03	1.0E-03	1.0E-03	1.0E-03
7	Innu Tent	2470	2442	0.0633	0.0626	0.06271	0.670	0.662	0.664	3.4E-03	3.4E-03	3.4E-03	0.18595	0.18382	0.18414	1366.7	720.6	721.8	0.09789	0.09676	0.09693	2.225	2.199	2.203	9.2E-05	9.1E-05	9.1E-05	5.6E-03	5.6E-03	5.6E-03	1.1E-03	1.0E-03	1.0E-03
8	Innu Tent	2380	2368	0.0610	0.0607	0.06076	0.646	0.642	0.643	3.3E-03	3.3E-03	3.3E-03	0.1792	0.17827	0.17841	1317.1	698.8	699.4	0.09433	0.09385	0.09392	2.144	2.133	2.135	8.9E-05	8.8E-05	8.8E-05	5.4E-03	5.4E-03	5.4E-03	1.0E-03	1.0E-03	1.0E-03
9	Young Naskapi Camp (Pinette Lake)	3350	3179	0.0859	0.0815	0.08216	0.909	0.862	0.869	4.7E-03	4.4E-03	4.5E-03	0.25217	0.2393	0.24123	1853.4	938.0	945.6	0.13275	0.12597	0.12699	3.017	2.863	2.886	1.3E-04	1.2E-04	1.2E-04	7.6E-03	7.3E-03	7.3E-03	1.4E-03	1.4E-03	1.4E-03
10	Young Naskapi Camp	3156	2976	0.0809	0.0763	0.07699	0.856	0.807	0.815	4.4E-03	4.2E-03	4.2E-03	0.23761	0.22402	0.22606	1746.4	878.1	886.1	0.12508	0.11793	0.119	2.843	2.680	2.705	1.2E-04	1.1E-04	1.1E-04	7.2E-03	6.8E-03	6.9E-03	1.3E-03	1.3E-03	1.3E-03
11	Young Naskapi Trailer tent (Triangle Lake)	2975	2857	0.0763	0.0733	0.07372	0.807	0.775	0.780	4.2E-03	4.0E-03	4.0E-03	0.224	0.21511	0.21645	1646.4	843.2	848.5	0.11792	0.11324	0.11394	2.680	2.574	2.590	1.1E-04	1.1E-04	1.1E-04	6.8E-03	6.5E-03	6.6E-03	1.3E-03	1.2E-03	1.2E-03
12	Young Naskapi Camp	2762	2723	0.0708	0.0698	0.06998	0.749	0.739	0.741	3.9E-03	3.8E-03	3.8E-03	0.20796	0.20504	0.20547	1528.5	803.7	805.4	0.10948	0.10794	0.10817	2.488	2.453	2.459	1.0E-04	1.0E-04	1.0E-04	6.3E-03	6.2E-03	6.2E-03	1.2E-03	1.2E-03	1.2E-03
13	Uashat people's camp 2	2971	2870	0.0762	0.0736	0.07398	0.806	0.779	0.783	4.1E-03	4.0E-03	4.0E-03	0.2237	0.21607	0.21721	1644.2	847.0	851.5	0.11776	0.11374	0.11434	2.677	2.585	2.599	1.1E-04	1.1E-04	1.1E-04	6.8E-03	6.6E-03	6.6E-03	1.3E-03	1.2E-03	1.2E-03
14	Young Naskapi Camp	2358	2351	0.0605	0.0603	0.06031	0.640	0.638	0.638	3.3E-03	3.3E-03	3.3E-03	0.17753	0.17699	0.17707	1304.8	693.8	694.1	0.09346	0.09317	0.09321	2.124	2.118	2.119	8.8E-05	8.8E-05	8.8E-05	5.4E-03	5.4E-03	5.4E-03	1.0E-03	1.0E-03	1.0E-03
15	Young Naskapi Camp (Howells River)	2434	2420	0.0624	0.0620	0.06210	0.660	0.657	0.657	3.4E-03	3.4E-03	3.4E-03	0.18325	0.18217	0.18233	1346.9	714.1	714.7	0.09647	0.0959	0.09598	2.193	2.180	2.182	9.1E-05	9.0E-05	9.0E-05	5.6E-03	5.5E-03	5.5E-03	1.0E-03	1.0E-03	1.0E-03
16	Uashat - Mani-Utenam Camp	3554	3493	0.0911	0.0896	0.08980	0.964	0.948	0.950	5.0E-03	4.9E-03	4.9E-03	0.26756	0.26297	0.26366	1966.6	1030.8	1033.5	0.14085	0.13843	0.13879	3.201	3.147	3.155	1.3E-04	1.3E-04	1.3E-04	8.1E-03	8.0E-03	8.0E-03	1.5E-03	1.5E-03	1.5E-03
17	Uashat - Mani-Utenam Camp	2599	2540	0.0667	0.0651	0.06536	0.705	0.689	0.692	3.6E-03	3.5E-03	3.6E-03	0.19569	0.19123	0.1919	1438.3	749.6	752.2	0.10302	0.10067	0.10102	2.342	2.288	2.296	9.7E-05	9.5E-05	9.5E-05	5.9E-03	5.8E-03	5.8E-03	1.1E-03	1.1E-03	1.1E-03
18	Uashat - Mani-Utenam Camp (Inukshuk Lake)	3654	3588	0.0937	0.0920	0.09224	0.991	0.973	0.976	5.1E-03	5.0E-03	5.0E-03	0.27505	0.2701	0.27084	2021.6	1058.8	1061.7	0.14479	0.14218	0.14258	3.291	3.232	3.241	1.4E-04	1.3E-04	1.3E-04	8.3E-03	8.2E-03	8.2E-03	1.6E-03	1.5E-03	1.5E-03
19	Naskapi Cabin	2403	2382	0.0616	0.0611	0.06115	0.652	0.646	0.647	3.4E-03	3.3E-03	3.3E-03	0.18093	0.17929	0.17954	1329.8	702.8	703.8	0.09524	0.09438	0.09451	2.165	2.145	2.148	9.0E-05	8.9E-05	8.9E-05	5.5E-03	5.4E-03	5.4E-03	1.0E-03	1.0E-03	1.0E-03
20	Naskapi Cabin	2422	2396	0.0621	0.0614	0.06152	0.657	0.650	0.651	3.4E-03	3.3E-03	3.3E-03	0.18233	0.18035	0.18064	1340.1	706.9	708.1	0.09598	0.09494	0.09509	2.182	2.158	2.161	9.0E-05	8.9E-05	9.0E-05	5.5E-03	5.5E-03	5.5E-03	1.0E-03	1.0E-03	1.0E-03
21	Bustard - Observation and hunting site	2374	2367	0.0609	0.0607	0.06072	0.644	0.642	0.643	3.3E-03	3.3E-03	3.3E-03	0.17872	0.17822	0.17829	1313.5	698.6	698.9	0.09408	0.09382	0.09386	2.138	2.132	2.133	8.9E-05	8.8E-05	8.8E-05	5.4E-03	5.4E-03	5.4E-03	1.0E-03	1.0E-03	1.0E-03
22	Bustard - Observation and hunting site	2442	2416	0.0626	0.0619	0.06204	0.663	0.655	0.656	3.4E-03	3.4E-03	3.4E-03	0.18385	0.18186	0.18216	1351.3	712.9	714.0	0.09678	0.09573	0.09589	2.200	2.176	2.180	9.1E-05	9.0E-05	9.0E-05	5.6E-03	5.5E-03	5.5E-03	1.0E-03	1.0E-03	1.0E-03
23	Picking site (berries / tea)	3342	3309	0.0857	0.0848	0.08497	0.907	0.898	0.899	4.7E-03	4.6E-03	4.6E-03	0.25159	0.24912	0.24949	1849.2	976.5	978.0	0.13244	0.13114	0.13134	3.010	2.981	2.985	1.2E-04	1.2E-04	1.2E-04	7.6E-03	7.6E-03	7.6E-03	1.4E-03	1.4E-03	1.4E-03
24	Irony Mountain	2844	2767	0.0729	0.0710	0.07125	0.772	0.751	0.754	4.0E-03	3.9E-03	3.9E-03	0.21408	0.20833	0.20919	1573.4	816.6	820.0	0.11269	0.10967	0.11012	2.562	2.493	2.503	1.1E-04	1.0E-04	1.0E-04	6.5E-03	6.3E-03	6.3E-03	1.2E-03	1.2E-03	1.2E-03
25	Innu Cabin	2404	2383	0.0616	0.0611	0.06119	0.652	0.647	0.647	3.4E-03	3.3E-03	3.3E-03	0.18101	0.17942	0.17966	1330.4	703.3	704.3	0.09529	0.09445	0.09458	2.166	2.147	2.150	9.0E-05	8.9E-05	8.9E-05	5.5E-03	5.4E-03	5.4E-03	1.0E-03	1.0E-03	1.0E-03
26	Innu Cabin	2389	2369	0.0612	0.0607	0.06082	0.648	0.643	0.644	3.3E-03	3.3E-03	3.3E-03	0.17982	0.17835	0.17857	1321.7	699.1	700.0	0.09466	0.09389	0.094	2.152	2.134	2.137	8.9E-05	8.8E-05	8.9E-05	5.5E-03	5.4E-03	5.4E-03	1.0E-03	1.0E-03	1.0E-03
27	Innu Cabin	2376	2359	0.0609	0.0605	0.06054	0.645	0.640	0.641	3.3E-03	3.3E-03	3.3E-03	0.17885	0.17756	0.17775	1314.5	696.0	696.8	0.09415	0.09347	0.09357	2.140	2.125	2.127	8.9E-05	8.8E-05	8.8E-05	5.4E-03	5.4E-03	5.4E-03	1.0E-03	1.0E-03	1.0E-03
28	Innu Cabin	2367	2352	0.0607	0.0603	0.06036	0.642	0.638	0.639	3.3E-03	3.3E-03	3.3E-03	0.17822	0.17704	0.17721	1309.9	694.0	694.7	0.09382	0.0932	0.09329	2.132	2.118	2.120	8.8E-05	8.8E-05	8.8E-05	5.4E-03	5.4E-03	5.4E-03	1.0E-03	1.0E-03	1.0E-03
29	Innu Cabin	2371	2355	0.0608	0.0604	0.06045	0.643	0.639	0.640	3.3E-03	3.3E-03	3.3E-03	0.17852	0.1773	0.17748	1312.1	695.0	695.7	0.09398	0.09333	0.09343	2.136	2.121	2.124	8.9E-05	8.8E-05	8.8E-05	5.4E-03	5.4E-03	5.4E-03	1.0E-03	1.0E-03	1.0E-03
30	Innu Cabin	2362	2347	0.0606	0.0602	0.06023	0.641	0.637	0.637	3.3E-03	3.3E-03	3.3E-03	0.17781	0.17669	0.17685	1306.9	692.6	693.3	0.0936	0.09301	0.0931	2.128	2.114	2.116	8.8E-05	8.8E-05	8.8E-05	5.4E-03	5.4E-03	5.4E-03	1.0E-03	1.0E-03	1.0E-03
31	Innu Cabin	2376	2357	0.0609	0.0604	0.06051	0.645	0.640	0.640	3.3E-03	3.3E-03	3.3E-03	0.17888	0.17745	0.17766	1314.7	695.6	696.4	0.09416	0.09341	0.09353	2.140	2.123	2.126	8.9E-05	8.8E-05	8.8E-05	5.4E-03	5.4E-03	5.4E-03	1.0E-03	1.0E-03	1.0E-03
32	Innu Cabin	2356	2347	0.0604	0.0602	0.06021	0.639	0.637	0.637	3.3E-03	3.3E-03	3.3E-03	0.1774	0.17667	0.17678	1303.9	692.5	693.0	0.09339	0.093	0.09306	2.123	2.114	2.115	8.8E-05	8.8E-05	8.8E-05	5.4E-03	5.4E-03	5.4E-03	1.0E-03	1.0E-03	1.0E-03
33	Naskapi Cabin	2400	2381	0.0615	0.0611	0.06113	0.651	0.646	0.647	3.3E-03	3.3E-03	3.3E-03	0.18068	0.17927	0.17948	1328.0	702.7	703.6	0.09511	0.09437	0.09448	2.162	2.145	2.148	9.0E-05	8.9E-05	8.9E-05	5.5E-03	5.4E-03	5.4E-03	1.0E-03	1.0E-03	1.0E-03
34	Naskapi Cabin	2470	2439	0.0633	0.0625	0.06266	0.670	0.662	0.663	3.4E-03	3.4E-03	3.4E-03	0.18595	0.18364	0.18399	1366.8	719.9	721.2	0.09789	0.09667	0.09686	2.225	2.197	2.201	9.2E-05	9.1E-05	9.1E-05	5.6E-03	5.6E-03	5.6E-03	1.1E-03	1.0E-03	1.0E-03
35	Naskapi Cabin	2416	2399	0.0620	0.0615	0.06158	0.656	0.651	0.652	3.4E-03	3.3E-03	3.4E-03	0.18192	0.18061	0.18081	1337.1	708.0	708.8	0.09577	0.09508	0.09518	2.177	2.161	2.163	9.0E-05	9.0E-05	9.0E-05	5.5E-03	5.5E-03	5.5E-03	1.0E-03	1.0E-03	1.0E-03
36	Kawawachikamak (Town)	2317	2314	0.0594	0.0593	0.05934	0.629	0.628	0.628	3.2E-03	3.2E-03	3.2E-03	0.17441	0.17421	0.17424	1281.9	682.9	683.0	0.09181	0.09171	0.09172	2.087	2.084	2.085	8.6E-05	8.6E-05	8.6E-05	5.3E-03	5.3E-03	5.3E-03	9.9E-04	9.9E-04	9.9E-04
37	Lac John (Town)	2320	2316	0.0595	0.0594	0.05940	0.629	0.628	0.629	3.2E-03	3.2E-03	3.2E-03	0.17463	0.17436	0.1744	1283.5	683.5	683.6	0.09193	0.09178	0.09181	2.090	2.086	2.087	8.7E-05	8.6E-05	8.6E-05	5.3E-03	5.3E-03	5.3E-03	9.9E-04	9.9E-04	9.9E-04
38	Matimekush (Town)	2325	2321	0.0596	0.0595	0.05952	0.631	0.630	0.630	3.2E-03	3.2E-03	3.2E-03	0.17505	0.1747	0.17475	1286.6	684.8	685.0	0.09215	0.09197	0.09199	2.095	2.090	2.091	8.7E-05	8.7E-05	8.7E-05	5.3E-03	5.3E-03	5.3E-03	9.9E-04	9.9E-04	9.9E-04
39	Schefferville (Town)	2328	2323	0.0597	0.0596	0.05958	0.632	0.630	0.630	3.2E-03	3.2E-03	3.2E-03	0.17528	0.17489	0.17494	1288.3	685.5	685.8	0.09227	0.09206	0.09209	2.097	2.093	2.093	8.7E-05	8.7E-05	8.7E-05	5.3E-03	5.3E-03	5.3E-03	9.9E-04	9.9E-04	9.9E-04
40	Workers' Camp	4619	4444	0.1184	0.1140	0.11463	1.253	1.206	1.213	6.4E-03	6.2E-03	6.2E-03	0.34777	0.33458	0.33656	2556.1	1311.5	1319.3	0.18307	0.17613	0.17717	4.161	4.003	4.027	1.7E-04	1.7E-04	1.7E-04	1.1E-02	1.0E-02	1.0E-02	2.0E-03	1.9E-03	1.9E-03
	"Off-Property Limit" Maximum	9183	9096	0.2355	0.2332	0.23356	2.492	2.468	2.471	1.3E-02	1.3E-02	1.3E-02	0.69133	0.68478	0.68576	5081.3	2684.3	2688.2	0.36393	0.36048	0.361	8.272	8.194	8.205	3.4E-04	3.4E-04	3.4E-04	2.1E-02	2.1E-02	2.1E-02	3.9E-03	3.9E-03	3.9E-03

D2. GoldSim® Multimedia Exposure Model

Appendix D
GoldSim Multi-Media Exposure and Risk Model
Proposed Howse Property Mine Development



1. Baseline Deterministic Assessment
Baseline assessment conducted as banchmark for determination of incremental project and cumulative human health risks.

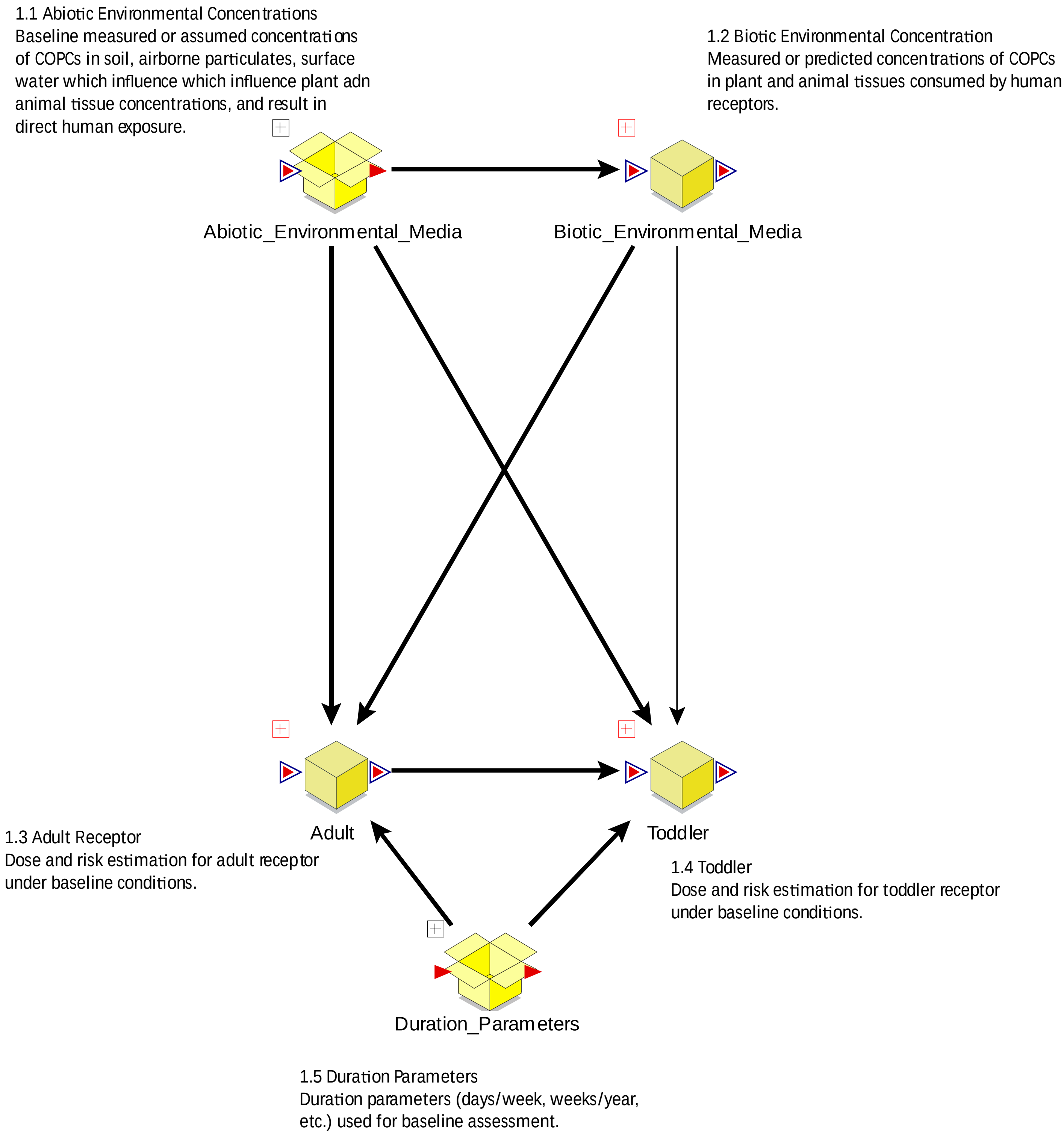
2. Project Deterministic Assessment
Project + baseline deterministic assessment of adult and toddler receptors. Exposure point concentrations influenced by fugitive dust and subsequent soil deposition. Exposure assumes 16 weeks per year in project area with remaining 36 weeks in local communities.

3. Cumulative Deterministic Assessment
Mechanics and exposure duration assumptions for the cumulative deterministic risk assessment are identical to the project scenario deterministic assessment. Only exposure point conentrations vary based on increased particulate dispersion adn associated impacts on soil quality and tissue quality. Refer to Model Section 2 for mechanistic details of the calculations.

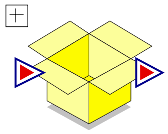
4. Geospatial Probabilistic Inhalation

5. Input/Output Global Container
Contains functions to import and exposrt point estimates to an external Microsoft Excel workbook
.

1 Baseline Assessment

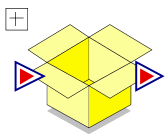


1.1 Abiotic Environmental Concentrations



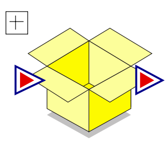
COPC_Water

1.1.1 Water
Baseline exposure point concentrations for surface water.



COPC_Soil

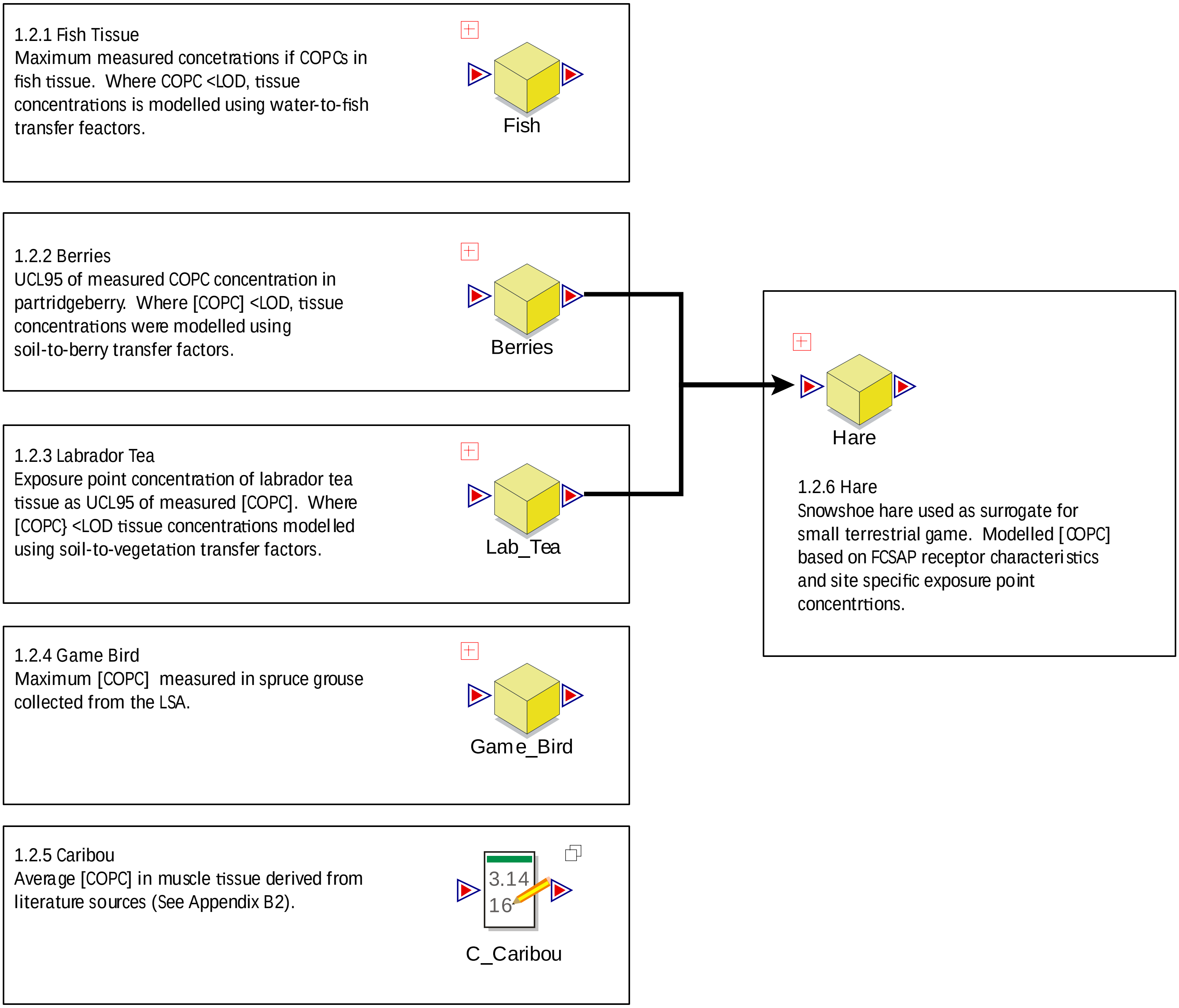
1.1.2 Soil
Baseline exposure point concentrations for soil.



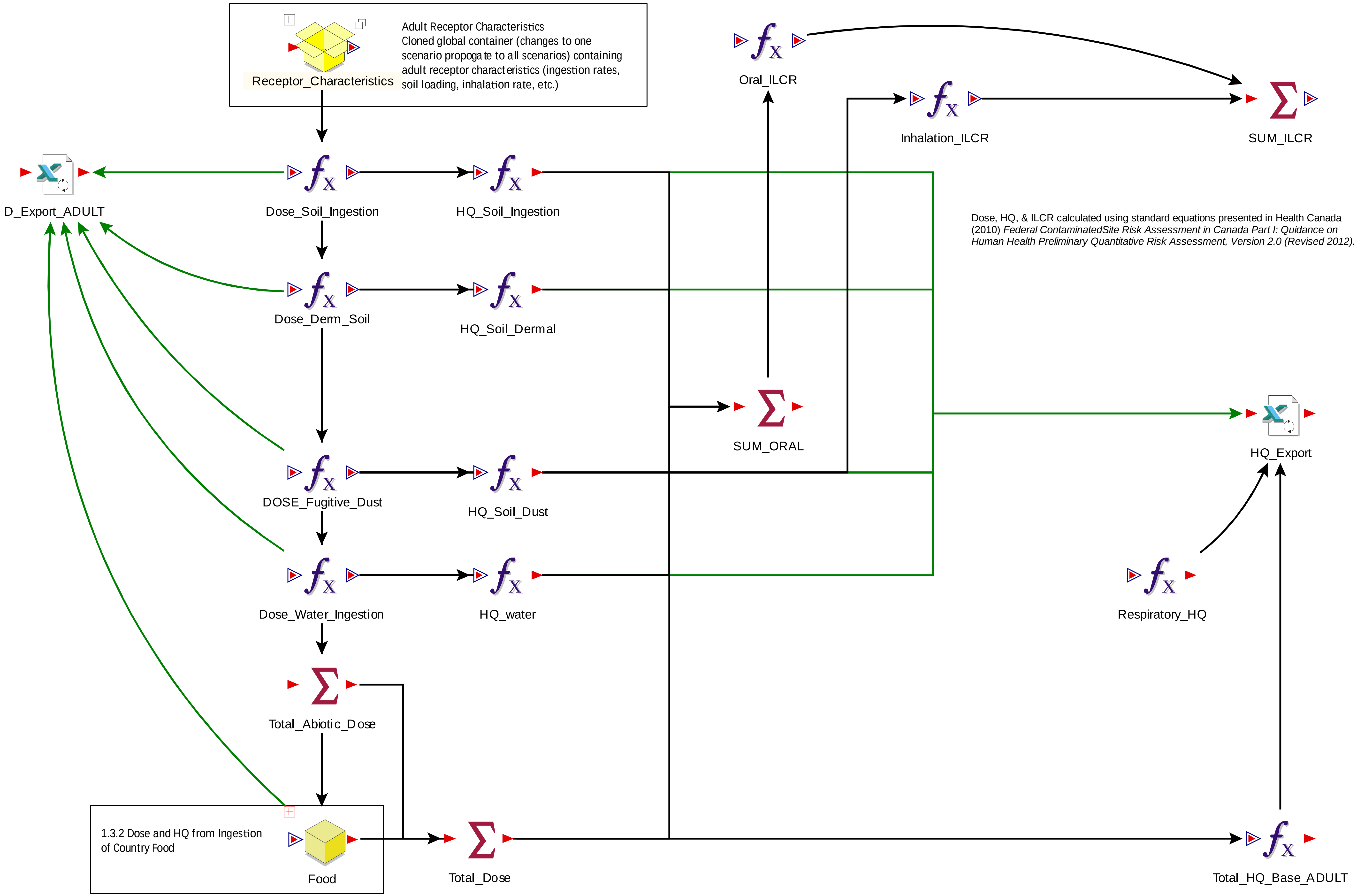
COPC_Particulate

1.1.3 Airborne Particulates
Exposure point coinentrations for airborne particulates

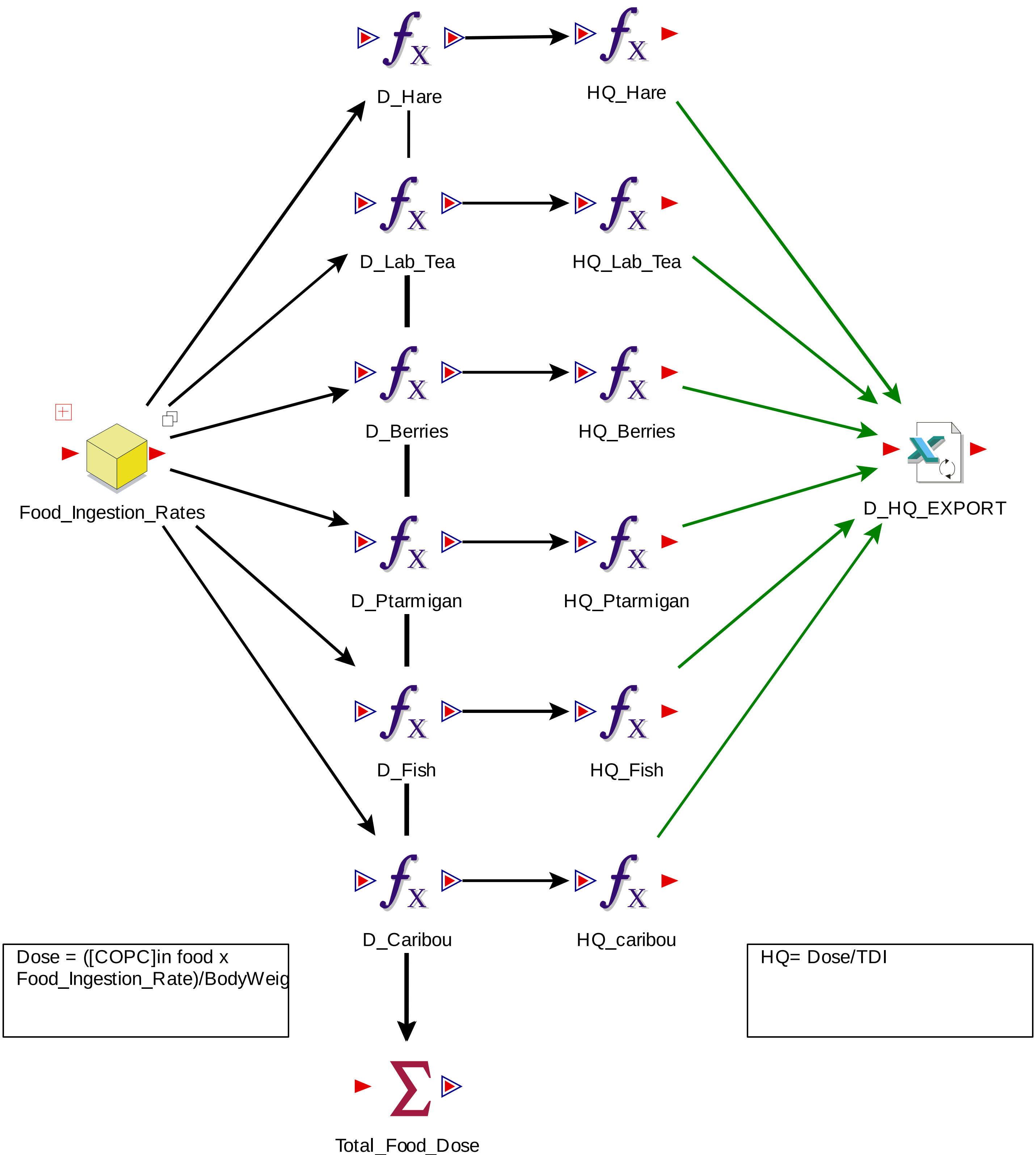
1.2 Biotic Environmental Concentrations



1.3 Adult Receptor - Dose and Risk Estimates under Baseline Conditions



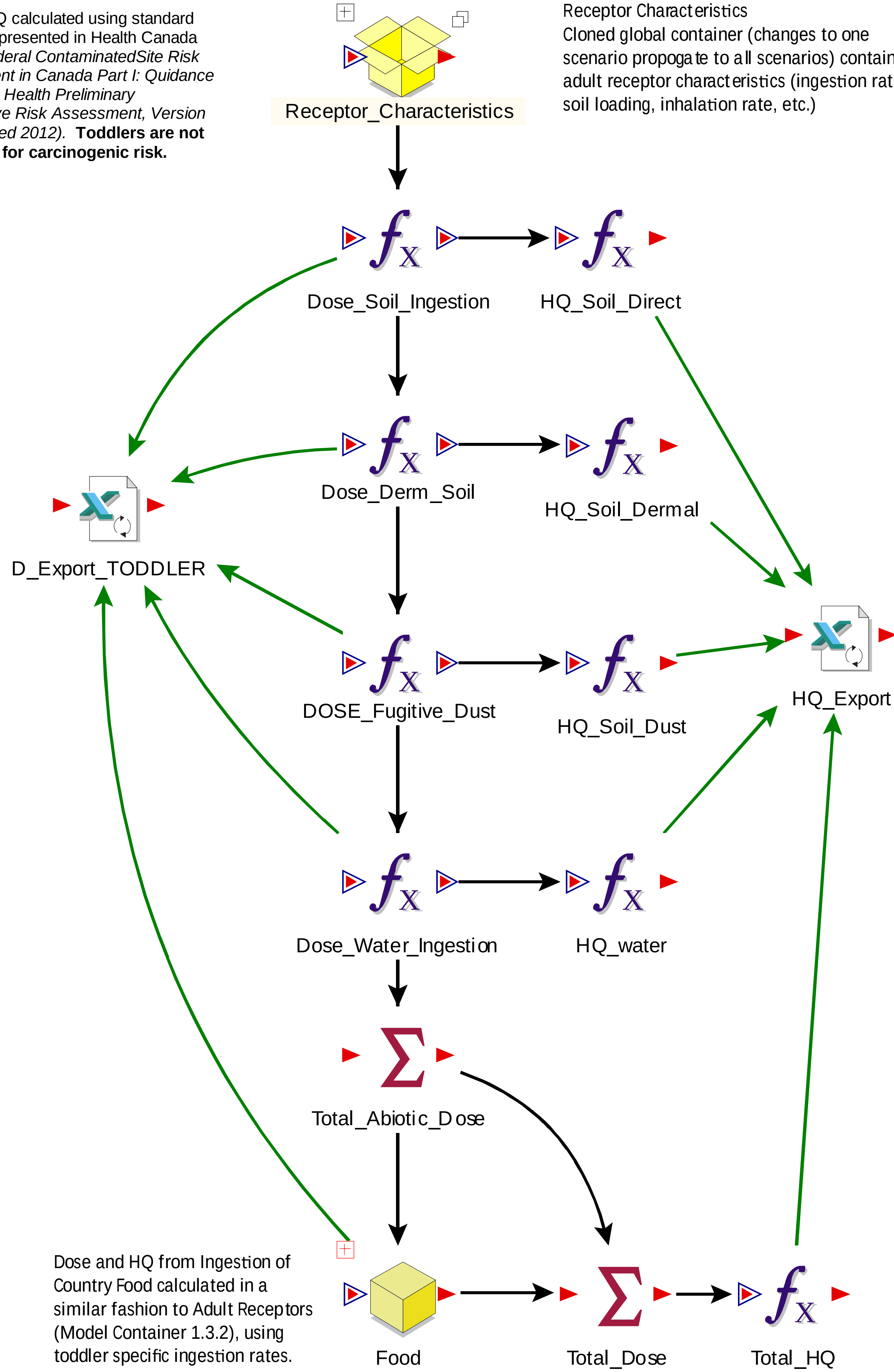
1.3.2 Adult Dose and HQs: Ingestion of Country Food



1.4 Toddler Receptor - Dose and HQs under Baseline Conditions

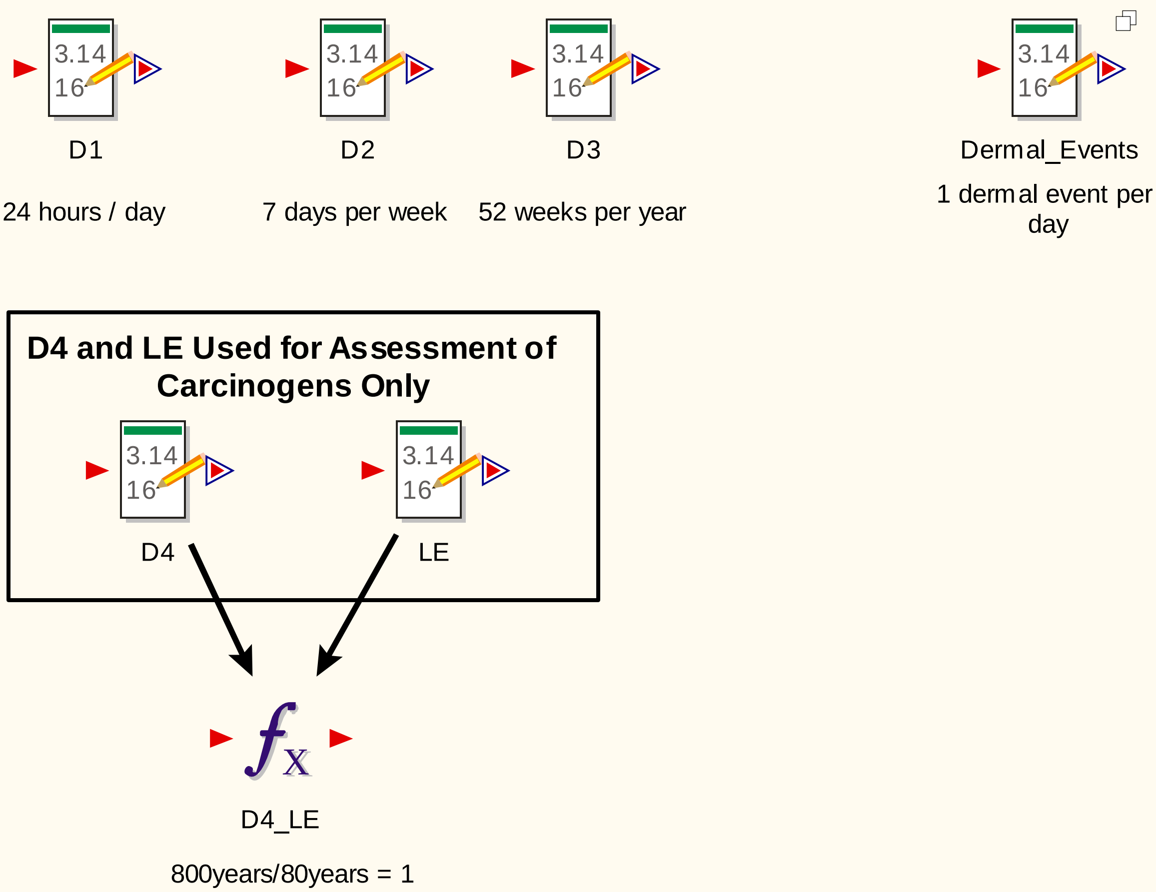
Dose & HQ calculated using standard equations presented in Health Canada (2010) *Federal ContaminatedSite Risk Assessment in Canada Part I: Quidance on Human Health Preliminary Quantitative Risk Assessment, Version 2.0 (Revised 2012).* **Toddlers are not assessed for carcinogenic risk.**

Receptor Characteristics
Cloned global container (changes to one scenario propogate to all scenarios) containing adult receptor characteristics (ingestion rates, soil loading, inhalation rate, etc.)



Dose and HQ from Ingestion of Country Food calculated in a similar fashion to Adult Receptors (Model Container 1.3.2), using toddler specific ingestion rates.

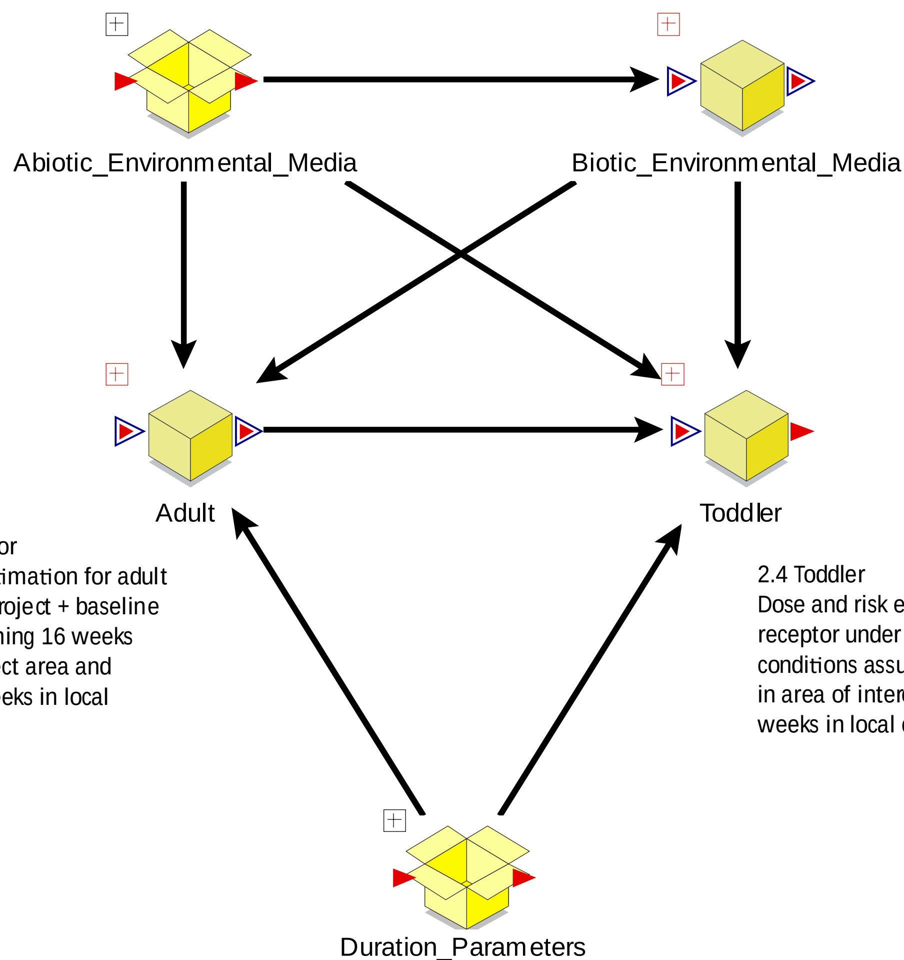
1.5 Duration Parameters



2 Project Deterministic Assessment

2.1 Abiotic Environmental Concentrations
Baseline measured or predicted concentrations of COPCs in soil, airborne particulates, surface water. Soil concentration predicted from air deposition (See Appendix B3). Predicted concetrations influence plant and animal tissue concentrations, and result in direct human exposure.

2.2 Biotic Environmental Concentration
Predicted concentrations of COPCs in plant and animal tissues consumed by human receptors. Refer to Appendix B3 for details of food web model.

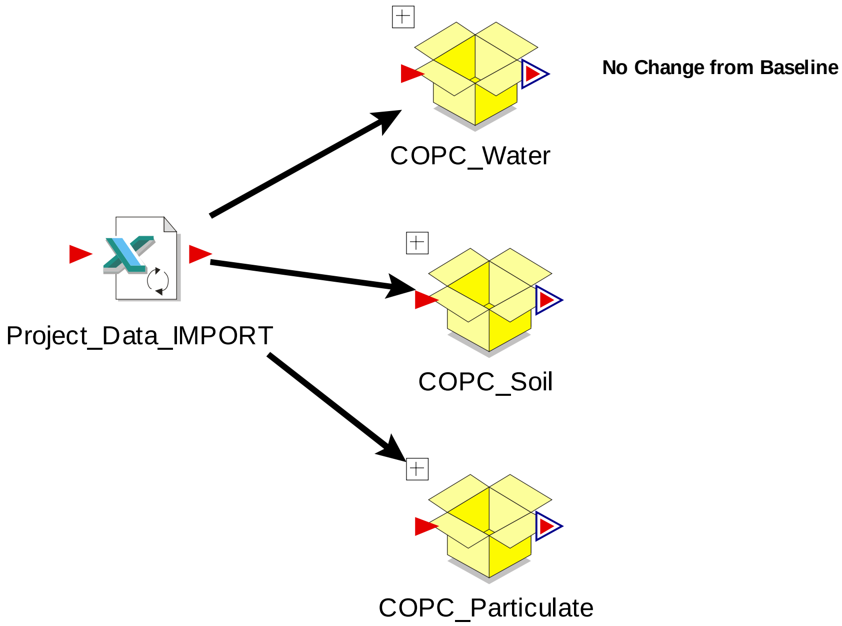


2.3 Adult Receptor
Dose and risk estimation for adult receptor under project + baseline conditions assuming 16 weeks exposure in project area and remaining 36 weeks in local communities..

2.4 Toddler
Dose and risk estimation for toddler receptor under project + baseline conditions assuming 16 weeks exposure in area of interest, with remaining 36 weeks in local communities..

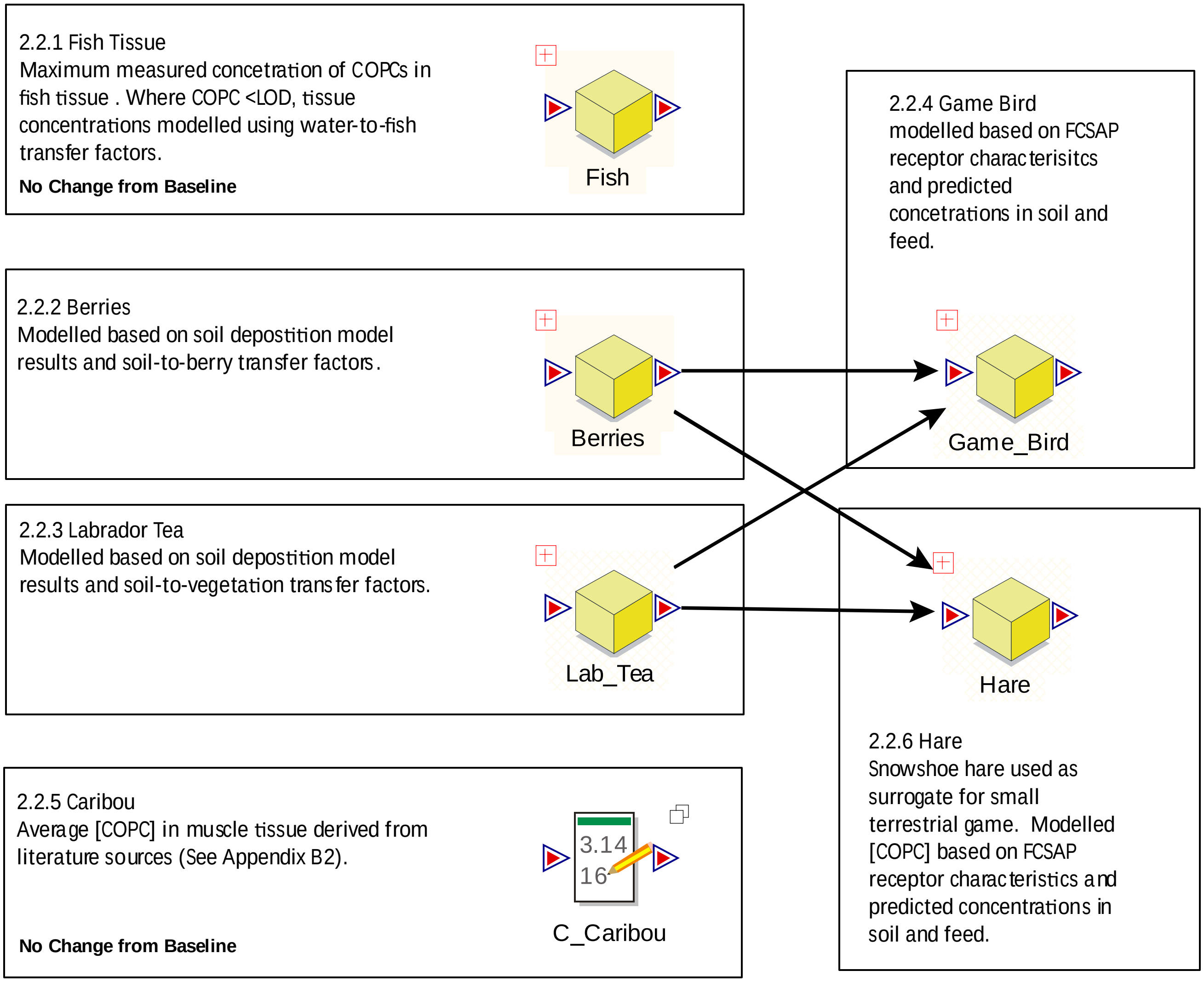
2.5 Duration Parameters
Duration parameters (days/week, weeks/year, etc.) used for project assessment.

2.1 Abiotic Environmental Concentrations



Baseline measured or predicted concentrations of COPCs in soil, airborne particulates and surface water are imported from an external MS Excel Spreadhseet. (Appendix D2).

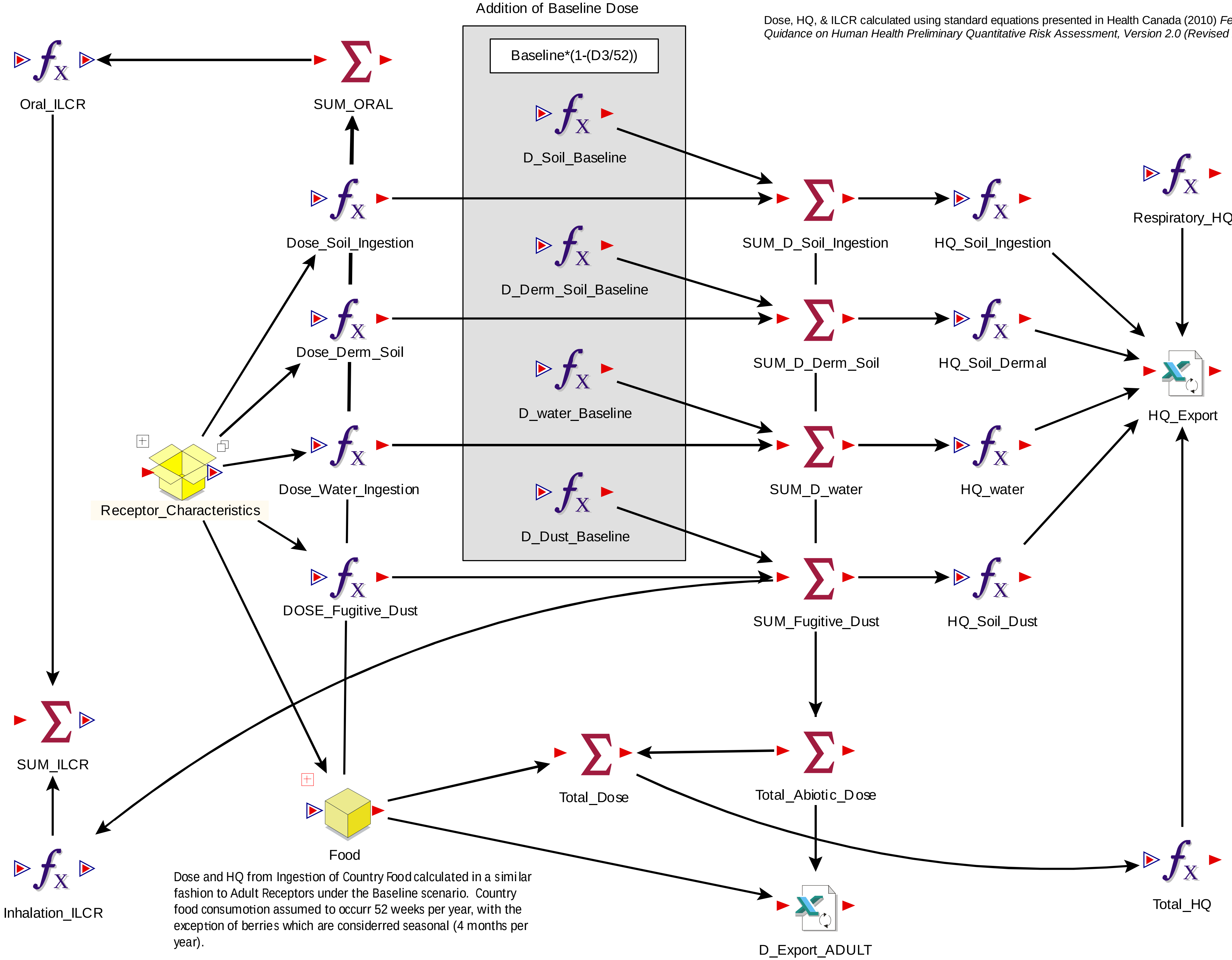
2.2 Biotic Environmental Concentrations



2.3 Adult Receptor Deterministic Project + Baseline

Dose and risk estimation for adult receptor under project + baseline conditions assuming 16 weeks exposure in project area and remaining 36 weeks in local communities. Calculated dose assumes 16 weeks occupance in the project area. Total dose = project dose + (baslien dose x (36/52)).

Dose, HQ, & ILCR calculated using standard equations presented in Health Canada (2010) *Federal ContaminatedSite Risk Assessment in Canada Part I: Quidance on Human Health Preliminary Quantitative Risk Assessment, Version 2.0 (Revised 2012).*

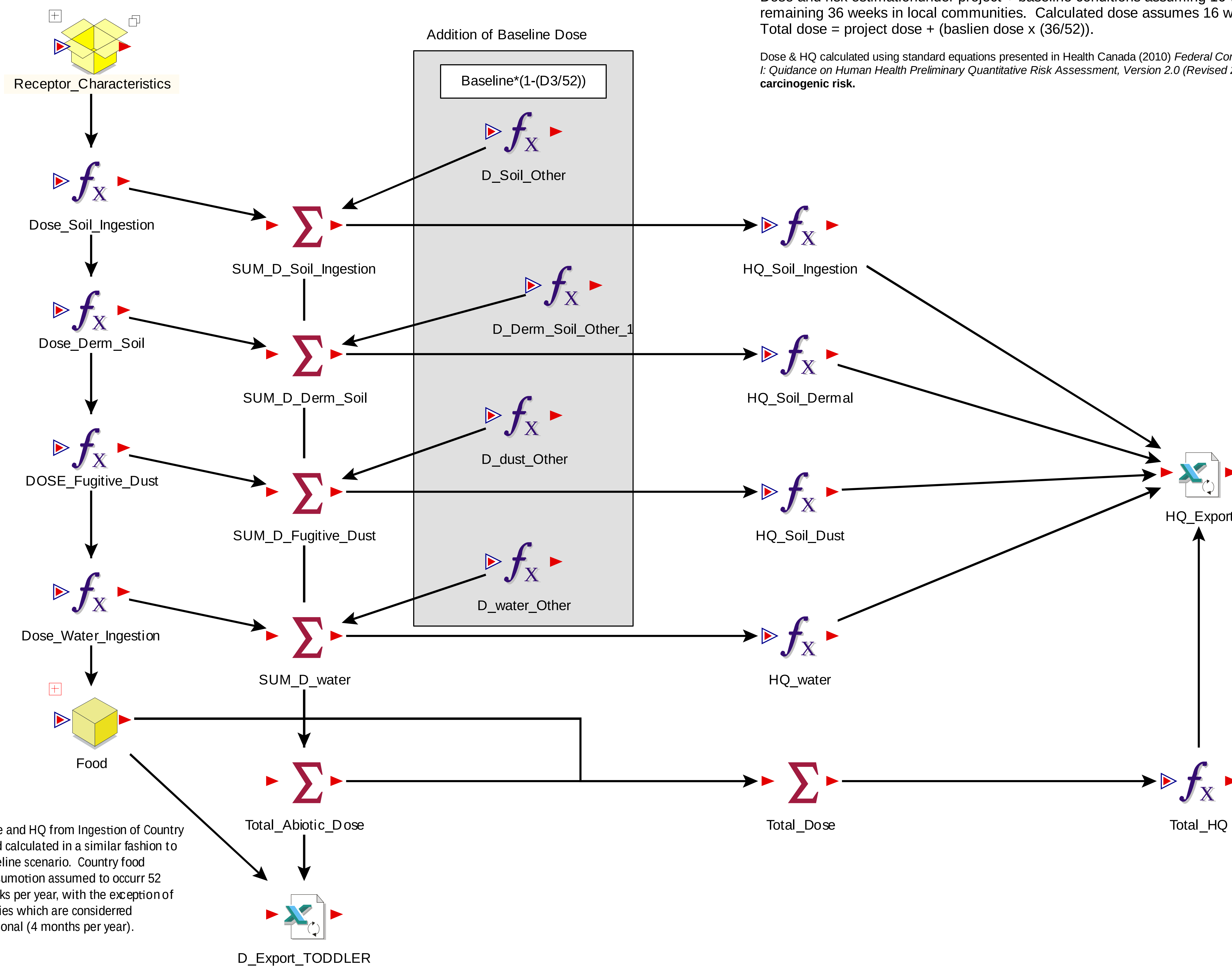


Dose and HQ from Ingestion of Country Food calculated in a similar fashion to Adult Receptors under the Baseline scenario. Country food consumotion assumed to occurr 52 weeks per year, with the exception of berries which are considerred seasonal (4 months per year).

2.4 Toddler Project + Baseline Deterministic Assessment

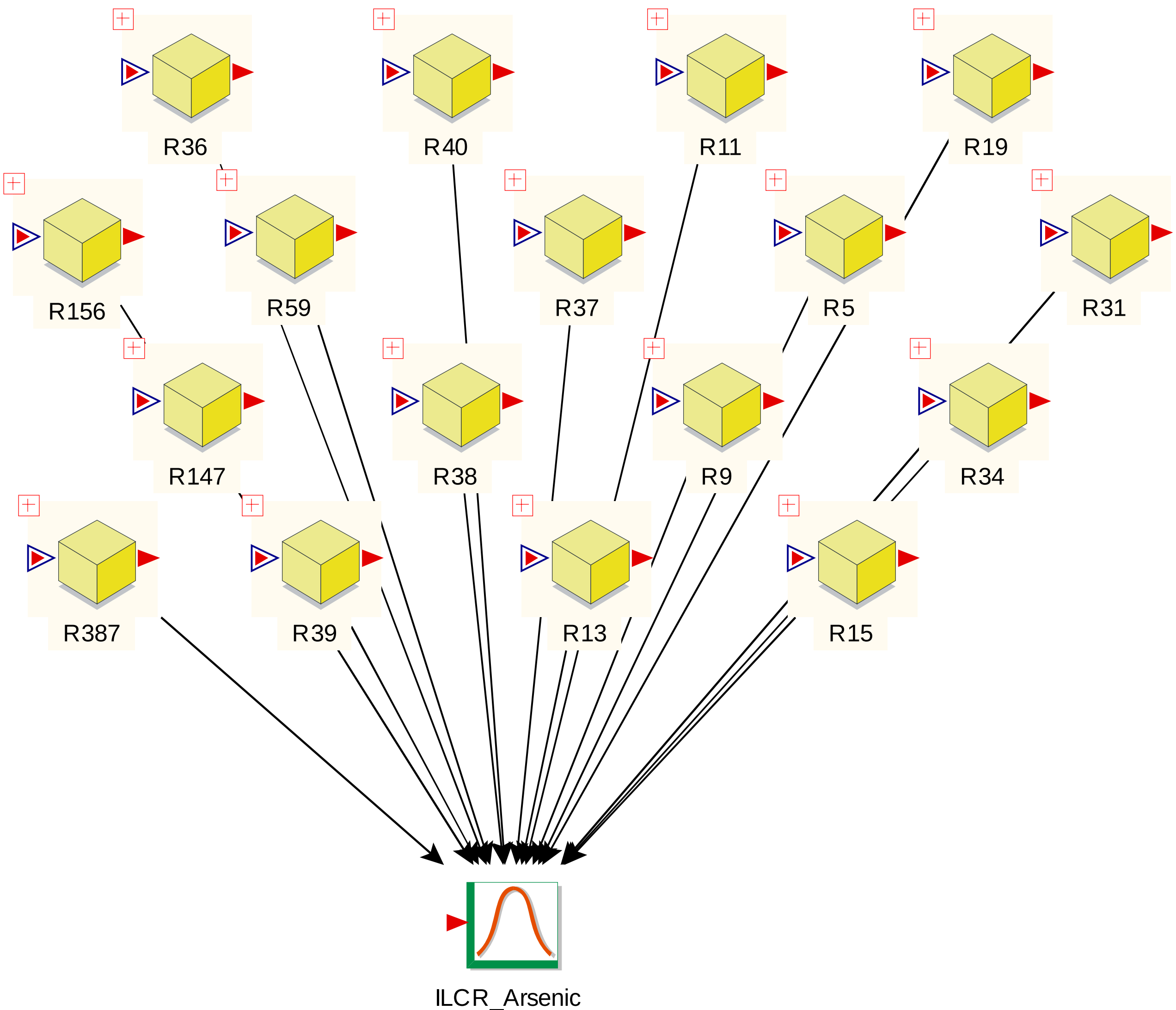
Dose and risk estimationunder project + baseline conditions assuming 16 weeks exposure in project area and remaining 36 weeks in local communities. Calculated dose assumes 16 weeks occupance in the project area. Total dose = project dose + (baslien dose x (36/52)).

Dose & HQ calculated using standard equations presented in Health Canada (2010) *Federal ContaminatedSite Risk Assessment in Canada Part I: Quidance on Human Health Preliminary Quantitative Risk Assessment, Version 2.0 (Revised 2012).* **Toddlers are not assessed for carcinogenic risk.**



Dose and HQ from Ingestion of Country Food calculated in a similar fashion to baseline scenario. Country food consumotion assumed to occurr 52 weeks per year, with the exception of berries which are considered seasonal (4 months per year).

4. Geospatial Probabilistic Inhalation

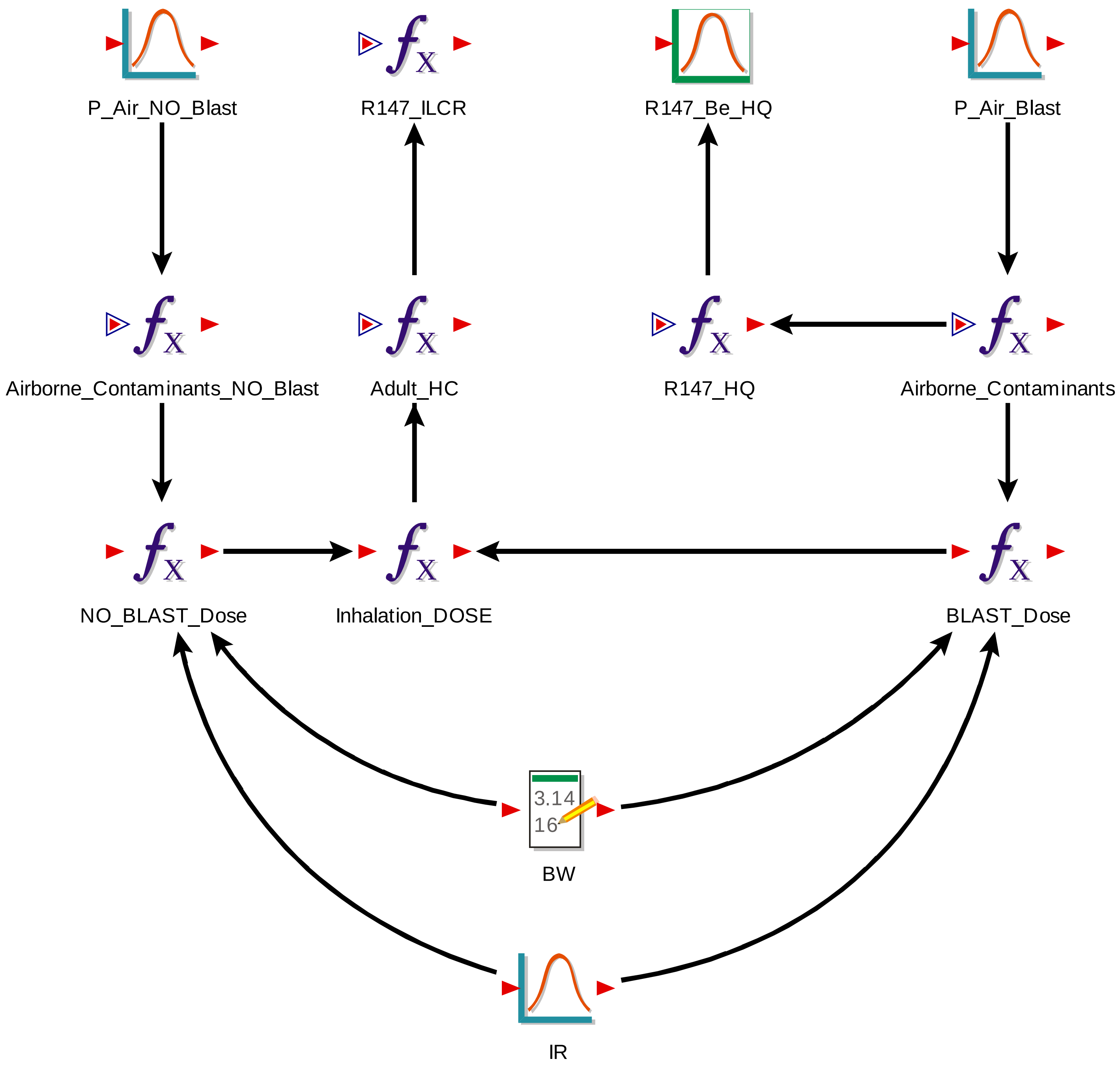


ID	Name	UTM Coordinates
147	Grid 147 off property max location with blast	625.4565 , 6083.702
156	Grid 156 off property max location with blast	625.6801 , 6083.313
59	Grid 59 off property max location without blast	622.2434, 6085.730
387	Grid 387 off property max location without blast	618.5496 , 6086.562
5	Innu Camp	614.85 , 6087.33
9	Young Naskapi Camp (Pinette Lake)	620.46 , 6084.82
11	Young Naskapi Trailer tent (Triangle Lake)	618.09 , 6088.32
13	Uashat people's camp 2	617.80 , 6087.04
15	Young Naskapi Camp (Howells River)	622.30 , 6077.86
19	Naskapi Cabin	631.68 , 6080.09
31	Innu Cabin	633.13 , 6080.34
34	Naskapi Cabin	616.69 , 6084.22
36	Kawawachikamak (Town)	643.50 , 6082.13
37	Lac John (Town)	642.39 , 6076.24
38	Matimekush (Town)	640.80 , 6075.60
39	Schefferville (Town)	640.60 , 6075.00
40	Workers' Camp	624.47 , 6082.77

4.1 Example Probabilistic Framework

Dose and risk estimation for adult receptors via the inhalation of fugitive dust under cumulative scenario. Calculated dose assumes 52 weeks exposure. Chemistry of particulates is drawn from a stochastic element (log-normal probability distribution) for the individual COPCs. This element is contained within model container #5 (Input_Output). Stochastic inputs also include particulate concentrations during blast and no-blast conditions, as well as receptor inhalation rate.

Dose, HQ, & ILCR calculated using standard equations presented in Health Canada (2010) *Federal ContaminatedSite Risk Assessment in Canada Part I: Quidance on Human Health Preliminary Quantitative Risk Assessment, Version 2.0 (Revised 2012).*



Appendix E

Environmental Chemistry

- E1. Statistical Summary
- E2. Human Health Risk Assessment Data Tables

E1. Statistical Summary

Appendix E1
Summary Statistics for Environmental Concentration Data

This Appendix outlines the workflow process for computation of summary statistics, including 95% Upper Confidence Limits of the mean (UCL95) for environmental concentration data with and without non-detect. Summary statistics were computed using the US Environmental Protection Agencies' statistical platform ProUCL Version 4.1. This workflow was developed based on a review of relevant literature, and guidance delivered by Dr. Dennis Helsel [1,2]. The flowchart included as Figure 1 shows the workflow process. The rationale for selection of statistical procedures is described in the text below. Text specific to portion of the flowchart are signified by corresponding numbers, (ι) for example.

Calculating an upper confidence limit on environmental data that does not have ND values is largely influenced by the number of observations (n) and the skewness of the data. For data sets where the number of observations is less than twenty (n<20) bootstrap re-sampling techniques are unlikely to capture the breadth of the sample population shape, and are likely to return inaccurate estimates of the UCL. Under these circumstances either a normal or gamma distribution is assumed based on the strongest goodness of fit statistic provided by ProUCL (i.e. larger R-squared value). ProUCL does not include suitable methods for computation of 95% UCLs based on lognormal distributions, so non-normal (i.e. skewed) distributions are assumed to resemble a gamma distribution. Based on the selected distribution the 95% Student's-t UCL or 95% Adjusted Gamma UCL was carried forward for normal and gamma distributions respectively (ι). For datasets without non-detect values and a sample size of n≥20 bootstrap re-sampling techniques are the best way to compute a UCL95 from skewed data (Helsel, 2012). The Bias Corrected Accelerated Bootstrap (BCA) intervals are recommended for general use, especially for non-parametric problems[3]. The BCA bootstrap technique adjusts for skewness and provides a confidence limit of the mean that that should exceed the true population mean in 95% of cases (i.e. 95% coverage). Under these circumstances (φ) the 95% BCA Bootstrap UCL was used.

In the past, regulatory guidance in environmental sciences supported the use of substitution methods for handing data below reportable limits of detection (ND values). Substitution methods introduce invasive data resulting in poor estimates and incorrect statistical tests (Helsel, 2012). Substitution methods do not provide adequate coverage for UCLs computed on censored data, even when censoring levels are as low as 10% [4] and based on this study the US EPA have stated that "*it is strongly recommended to avoid the use of the DL/2 method….even when the percentage of NDs if as low as 5-10%*"[5]. Accordingly, AECOM did not use substitution methods in this statistical analysis.

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[1] Course presented January 19th 2012 to the Society of Contaminated Sites Approved Professionals of British Columbia titled *Environmental Statistics Using ProUCL.*
[2] Course presented November 29th 2012 titled *Practical Statistics for Contaminated Site Studies* through GeoEnviroLogic Professional Development.
[3] B. Efron and R. J. Tibshirani, An Introduction to the Bootstrap, Boca Raton, FL: CRC Press, 1994..
[4] Singh, A., Maichle, R., and Lee, S. 2006. On the Computation of a 95% Upper Confidence Limit of the Unknown Population Mean Based Upon Data Sets with Below Detection Limit Observations. EPA/600/R-06/022, March 2006. Available at: http://www.epa.gov/osp/hstl/tsc/softwaredocs.htm
[5] USEPA 2012 ProUCL Version 4.1 User Guide (Draft). EPA/600/r-07/041. US Environmental Protection Agency, Office of Research and Development, Washington, DC. Available at http:// http://www.epa.gov/osp/hstl/tsc/ProUCL_v4.1_user.pdf.

Two non-substitution methods for handling non-detects are include in ProUCL; (a) the Kaplan-Meier procedure (KM), and; (b) Robust Regression on Order Statistics (ROS).

a. Kaplan-Meier: The KM procedure is a nonparametric method thereby not requiring transformations or assumptions of distribution, and is the standard in medical and industrial statistics for estimating a mean of censored data[(6)]. KM was determined to be the most reliable method for computing the 95% upper confidence limit on the mean (UCL95) of concentration data[(4)]. The KM method was not developed for use where a single censoring value (i.e. one reportable detection limit) exists in the population. In this case the KM estimates of the mean will be equal to the mean based on DL substitution. Datasets with a single censoring level are common for projects of a short duration where a single laboratory has been used. AECOM have used KM methods for datasets with multiple detections limits (κ).
b. Robust Regression on Order Statistics (ROS): The ROS procedure is the most suitable method for datasets with a single detection limit [(7)]. ROS uses regression on a probability plot to estimate distributional parameters, usually in log units. Individual estimates are then predicted from the line, and retransformed back into original units. No transformation of the estimated summary statistics occurs. The imputed values are then used collectively with the detected data to compute summary statistics. This is the preferred method for datasets with a single censoring level (λ).

Calculation of summary statistics, including 95% UCLs, for datasets with NDs is based on the both the number of censoring levels as described above as well as the percentage of the dataset being censored (μ). For datasets where less than 40% of the observations are censored, the BCA method is used. BCA intervals are recommended for general use for datasets where the degree of censoring is low (<40%) however the method breaks down when the degree of censoring is high (≥40%) [(4)]. Under these circumstances the median value, which is used to make the adjustment for skewness, is difficult/impossible to determine [(4)]. Therefore, AECOM have elected to use BCA Bootstrap UCL95s for datasets where the degree of censoring is low (<40%), and 95% Percentile Bootstrap UCLs where 40% or more of the observations are NDs (μ).

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[6] Klein and Moeschberger, 2003; as cited in Denis R. Helsel. 2009. Summing Nondetects: Incorporating Low-Level contaminants in Risk Assessment. Integrated Environmental Assessment and Management. Vol.6, No. 3, pp. 361-366.

[7] Helsel D.R. 2005. Nondetects and data analysis: Statistics for censored environmental data. Hoboken (NJ). John Wiley & Sons, 250p.

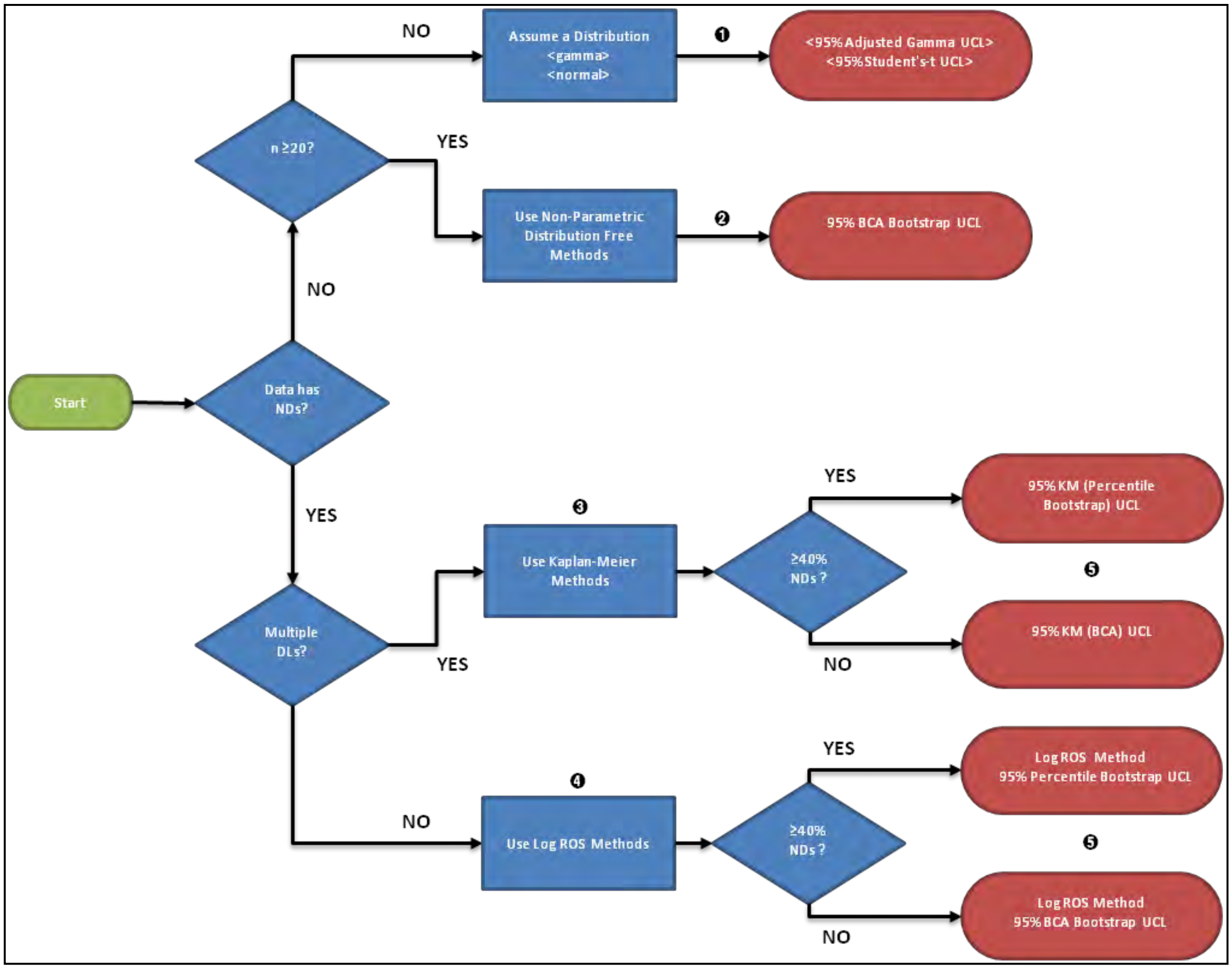


Figure 1: Flowchart showing decision making process for selection of appropriate UCL95s from ProUCL output for environmental concentration data

Table 1: Summary Statistics – All Collocated Soil Samples (mg/kg)

Contaminant	n	n Detected	% ND	n Distinct	n Missing	Max.	Min.	Mean	SD	CV	Skewness	UCL95	Method
Arsenic	31	30	3%	10	0	17	5	10.13	3.099	0.306	-	10.74	6
Barium	31	31	0%	22	0	150	12	36.39	30.82	0.847	2.823	49.26	2
Beryllium	27	26	4%	5	0	0.6	0.2	0.342	0.115	0.336	-	0.37	6
Chromium	31	31	0%	16	0	29	5	17.42	6.015	0.345	-0.508	19.13	2
Iron	31	31	0%	24	0	62000	9600	46052	12518	0.272	-1.328	49148	2
Lead	31	31	0%	16	0	51	2	13.71	8.137	0.594	3.253	17.26	2
Manganese	31	31	0%	27	0	1900	50	1028	516	0.502	0.144	1177	2
Mercury	27	26	4%	10	0	0.24	0.02	0.0612	0.0454	0.742	-	0.0808	6
Molybdenum	31	26	16%	18	0	3.3	0.7	2.146	0.842	0.392	-	2.24	4
Selenium	31	3	90%	2	0	0.8	0.5	0.6	0.134	0.223	-	0.8	Max

Method:
1. 95% Adjusted Gamma UCL
2. 95% BCA Bootstrap UCL
3. 95% KM (Percentile Bootstrap) UCL
4. 95% KM (BCA) UCL
5. Log ROS 95% Percentile Bootstrap UCL
6. Log ROS 95% BCA Bootstrap UCL

Table 2: Summary Statistics – Collocated Partridge Berries Samples

Contaminant	n	n Detected	% ND	n Distinct	n Missing	Max.	Min.	Mean	SD	CV	Skewness	UCL95	Method
Arsenic	12	0	100	0	0	<2.0	-	-	-	-	-	<2.0	Max
Barium	12	12	0%	10	0	23	9	15.83	4.387	0.277	0.173	18.91	1
Beryllium	12	0	100	0	0	<0.1	-	-	-	-	-	<0.1	Max
Chromium	12	0	100	0	0	<1.0	-	-	-	-	-	<1.0	Max
Iron	12	12	0%	11	0	560	54	230.9	178.2	0.772	1.127	374.9	1
Lead	12	0	100	100	0	0	<1.0	-	-	-	-	<1.0	Max
Manganese	12	12	0%	8	0	360	140	293.3	68.14	0.232	-1.479	347	1
Mercury	12	0	100	100	0	0	<0.01	-	-	-	-	<0.01	Max
Molybdenum	12	0	100	100	0	0	<0.5	-	-	-	-	<0.5	Max
Selenium	12	0	100	100	0	0	<0.5	-	-	-	-	<0.5	Max

Method: Locally collected unwashed Partridge Berries.
1. 95% Adjusted Gamma UCL
2. 95% BCA Bootstrap UCL
3. 95% KM (Percentile Bootstrap) UCL
4. 95% KM (BCA) UCL
5. Log ROS 95% Percentile Bootstrap UCL
6. Log ROS 95% BCA Bootstrap UCL

Table 3: Summary Statistics – Collocated Labrador Tea Samples

Contaminant	n	n Detected	% ND	n Distinct	n Missing	Max.	Min.	Mean	SD	CV	Skewness	UCL95	Method
Arsenic	13	0	100	0	0	<2.0	-	-	-	-	-	<2.0	Max
Barium	13	13	13	0%	12	0	78	29	50.69	17.39	0.343	0.418	1
Beryllium	13	0	100	0	0	<0.1	-	-	-	-	-	<0.1	Max
Chromium	13	0	100	0	0	<1.0	-	-	-	-	-	<1.0	Max
Iron	13	13	13	0%	13	0	3200	42	766.5	1005	1.311	1.618	1
Lead	13	0	100	100	0	0	<1.0	-	-	-	-	<1.0	Max
Manganese	13	13	13	0%	11	0	1600	620	1002	298.8	0.298	0.811	1
Mercury	13	0	100	100	0	0	<0.01	-	-	-	-	<0.01	Max
Molybdenum	13	0	100	100	0	0	<0.5	-	-	-	-	<0.5	Max
Selenium	13	0	100	100	0	0	<0.5	-	-	-	-	<0.5	Max

Method: Locally collected unwashed Labrador Tea leaves.
1. 95% Adjusted Gamma UCL
2. 95% BCA Bootstrap UCL
3. 95% KM (Percentile Bootstrap) UCL
4. 95% KM (BCA) UCL
5. Log ROS 95% Percentile Bootstrap UCL
6. Log ROS 95% BCA Bootstrap UCL

Table 4: Summary Statistics – Surface Water from Triangle and Pinette Lake

Contaminant	n	n Detected	% ND	Max.	Method
Arsenic	10	0	100	<0.001	Max
Barium	1	1	0	0.0033	Max
Beryllium	10	0	100	<0.0001	Max
Chromium	10	0	100	<0.001	Max
Iron	10	8	80	1.08	Max
Lead	10	0	100	<0.0005	Max
Manganese	10	10	100	0.104	Max
Mercury	10	0	100	<0.0001	Max
Molybdenum	10	0	100	<0.001	Max
Selenium	10	0	100	<0.003	Max

Method: Maximum for unbalanced data set from Pinette Lake (n=8) and Triangle Lake (n=2)

Table 2: Summary Statistics – Benthic Invertebrates from Triangle and Pinette Lake

Contaminant	n	n Detected	% ND	n Distinct	n Missing	Max.	Min.	Mean	SD	CV	Skewness	UCL95	Method
Arsenic	6	5	17%	5	0	0.61	0.0314	0.212	0.218	1.028	-	0.384	6
Barium	6	6	0%	6	0	8.77	0.245	5.683	3.289	0.579	-0.902	22.3	1
Bismuth	6	1	83%	1	0	0.0149						0.0149	Max
Beryllium	6	0	100%	0	0	<0.6						<0.6	Max
Chromium	6	5	17%	5	0	3.74	0.047	0.872	1.423	1.632	-	2.162	6
Iron	6	6	0%	6	0	4540	160	1147	1704	1.486	2.206	7068	1
Lead	6	6	0%	6	0	1.58	0.0402	0.476	0.555	1.166	2.17	2.186	1
Manganese	6	6	0%	5	0	126	4.36	71.94	49.58	0.689	-0.175	286.7	1
Mercury	6	5	17%	5	0	0.062	0.0082	0.0224	0.0201	0.897	-	0.0411	6
Molybdenum	6	5	17%	5	0	0.32	0.016	0.119	0.106	0.891	-	0.205	6
Selenium	6	5	17%	5	0	0.635	0.134	0.357	0.226	0.633	-	0.499	6

Method:
1. 95% Adjusted Gamma UCL
2. 95% BCA Bootstrap UCL
3. 95% KM (Percentile Bootstrap) UCL
4. 95% KM (BCA) UCL
5. Log ROS 95% Percentile Bootstrap UCL
6. Log ROS 95% BCA Bootstrap UCL

Table 6: Summary Statistics – Fish Collected from Triangle Lake and Pinette Lake

Contaminant	n	n Detected	% ND	Max.	Method
Arsenic	10	5	50	0.0355	Max
Barium	10	4	60	0.093	Max
Beryllium	10	0	100	<0.0020	Max
Chromium	10	0	100	<0.040	Max
Iron	10	10	100	7.2	Max
Lead	10	3	30	0.01	Max
Manganese	10	10	100	0.233	Max
Mercury	10	10	100	0.315	Max
Molybdenum	10	0	100	<0.010	Max
Selenium	10	10	100	1.49	Max

Method: Maximum selected between lake trout (n=5) and brook trout (n=5) collected from Triangle Lake and Pinette Lake.

Table 7: Summary Statistics – Spruce Grouse

Contaminant	n	n Detected	% ND	Max.	Method
Arsenic	3	2	67	0.0123	Max
Barium	3	0	100	<0.020	Max
Beryllium	3	0	100	<0.0020	Max
Chromium	3	0	100	<0.040	Max
Iron	3	3	100	60	Max
Lead	3	3	100	0.341	Max
Manganese	3	3	100	0.63	Max
Mercury	3	1	33	0.0026	Max
Molybdenum	3	3	100	0.017	Max
Selenium	3	3	100	0.388	Max

Method: Maximum selected from locally collected spruce grouse (n=3)

E2. Human Health Risk Assessment Data Tables

Table 1 - Metals Concentration in Fish Tissue Collected From Triangle Lake and Pinette Lake (mg/kg ww)
AECOM
2015

		PI-BROOK1	PI-BROOK2	PI-BROOK3	PI-BROOK4	PI-BROOK5	LAKER 1	LAKER 2	LAKER 2	LAKER 3	LAKER 4	LAKER 5	RDL
		Pinette Lake	Pinette Lake	Pinette Lake	Pinette Lake	Pinette Lake	Triangle Lake	Triangle Lake	Triangle Lake	Triangle Lake	Triangle Lake	Triangle Lake	
Sampling Date		5-Aug-15	5-Aug-15	5-Aug-15	5-Aug-15	5-Aug-15	6-Aug-15	6-Aug-15	6-Aug-15	7-Aug-15	7-Aug-15	7-Aug-15	
Total Metals	**UNITS**												
Total Aluminum	mg/kg	0.31	0.35	<0.20	0.26	<0.20	0.24	<0.20	<0.20	<0.20	<0.20	0.63	0.2
Total Antimony	mg/kg	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.001
Total Arsenic	mg/kg	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0304	0.0338	0.0347	0.0355	0.0254	0.0161	0.005
Total Barium	mg/kg	0.093	0.056	0.073	0.048	0.032	<0.020	<0.020	<0.020	<0.020	<0.020	0.025	0.02
Total Beryllium	mg/kg	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	0.002
Total Bismuth	mg/kg	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.02
Total Boron	mg/kg	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	0.4
Total Cadmium	mg/kg	0.002	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	0.002
Total Calcium	mg/kg	118	96.7	143	71.3	93.7	61.7	54.7	54.5	55.8	50.6	77.8	2
Total Chromium	mg/kg	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	0.04
Total Cobalt	mg/kg	0.0043	<0.0040	0.0045	0.0053	0.0047	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	0.004
Total Copper	mg/kg	0.298	0.211	0.28	0.383	0.341	0.215	0.246	0.277	0.222	0.192	0.286	0.01
Total Iron	mg/kg	6	3.8	3.9	7.2	4.7	3.7	2.9	3.5	3	3.9	3.8	2
Total Lead	mg/kg	0.0031	0.0051	<0.0020	<0.0020	0.01	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	0.002
Total Magnesium	mg/kg	302	299	321	296	326	305	311	310	286	257	264	2
Total Manganese	mg/kg	0.233	0.111	0.142	0.204	0.117	0.068	0.073	0.074	0.061	0.053	0.088	0.02
Total Mercury	mg/kg	0.244	0.0759	0.162	0.102	0.1	0.212	0.229	0.282	0.315	0.239	0.197	0.002
Total Molybdenum	mg/kg	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.01
Total Nickel	mg/kg	0.017	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.01
Total Phosphorus	mg/kg	2640	2630	2740	2560	2880	2720	2720	2740	2530	2300	2380	2
Total Potassium	mg/kg	4540	4550	4470	4200	4840	4480	4630	4590	4350	3930	3810	2
Total Selenium	mg/kg	0.316	0.319	0.311	0.306	0.338	1.45	1.38	1.49	1.3	1.26	1.46	0.01
Total Silver	mg/kg	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	0.004
Total Sodium	mg/kg	263	213	253	192	242	285	299	306	299	294	272	2
Total Strontium	mg/kg	0.306	0.258	0.483	0.169	0.258	0.031	<0.020	<0.020	<0.020	<0.020	0.052	0.02
Total Thallium	mg/kg	0.00326	0.00254	0.00196	0.0027	0.00279	0.00108	0.00166	0.00195	0.00181	0.00166	0.00129	0.0004
Total Tin	mg/kg	0.041	0.027	0.023	0.034	0.031	0.024	0.024	<0.020	<0.020	0.029	0.024	0.02
Total Titanium	mg/kg	0.091	0.086	0.082	0.08	0.089	0.077	0.06	0.072	0.065	0.055	<0.050	0.05
Total Uranium	mg/kg	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	0.0004
Total Vanadium	mg/kg	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	0.04
Total Zinc	mg/kg	3.37	3.23	3.42	3.54	3.48	2.8	3.02	3.29	2.57	2.61	3.02	0.04

RDL = Reportable Detection Limit
Lab-Dup = Laboratory Initiated Duplicate

Table 2 - Metals Concentrations in Benthic Invertebrates (mg/kg ww) from Triangle Lake and Pinette Lake
AECOM
2015

		PI-INV1	RDL	PI-INV2	RDL	PI-INV3	RDL	TR-INV1	RDL	TR-INV2	RDL	TR-INV3	RDL
		Pinette Lake		Pinette Lake		Pinette Lake		Triangle Lake		Triangle Lake		Triangle Lake	
Sampling Date		5-Aug-15		7-Aug-15		7-Aug-15		7-Aug-15		7-Aug-15		7-Aug-15	
Total Metals by ICPMS	**UNITS**												
Total Aluminum	mg/kg	53.4	1	143	6	17.9	0.2	37.8	0.6	248	0.4	1840	4
Total Antimony	mg/kg	0.0157	0.005	<0.030	0.03	0.0012	0.001	0.0158	0.003	0.01	0.002	0.048	0.02
Total Arsenic	mg/kg	0.095	0.025	<0.15	0.15	0.0314	0.005	0.292	0.015	0.188	0.01	0.61	0.1
Total Barium	mg/kg	7.14	0.1	5.43	0.6	0.245	0.02	8.77	0.06	3.79	0.04	8.72	0.4
Total Beryllium	mg/kg	<0.010	0.01	<0.060	0.06	<0.0020	0.002	<0.0060	0.006	0.0149	0.004	<0.040	0.04
Total Bismuth	mg/kg	<0.10	0.1	<0.60	0.6	<0.020	0.02	<0.060	0.06	<0.040	0.04	<0.40	0.4
Total Boron	mg/kg	2.4	2	<12	12	<0.40	0.4	1.5	1.2	5.46	0.8	<8.0	8
Total Cadmium	mg/kg	0.045	0.01	0.152	0.06	0.0213	0.002	0.161	0.006	0.0493	0.004	0.054	0.04
Total Calcium	mg/kg	255	10	336	60	43.4	2	17600	6	451	4	474	40
Total Chromium	mg/kg	<0.20	0.2	<1.2	1.2	0.047	0.04	0.3	0.12	0.725	0.08	3.74	0.8
Total Cobalt	mg/kg	0.18	0.02	0.18	0.12	0.0172	0.004	0.05	0.012	0.373	0.008	0.834	0.08
Total Copper	mg/kg	2.55	0.05	2.68	0.3	2.96	0.01	3.58	0.03	2.53	0.02	5.27	0.2
Total Iron	mg/kg	502	10	287	60	160	2	211	6	1180	4	4540	40
Total Lead	mg/kg	0.375	0.01	0.204	0.06	0.0402	0.002	0.359	0.006	0.297	0.004	1.58	0.04
Total Magnesium	mg/kg	192	10	203	60	60.5	2	321	6	336	4	1440	40
Total Manganese	mg/kg	68.6	0.1	126	0.6	4.36	0.02	29.1	0.06	77.6	0.04	126	0.4
Total Mercury	mg/kg	0.024	0.01	0.062	0.06	0.0125	0.002	0.0082	0.006	0.0135	0.004	<0.040	0.04
Total Molybdenum	mg/kg	0.128	0.05	<0.30	0.3	0.016	0.01	0.079	0.03	0.107	0.02	0.32	0.2
Total Nickel	mg/kg	0.144	0.05	0.44	0.3	0.136	0.01	0.15	0.03	0.622	0.02	2.61	0.2
Total Phosphorus	mg/kg	839	10	1090	60	664	2	2810	6	1020	4	1660	40
Total Potassium	mg/kg	349	10	458	60	187	2	54.9	6	134	4	187	40
Total Selenium	mg/kg	0.162	0.05	<0.30	0.3	0.134	0.01	0.635	0.03	0.523	0.02	0.52	0.2
Total Silver	mg/kg	<0.020	0.02	<0.12	0.12	0.02	0.004	0.411	0.012	0.0114	0.008	<0.080	0.08
Total Sodium	mg/kg	393	10	449	60	79.1	2	138	6	327	4	704	40
Total Strontium	mg/kg	1.71	0.1	3.77	0.6	0.089	0.02	22.5	0.06	0.809	0.04	2.6	0.4
Total Thallium	mg/kg	0.0023	0.002	0.024	0.012	0.0017	0.0004	0.0074	0.0012	0.00294	0.0008	0.0112	0.008
Total Tin	mg/kg	<0.10	0.1	<0.60	0.6	<0.020	0.02	<0.060	0.06	0.042	0.04	<0.40	0.4
Total Titanium	mg/kg	1.22	0.25	2.7	1.5	0.478	0.05	0.92	0.15	4.97	0.1	33.2	1
Total Uranium	mg/kg	0.0097	0.002	0.023	0.012	0.0026	0.0004	0.0198	0.0012	0.0424	0.0008	0.122	0.008
Total Vanadium	mg/kg	<0.20	0.2	<1.2	1.2	<0.040	0.04	<0.12	0.12	0.452	0.08	2.38	0.8
Total Zinc	mg/kg	33.5	0.2	32	1.2	15.8	0.04	15.1	0.12	29.3	0.08	53.9	0.8

RDL = Reportable Detection Limit

Table 3 - Metals Concentrations in Spruce Grouse (mg/kg ww) from the Howse Project Property
AECOM, 2015

	UNITS	H-BS-P-1	H-BS-P-1 (Lab Dup)	RPD	H-BS-P-2	H-BS-P-3	RDL
Sampling Date		26-Aug-15	26-Aug-15		26-Aug-15	26-Aug-15	
Total Metals							
Total Aluminum	mg/kg	0.96	0.7	31.3%	1.03	0.71	0.2
Total Antimony	mg/kg	<0.0010	<0.0010	-	0.0061	0.0188	0.001
Total Arsenic	mg/kg	<0.0050	<0.0050	-	0.0123	0.0111	0.005
Total Barium	mg/kg	<0.020	<0.020	-	<0.020	<0.020	0.02
Total Beryllium	mg/kg	<0.0020	<0.0020	-	<0.0020	<0.0020	0.002
Total Bismuth	mg/kg	<0.020	<0.020	-	<0.020	<0.020	0.02
Total Boron	mg/kg	<0.40	<0.40	-	<0.40	<0.40	0.4
Total Cadmium	mg/kg	0.0029	0.0031	6.7%	0.0042	0.0073	0.002
Total Calcium	mg/kg	40.6	41.6	2.4%	59.2	73.5	2
Total Chromium	mg/kg	<0.040	<0.040	-	<0.040	<0.040	0.04
Total Cobalt	mg/kg	<0.0040	<0.0040	-	<0.0040	<0.0040	0.004
Total Copper	mg/kg	3.28	3.4	3.6%	3.4	3.06	0.01
Total Iron	mg/kg	49.9	53	6.0%	60	49.6	2
Total Lead	mg/kg	0.0047	0.0039	18.6%	0.0553	0.341	0.002
Total Magnesium	mg/kg	299	297	0.7%	318	336	2
Total Manganese	mg/kg	0.556	0.503	10.0%	0.612	0.63	0.02
Total Mercury	mg/kg	<0.0020	<0.0020	-	<0.0020	0.0026	0.002
Total Molybdenum	mg/kg	0.013	0.017	26.7%	0.017	0.013	0.01
Total Nickel	mg/kg	<0.010	<0.010	-	<0.010	<0.010	0.01
Total Phosphorus	mg/kg	2630	2730	3.7%	2900	2970	2
Total Potassium	mg/kg	3060	3130	2.3%	3330	3640	2
Total Selenium	mg/kg	0.273	0.293	7.1%	0.388	0.318	0.01
Total Silver	mg/kg	<0.0040	<0.0040	-	<0.0040	<0.0040	0.004
Total Sodium	mg/kg	555	545	1.8%	673	471	2
Total Strontium	mg/kg	0.096	0.097	1.0%	0.088	0.192	0.02
Total Thallium	mg/kg	<0.00040	<0.00040	-	<0.00040	<0.00040	0.0004
Total Tin	mg/kg	0.026	0.032	20.7%	0.035	<0.020	0.02
Total Titanium	mg/kg	0.077	0.084	8.7%	0.07	0.11	0.05
Total Uranium	mg/kg	<0.00040	<0.00040	-	<0.00040	<0.00040	0.0004
Total Vanadium	mg/kg	<0.040	<0.040	-	<0.040	<0.040	0.04
Total Zinc	mg/kg	6.44	6.44	0.0%	6.54	6.58	0.04

RDL = Reportable Detection Limit

Lab-Dup = Laboratory Initiated Duplicate

Table 4 - Petroleum Aromatic Hydrocarbon Concentrations in Labrador Tea (mg/kg dw) from the Howse Project Property and Greenbush Area
AECOM, 2015

		HOWSE PROJECT PROPERTY														
		HOW-LT-1 A	HOW-LT-1 A Lab-Dup	RPD	HOW-LT-1 B	HOW-LT-2 A	HOW-LT-2 B	HOW-LT-2 B Lab-Dup	RPD	HOW-LT-3 A	HOW-LT-3 B	HOW-LT-4 A	HOW-LT-4 B	HOW-LT-5 A	HOW-LT-5 B	HOW-LT-5 C
Sampling Date		26-Jul-15	26-Jul-15		26-Jul-15	26-Jul-15	26-Jul-15	26-Jul-15		26-Jul-15	26-Jul-15	26-Jul-15	26-Jul-15	26-Jul-15	26-Jul-15	26-Jul-15
% MOISTURE	%	77	77	-	59	75	60	60	-	80	60	80	59	78	67	65
PAH	**Units**															
Acenaphthene	mg/kg	<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
Acenaphthylene	mg/kg	<0.1	<0.1	-	<0.1	<0.1	<0.1	<0.1	-	0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Anthracene	mg/kg	<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
Benzo(a)anthracene	mg/kg	<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
Benzo(a)pyrene	mg/kg	<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
Benzo(b)fluoranthene	mg/kg	<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
Benzo(j)fluoranthene	mg/kg	<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
Benzo(k)fluoranthene	mg/kg	<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
Benzo(c)phenanthrene	mg/kg	<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
Benzo(ghi)perylene	mg/kg	<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
Chrysene	mg/kg	<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
Dibenz(a,h)anthracene	mg/kg	<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
Dibenzo(a,i)pyrene	mg/kg	<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
Dibenzo(a,h)pyrene	mg/kg	<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
Dibenzo(a,l)pyrene	mg/kg	<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
7,12-Dimethylbenzanthracene	mg/kg	<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
Fluoranthene	mg/kg	<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
Fluorene	mg/kg	<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
Indeno(1,2,3-cd)pyrene	mg/kg	<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
3-Methylcholanthrene	mg/kg	<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
Naphthalene	mg/kg	<0.4 (1)	<0.3 (1)	-	<0.2 (1)	<0.01	<0.01	<0.01	-	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Phenanthrene	mg/kg	<0.04	<0.04	-	<0.04	<0.04	<0.04	<0.04	-	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
Pyrene	mg/kg	<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
2-Methylnaphthalene	mg/kg	<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
1-Methylnaphthalene	mg/kg	<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
1,3-Dimethylnaphthalene	mg/kg	0.2	0.2	-	0.3	<0.2 (1)	<0.1	<0.1	-	<0.3 (1)	<0.1	<0.1	<0.1	<0.3 (1)	<0.5 (1)	<0.6 (1)
2,3,5-Trimethylnaphthalene	mg/kg	<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

A - Washed, B - Unwashed, C- Unwashed Replicate

RDL = Reportable Detection Limit

(1) Detection limit raised due to matrix interference.

Table 4 - Petroleum Aromatic Hydrocarbon Concentrations in Labrador Tea (mg/kg dw) from the Howse Project Property and Greenbush Area
AECOM, 2015

		GREENBUSH AREA											
		GB-LT-1 A	**GB-LT-1 B**	**GB-LT-2 A**	**GB-LT-2 B**	**GB-LT-3 A**	**GB-LT-3 B**	**GB-LT-4 A**	**GB-LT-4 B**	**GB-LT-5 A**	**GB-LT-5 B**	**GB-LT-5 C**	**RDL**
Sampling Date		26-Jul-15	26-Jul-15	26-Jul-15	26-Jul-15	26-Jul-15	26-Jul-15	26-Jul-15	26-Jul-15	26-Jul-15	26-Jul-15	26-Jul-15	
% MOISTURE	%	88	64	88	66	77	63	81	64	85	60	60	N/A
PAH	**Units**												
Acenaphthene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Acenaphthylene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Benzo(a)anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Benzo(a)pyrene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Benzo(b)fluoranthene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Benzo(j)fluoranthene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Benzo(k)fluoranthene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Benzo(c)phenanthrene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Benzo(ghi)perylene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Chrysene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Dibenz(a,h)anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Dibenzo(a,i)pyrene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Dibenzo(a,h)pyrene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Dibenzo(a,l)pyrene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
7,12-Dimethylbenzanthracene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Fluoranthene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Fluorene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.3 (1)	<0.3 (1)	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Indeno(1,2,3-cd)pyrene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
3-Methylcholanthrene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Naphthalene	mg/kg	0.03	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01
Phenanthrene	mg/kg	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	0.04
Pyrene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
2-Methylnaphthalene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
1-Methylnaphthalene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
1,3-Dimethylnaphthalene	mg/kg	<0.9 (1)	<0.3 (1)	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
2,3,5-Trimethylnaphthalene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1

A - Washed, B - Unwashed, C- Unwashed

RDL = Reportable Detection Limit

(1) Detection limit raised due to matrix in

Table 5 - Metals Concentrations in Labrador Tea (mg/kg dw) from the Howse Project Property and Greenbush Area
AECOM, 2015

		HOWSE PROJECT PROPERTY														
	Units	HOW-LT-1 A	HOW-LT-1 A Lab-Dup	RPD	HOW-LT-1 B	HOW-LT-1 B Lab-Dup	RPD	HOW-LT-2 A	HOW-LT-2 B	HOW-LT-3 A	HOW-LT-3 B	HOW-LT-4 A	HOW-LT-4 B	HOW-LT-5 A	HOW-LT-5 B	HOW-LT-5 C
% MOISTURE	%	77	77		59	59		75	60	80	60	80	59	78	67	65
Sampling Date		26-Jul-15	26-Jul-15		26-Jul-15	26-Jul-15		26-Jul-15	26-Jul-15	26-Jul-15	26-Jul-15	26-Jul-15	26-Jul-15	26-Jul-15	26-Jul-15	26-Jul-15
METALS																
Aluminum	mg/kg	<20	<20	-	<20	<20	-	31	28	23	26	<20	27	49	<20	23
Antimony	mg/kg	0.7	0.3 (1)	80%	<0.1	<0.1	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Silver	mg/kg	<0.5	<0.5	-	<0.5	<0.5	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Arsenic	mg/kg	<2	<2	-	<2	<2	-	<2	<2	<2	<2	<2	<2	<2	<2	<2
Barium	mg/kg	34	31	9%	29	29	0%	66	70	71	74	46	66	48	32	35
Beryllium	mg/kg	<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
Bismuth	mg/kg	<2	<2	-	<2	<2	-	<2	<2	<2	<2	<2	<2	<2	<2	<2
Boron	mg/kg	10	10	0%	10	10	0%	14	12	12	11	13	14	16	16	17
Cadmium	mg/kg	<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
Calcium	mg/kg	2500	2500	0%	2300	2300	0%	3900	4100	4500	4400	3200	4100	5700	4100	4300
Chromium	mg/kg	<1	<1	-	<1	<1	-	<1	<1	<1	<1	<1	<1	<1	<1	<1
Copper	mg/kg	6	6	0%	6	6	0%	5	4	6	5	6	5	5	6	6
Cobalt	mg/kg	<1	<1	-	<1	<1	-	<1	<1	<1	<1	<1	<1	<1	<1	<1
Tin	mg/kg	1	1	0%	1	1	0%	1	1	1	1	1	1	1	1	1
Iron	mg/kg	43	43	0%	42	41	2%	44	45	150	180	120	190	63	65	68
Lithium	mg/kg	<5	<5	-	<5	<5	-	<5	<5	<5	<5	<5	<5	<5	<5	<5
Magnesium	mg/kg	670	680	1%	650	670	3%	710	680	850	810	880	890	660	760	740
Manganese	mg/kg	700	730	4%	620	660	6%	880	870	1600	1600	1000	1400	1500	880	990
Mercury	mg/kg	<0.010	-	-	<0.010	-	-	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Molybdenum	mg/kg	<0.5	<0.5	-	<0.5	<0.5	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Nickel	mg/kg	0.7	0.7	0%	0.5	0.5	0%	0.8	0.8	0.8	0.7	0.7	0.7	0.8	0.9	0.9
Phosphorus	mg/kg	1800	1800	0%	1800	1900	5%	1700	1500	2100	1900	2200	1700	1700	2400	2200
Potassium	mg/kg	7000	6500	7%	6700	6900	3%	6600	5900	7100	6300	8000	6000	6600	9100	8600
Lead	mg/kg	<1	<1	-	<1	<1	-	<1	<1	<1	<1	<1	<1	<1	<1	<1
Selenium	mg/kg	<0.5	<0.5	-	<0.5	<0.5	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Sodium	mg/kg	<10	<10	-	<10	<10	-	<10	<10	<10	<10	<10	<10	<10	<10	<10
Strontium	mg/kg	<5	<5	-	<5	<5	-	12	13	22	25	7	9	16	9	11
Tellurium	mg/kg	<0.5	<0.5	-	<0.5	<0.5	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Thallium	mg/kg	<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
Thorium	mg/kg	<4	<4	-	<4	<4	-	<4	<4	<4	<4	<4	<4	<4	<4	<4
Titanium	mg/kg	<2	<2	-	<2	<2	-	<2	<2	<2	<2	<2	<2	<2	<2	<2
Tungsten	mg/kg	<1	<1	-	<1	<1	-	<1	<1	<1	<1	<1	<1	<1	<1	<1
Vanadium	mg/kg	<2	<2	-	<2	<2	-	<2	<2	<2	<2	<2	<2	<2	<2	<2
Zinc	mg/kg	18	18	0%	17	19	11%	19	18	25	22	20	20	25	25	26
Zirconium	mg/kg	<2	<2	-	<2	<2	-	<2	<2	<2	<2	<2	<2	<2	<2	<2

A - Washed, B - Unwashed, C- Unwashed Replicate

RDL = Reportable Detection Limit

Table 5 - Metals Concentrations in Labrador Tea (mg/kg dw) from the Howse Project Property and Greenbush Area
AECOM, 2015

		GREENBUSH AREA											
	Units	GB-LT-1 A	GB-LT-1 B	GB-LT-2 A	GB-LT-2 B	GB-LT-3 A	GB-LT-3 B	GB-LT-4 A	GB-LT-4 B	GB-LT-5 A	GB-LT-5 B	GB-LT-5 C	RDL
% MOISTURE	%	88	64	88	66	77	63	81	64	85	60	60	N/A
Sampling Date		26-Jul-15	26-Jul-15	26-Jul-15	26-Jul-15	26-Jul-15	26-Jul-15	26-Jul-15	26-Jul-15	26-Jul-15	26-Jul-15	26-Jul-15	
METALS													
Aluminum	mg/kg	110	120	50	49	190	250	94	89	67	83	98	20
Antimony	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Silver	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Arsenic	mg/kg	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	2
Barium	mg/kg	42	43	83	78	43	42	42	40	44	38	46	4
Beryllium	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Bismuth	mg/kg	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	2
Boron	mg/kg	14	13	20	18	15	15	11	11	12	12	13	2
Cadmium	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Calcium	mg/kg	3200	3200	4100	3900	3700	3600	4500	3700	4100	3800	4200	20
Chromium	mg/kg	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	1
Copper	mg/kg	6	6	6	7	6	6	6	7	4	4	4	1
Cobalt	mg/kg	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	1
Tin	mg/kg	1	1	1	1	1	1	1	1	1	1	1	1
Iron	mg/kg	1900	2400	430	600	2400	3200	890	1200	620	930	1000	10
Lithium	mg/kg	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	5
Magnesium	mg/kg	870	920	760	780	850	810	810	760	750	730	730	5
Manganese	mg/kg	650	640	1200	1100	960	830	930	820	1100	1000	1400	2
Mercury	mg/kg	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.01
Molybdenum	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Nickel	mg/kg	1.2	1.3	1	0.9	1.3	1.2	1	1	0.8	0.9	1	0.5
Phosphorus	mg/kg	2100	2100	1900	2000	1800	1800	1900	1900	1300	1400	1200	20
Potassium	mg/kg	7700	7300	8100	8500	6900	7900	7200	7500	5500	5400	4900	20
Lead	mg/kg	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	1
Selenium	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Sodium	mg/kg	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	10
Strontium	mg/kg	11	11	5	5	9	8	8	8	10	9	9	5
Tellurium	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Thallium	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Thorium	mg/kg	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	4
Titanium	mg/kg	<2	<2	<2	<2	3	3	<2	<2	<2	<2	<2	2
Tungsten	mg/kg	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	1
Vanadium	mg/kg	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	2
Zinc	mg/kg	23	22	20	19	19	18	22	20	19	18	20	5
Zirconium	mg/kg	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	2

A - Washed, B - Unwashed, C-

RDL = Reportable Detection Li

Table 6 - Petroleum Aromatic Hydrocarbon Concentrations in Partridge Berries (mg/kg dw) from the Howse Project Property and Greenbush Area
AECOM, 2015

		HOWSE PROJECT PROPERTY										
	Units	**HOW-PB-1 A**	**HOW-PB-1 B**	**HOW-PB-2 A**	**HOW-PB-2 B**	**HOW-PB-3 A**	**HOW-PB-3 B**	**HOW-PB-4 A**	**HOW-PB-4 B**	**HOW-PB-5 A**	**HOW-PB-5 B**	**HOW-PB-5 C**
Sampling Date		30-Aug-15	30-Aug-15	30-Aug-15	30-Aug-15	30-Aug-15	30-Aug-15	30-Aug-15	30-Aug-15	30-Aug-15	30-Aug-15	30-Aug-15
% Moisture	%	89	88	88	85	88	87	90	88	88	88	88
PAH												
Acenaphthene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthylene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(a)anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(a)pyrene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(b)fluoranthene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(j)fluoranthene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(k)fluoranthene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(c)phenanthrene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(ghi)perylene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Chrysene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Dibenz(a,h)anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Dibenzo(a,i)pyrene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Dibenzo(a,h)pyrene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Dibenzo(a,l)pyrene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
7,12-Dimethylbenzanthracene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Fluoranthene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Fluorene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Indeno(1,2,3-cd)pyrene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
3-Methylcholanthrene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Naphthalene	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Phenanthrene	mg/kg	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
Pyrene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
2-Methylnaphthalene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
1-Methylnaphthalene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
1,3-Dimethylnaphthalene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
2,3,5-Trimethylnaphthalene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1

A - Washed, B - Unwashed, C - Unwashed Replicate

RDL = Reportable Detection Limit

Table 6 - Petroleum Aromatic Hydrocarbon Concentrations in Partridge Berries (mg/kg dw) from the Howse Project Property and Greenbush Area
AECOM, 2015

		GREENBUSH AREA (DI - DUST IMPACTED)															
	Units	**DI-PB-1 A**	**DI-PB-1 B**	**DI-PB-1 B Lab-Dup**	**RPD**	**DI-PB-2 A**	**DI-PB-2 B**	**DI-PB-3 A**	**DI-PB-3 B**	**DI-PB-4 A**	**DI-PB-4 B**	**DI-PB-5 A**	**DI-PB-5 A Lab-Dup**	**RPD**	**DI-PB-5 B**	**DI-PB-5 C**	**RDL**
Sampling Date		30-Aug-15	30-Aug-15	30-Aug-15		30-Aug-15	30-Aug-15	30-Aug-15	30-Aug-15	30-Aug-15	30-Aug-15	30-Aug-15	30-Aug-15		30-Aug-15	30-Aug-15	
% Moisture	%	87	87	87	-	89	88	88	87	88	88	88	88	-	88	88	N/A
PAH																	
Acenaphthene	mg/kg	<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	0.1
Acenaphthylene	mg/kg	<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	0.1
Anthracene	mg/kg	<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	0.1
Benzo(a)anthracene	mg/kg	<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	0.1
Benzo(a)pyrene	mg/kg	<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	0.1
Benzo(b)fluoranthene	mg/kg	<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	0.1
Benzo(j)fluoranthene	mg/kg	<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	0.1
Benzo(k)fluoranthene	mg/kg	<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	0.1
Benzo(c)phenanthrene	mg/kg	<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	0.1
Benzo(ghi)perylene	mg/kg	<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	0.1
Chrysene	mg/kg	<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	0.1
Dibenz(a,h)anthracene	mg/kg	<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	0.1
Dibenzo(a,i)pyrene	mg/kg	<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	0.1
Dibenzo(a,h)pyrene	mg/kg	<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	0.1
Dibenzo(a,l)pyrene	mg/kg	<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	0.1
7,12-Dimethylbenzanthracene	mg/kg	<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	0.1
Fluoranthene	mg/kg	<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	0.1
Fluorene	mg/kg	<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	0.1
Indeno(1,2,3-cd)pyrene	mg/kg	<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	0.1
3-Methylcholanthrene	mg/kg	<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	0.1
Naphthalene	mg/kg	<0.01	<0.01	<0.01	-	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	0.01
Phenanthrene	mg/kg	<0.04	<0.04	<0.04	-	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	-	<0.04	<0.04	0.04
Pyrene	mg/kg	<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	0.1
2-Methylnaphthalene	mg/kg	<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	0.1
1-Methylnaphthalene	mg/kg	<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	0.1
1,3-Dimethylnaphthalene	mg/kg	<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	0.1
2,3,5-Trimethylnaphthalene	mg/kg	<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	0.1

A - Washed, B - Unwashed, C - Unwashed

RDL = Reportable Detection Limit

Table 7 - Metal Concentrations in Partridge Berries (mg/kg dw) from the Howse Project Property and Greenbush Area
AECOM, 2015

		HOWSE PROJECT PROPERTY											
		HOW-PB-1 A	HOW-PB-1A Lab-Dup	HOW-PB-1 B	HOW-PB-2 A	HOW-PB-2 B	HOW-PB-3 A	HOW-PB-3 B	HOW-PB-4 A	HOW-PB-4 B	HOW-PB-5 A	HOW-PB-5 B	HOW-PB-5 C
Sampling Date		30-Aug-15	30-Aug-15	30-Aug-15	30-Aug-15	30-Aug-15	30-Aug-15	30-Aug-15	30-Aug-15	30-Aug-15	30-Aug-15	30-Aug-15	30-Aug-15
% Moisture	%	89	89	88	88	85	88	87	90	88	88	88	88
METALS	**Units**												
Aluminum	mg/kg	26	26	39	33	74	23	30	<20	22	43	66	26
Antimony	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Silver	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Arsenic	mg/kg	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Barium	mg/kg	16	14	14	17	21	18	15	13	13	15	17	15
Beryllium	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Bismuth	mg/kg	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Boron	mg/kg	9	7	7	10	10	8	7	6	7	6	6	5
Cadmium	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Calcium	mg/kg	1300	1200	1200	1300	1400	1300	1200	1400	1300	1300	1500	1400
Chromium	mg/kg	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Copper	mg/kg	4	4	4	4	4	4	4	3	3	4	4	4
Cobalt	mg/kg	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Tin	mg/kg	1	1	1	1	1	1	1	1	1	1	1	1
Iron	mg/kg	30	27	170	110	530	20	72	29	54	170	170	150
Lithium	mg/kg	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Magnesium	mg/kg	480	450	460	320	340	460	450	410	380	450	540	470
Manganese	mg/kg	320	290	300	170	180	340	330	310	280	320	350	320
Mercury (Hg)	mg/kg	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Nickel	mg/kg	0.9	0.9	0.8	1.8	1.9	0.8	0.8	0.7	0.6	0.6	0.8	0.7
Phosphorus	mg/kg	860	850	860	870	820	790	770	780	730	790	950	860
Potassium	mg/kg	5800	5700	5800	4200	4000	5400	5200	5400	5500	5300	5400	5300
Lead	mg/kg	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Selenium	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Sodium	mg/kg	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Strontium	mg/kg	7	6	6	8	9	6	<5	<5	<5	<5	6	5
Tellurium	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Thallium	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Thorium	mg/kg	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4
Titanium	mg/kg	<2	<2	<2	<2	2	<2	<2	<2	<2	<2	2	<2
Tungsten	mg/kg	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Vanadium	mg/kg	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Zinc	mg/kg	9	8	9	10	11	8	8	8	8	9	10	9
Zirconium	mg/kg	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2

A - Washed, B - Unwashed, C - Unwashed Replicate

RDL = Reportable Detection Limit

Table 7 - Metal Concentrations in Partridge Berries (mg/kg dw) from the Howse Project Property and Greenbush Area
AECOM, 2015

		GREENBUSH AREA											
		DI-PB-1 A	DI-PB-1 B	DI-PB-2 A	DI-PB-2 B	DI-PB-3 A	DI-PB-3 B	DI-PB-4 A	DI-PB-4 B	DI-PB-5 A	DI-PB-5 B	DI-PB-5 C	RDL
Sampling Date		30-Aug-15	30-Aug-15	30-Aug-15	30-Aug-15	30-Aug-15	30-Aug-15	30-Aug-15	30-Aug-15	30-Aug-15	30-Aug-15	30-Aug-15	
% Moisture	%	87	87	89	88	88	87	88	88	88	88	88	N/A
METALS	**Units**												
Aluminum	mg/kg	27	27	<20	<20	42	70	32	47	27	47	41	20
Antimony	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Silver	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Arsenic	mg/kg	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	2
Barium	mg/kg	22	23	11	11	11	12	10	9	15	20	20	4
Beryllium	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Bismuth	mg/kg	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	2
Boron	mg/kg	7	7	13	14	12	12	11	9	7	7	7	2
Cadmium	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Calcium	mg/kg	1300	1300	920	950	1100	1100	1100	920	1100	1400	1300	20
Chromium	mg/kg	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	1
Copper	mg/kg	5	5	4	4	4	4	3	3	4	4	5	1
Cobalt	mg/kg	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	1
Tin	mg/kg	1	1	1	1	1	1	1	1	1	1	1	1
Iron	mg/kg	51	95	81	120	180	560	230	450	43	190	210	10
Lithium	mg/kg	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	5
Magnesium	mg/kg	560	560	420	420	410	400	390	340	420	490	480	5
Manganese	mg/kg	300	300	140	140	360	330	300	280	300	360	350	2
Mercury (Hg)	mg/kg	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.01
Nickel	mg/kg	1.2	1	0.8	1	<0.5	<0.5	0.5	<0.5	0.7	1	1	0.5
Phosphorus	mg/kg	920	820	740	800	830	760	700	590	730	840	840	20
Potassium	mg/kg	5600	5200	6900	6400	6600	5900	4900	4400	5100	5600	4800	20
Lead	mg/kg	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	1
Selenium	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Sodium	mg/kg	<10	<10	<10	<10	<10	<10	<10	13	<10	11	<10	10
Strontium	mg/kg	9	9	<5	<5	<5	<5	<5	<5	<5	<5	<5	5
Tellurium	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Thallium	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Thorium	mg/kg	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	4
Titanium	mg/kg	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	2
Tungsten	mg/kg	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	1
Vanadium	mg/kg	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	2
Zinc	mg/kg	8	8	14	14	8	8	8	7	7	9	9	5
Zirconium	mg/kg	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	2

A - Washed, B - Unwashed, C - L

RDL = Reportable Detection Lim

Table 9 - Metal Concentrations in Collocated Soil (mg/kg dw) from the Howse Project Property and Greenbush Area
AECOM, 2015

							HOWSE PROJECT PROPERTY													
	Units	RDL	CCME Parkland SGQ HH	A	B	C	HOW-LT-1-S	HOW-LT-2-S	HOW-LT-3-S	HOW-LT-4-S	HOW-LT-5-S	HOW-LT-56 (DUP)-S	HOW-PB-1-S	HOW-PB-1-S Lab-Dup	HOW-PB-1-S Lab-Dup 2	HOW-PB-2-S	HOW-PB-3-S	HOW-PB-4-S	HOW-PB-5-S	HOW-PB-5B (DUP)-S
Sampling Date			mg/kg	mg/kg			26-Jul-15	26-Jul-15	26-Jul-15	26-Jul-15	26-Jul-15	26-Jul-15	30-Aug-15	30-Aug-15	30-Aug-15	30-Aug-15	30-Aug-15	30-Aug-15	30-Aug-15	30-Aug-15
% MOISTURE	%	N/A	-	-	-	-	18	25	31	67	24	20	22	22	22	16	21	31	22	22
METALS																				
Aluminum	mg/kg	20	-	-	-	-	2800	4400	9100	3100	5400	4200	12000	12000	12000	9100	13000	9100	9400	10000
Antimony	mg/kg	0.1	-	-	-	-	0.4	0.5	0.3	0.2	0.3	0.3	0.4	0.3	0.4	0.4	0.4	0.5	0.4	0.5
Silver	mg/kg	0.5		**2**	20	40	<0.5	<0.5	1	0.7	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Arsenic	mg/kg	2	12	**10**	30	50	**11**	**14**	**10**	5	**9**	**9**	**13**	**12**	**12**	**11**	**14**	**12**	**10**	**12**
Barium	mg/kg	4	500	**245**	500	2000	20	35	32	33	20	19	28	28	28	40	22	30	130	27
Beryllium	mg/kg	0.1	4	-	-	-	0.2	0.3	0.4	0.2	0.3	0.2	0.4	0.4	0.4	0.5	0.4	0.3	0.4	0.4
Bismuth	mg/kg	2		-	-	-	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Boron	mg/kg	2		-	-	-	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Cadmium	mg/kg	0.1	14	**1.5**	5	20	<0.1	0.1	0.1	0.2	<0.1	<0.1	<0.1	<0.1	<0.1	0.2	<0.1	0.1	0.2	0.1
Calcium	mg/kg	20		-	-	-	<20	<20	<20	170	<20	<20	88	110	82	150	110	190	250	190
Chromium	mg/kg	1	220	**85**	250	800	11	10	19	6	11	8	24	22	23	23	29	20	18	21
Copper	mg/kg	1	1100	**40**	100	500	5	6	8	4	7	5	15	13	13	28	14	13	16	20
Cobalt	mg/kg	1		**15**	50	300	2	4	7	<1	3	2	11	10	10	11	7	4	7	9
Tin	mg/kg	1		**5**	50	300	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Iron	mg/kg	10		-	-	-	34000	49000	49000	13000	40000	35000	58000	53000	54000	54000	55000	39000	41000	48000
Lithium	mg/kg	5		-	-	-	<5	<5	10	<5	<5	<5	9	9	9	9	10	7	7	9
Magnesium	mg/kg	5		-	-	-	600	490	2000	310	910	480	2500	2100	2200	3300	3000	2400	2700	3000
Manganese	mg/kg	2		**770**	1000	2200	450	**960**	**1000**	50	720	190	1800	1700	1600	1400	1200	470	1900	1300
Molybdenum	mg/kg	0.5		**2**	10	40	**2.5**	**3.1**	**2.2**	0.7	1.8	2	**3.3**	**3**	**3.1**	**2.4**	**2.9**	**3.3**	**2.4**	**2.7**
Gold	mg/kg			-	-	-	<10	<10	<10	<10	<10	<10	-	-	-	-	-	-	-	-
Nickel	mg/kg	0.5		**50**	100	500	4	3.9	10	2.9	5.7	3.8	13	11	12	18	14	11	14	16
Mercury	mg/kg	0.01	6.6	**0.2**	2	10	0.02	0.04	0.1	**0.24**	<0.01	0.02	0.04	0.04	0.03	0.07	0.07	0.08	0.06	0.07
Palladium	mg/kg			-	-	-	<20	<20	<20	<20	<20	<20	-	-	-	-	-	-	-	-
Phosphorus	mg/kg	20		-	-	-	160	270	310	620	210	180	530	530	500	270	390	350	410	390
Platinum	mg/kg			-	-	-	<10	<10	<10	<10	<10	<10	-	-	-	-	-	-	-	-
Potassium	mg/kg	20		-	-	-	240	140	190	210	190	150	340	320	330	370	320	390	290	300
Lead	mg/kg	1	140	**50**	500	1000	5	8	12	10	9	7	19	18	18	13	14	15	18	14
Selenium	mg/kg	0.5	80	**1**	3	10	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Sodium	mg/kg	10		-	-	-	29	24	25	39	22	21	21	20	21	19	21	22	23	21
Strontium	mg/kg	5		-	-	-	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Tellurium	mg/kg	0.5		-	-	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Thallium	mg/kg	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	0.1	0.1
Thorium	mg/kg	4		-	-	-	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4
Titanium	mg/kg	2		-	-	-	240	190	110	45	94	110	120	110	110	230	190	180	170	180
Tungsten	mg/kg	1		-	-	-	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Uranium	mg/kg		23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Vanadium	mg/kg	2		-	-	-	45	52	26	12	30	30	38	34	33	26	39	33	25	26
Zinc	mg/kg	5	500	**110**	500	1500	16	20	42	11	19	13	53	46	47	52	46	36	46	51
Zirconium	mg/kg	2		-	-	-	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2

RDL = Reportable Detection Limit

A - Quebec Soil Standards - Residential/Commercial background levels for inorganic parameters in the Labrador Trough Region.

B - Quebec Soil Standards - Maximum acceptable limit residential, recreational land use.

C - Quebec Soil Standards - Maximum acceptable limit for Non-residential Commercial or Industrial.

Table 9 - Metal Concentrations in Collocated Soil (mg/kg dw) from the Howse Project Property and Greenbush Area
AECOM, 2015

							GREENBUSH AREA												
	Units	RDL	CCME Parkland SGQ HH	A	B	C	GB-LT-1-S	GB-LT-2-S	GB-LT-3-S	GB-LT-3-S Lab-Dup	GB-LT-4-S	GB-LT-5-S	GB-LT-56 (DUP)-S	DI-PB-1-S	DI-PB-2-S	DI-PB-3-S	DI-PB-4-S	DI-PB-5-S	DI-PB-5B (DUP)-S
Sampling Date			mg/kg	mg/kg			26-Jul-15	26-Jul-15	26-Jul-15	26-Jul-15	26-Jul-15	26-Jul-15	26-Jul-15	30-Aug-15	30-Aug-15	30-Aug-15	30-Aug-15	30-Aug-15	30-Aug-15
% MOISTURE	%	N/A	-	-	-	-	26	20	24	24	32	32	27	21	20	18	25	15	14
METALS																			
Aluminum	mg/kg	20	-	-	-	-	7400	6800	4300	4400	4300	8600	9800	9000	6200	1500	8600	9300	7500
Antimony	mg/kg	0.1	-	-	-	-	0.4	0.4	0.3	0.3	0.3	0.3	0.3	0.4	<0.1	<0.1	0.3	0.3	0.3
Silver	mg/kg	0.5		**2**	20	40	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Arsenic	mg/kg	2	12	**10**	30	50	**10**	**17**	**9**	**9**	**10**	**11**	**11**	**10**	5	<2	**9**	**9**	**7**
Barium	mg/kg	4	500	**245**	500	2000	24	30	12	14	150	22	31	21	65	19	31	79	20
Beryllium	mg/kg	0.1	4	-	-	-	0.4	0.3	0.2	0.2	0.3	0.5	0.6	0.3	0.3	<0.1	0.3	0.4	0.3
Bismuth	mg/kg	2		-	-	-	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Boron	mg/kg	2		-	-	-	<2	<2	<2	<2	2	<2	<2	<2	<2	<2	<2	<2	<2
Cadmium	mg/kg	0.1	14	**1.5**	5	20	<0.1	<0.1	<0.1	<0.1	<0.1	0.2	0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Calcium	mg/kg	20		-	-	-	<20	<20	<20	<20	22	<20	68	180	2100	130	98	77	86
Chromium	mg/kg	1	220	**85**	250	800	21	19	12	13	10	19	22	20	11	5	16	23	20
Copper	mg/kg	1	1100	**40**	100	500	10	8	4	5	4	10	13	10	5	3	6	17	12
Cobalt	mg/kg	1		**15**	50	300	5	7	4	4	7	7	9	6	4	1	5	10	6
Tin	mg/kg	1		**5**	50	300	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Iron	mg/kg	10		-	-	-	62000	58000	60000	61000	53000	57000	53000	56000	44000	9600	50000	48000	42000
Lithium	mg/kg	5		-	-	-	7	7	<5	<5	<5	10	12	6	<5	<5	5	9	7
Magnesium	mg/kg	5		-	-	-	2000	1600	830	790	380	2000	2800	2100	1400	200	1300	2500	2200
Manganese	mg/kg	2		**770**	1000	2200	710	1900	**790**	**780**	1800	1200	1500	**850**	**920**	310	700	1600	540
Molybdenum	mg/kg	0.5		**2**	10	40	2	**2.7**	1.2	1.3	1.6	**2.2**	2	1.9	0.8	<0.5	1.7	1.6	1.4
Gold	mg/kg			-	-	-	<10	<10	<10	<10	<10	<10	<10	-	-	-	-	-	-
Nickel	mg/kg	0.5		**50**	100	500	11	7.9	5.2	4.9	4.9	10	13	11	6	1.7	6.5	15	11
Mercury	mg/kg	0.01	6.6	**0.2**	2	10	0.04	0.04	0.04	0.05	0.12	0.08	0.1	0.05	0.03	0.02	0.03	0.06	0.05
Palladium	mg/kg			-	-	-	<20	<20	<20	<20	<20	<20	<20	-	-	-	-	-	-
Phosphorus	mg/kg	20		-	-	-	280	300	330	350	500	280	270	320	280	130	370	240	230
Platinum	mg/kg			-	-	-	<10	<10	<10	<10	<10	<10	<10	-	-	-	-	-	-
Potassium	mg/kg	20		-	-	-	290	290	230	230	190	250	270	320	200	130	260	340	300
Lead	mg/kg	1	140	**50**	500	1000	12	17	9	9	14	14	13	11	8	2	11	**51**	10
Selenium	mg/kg	0.5	80	**1**	3	10	<0.5	<0.5	<0.5	<0.5	0.8	0.5	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Sodium	mg/kg	10		-	-	-	23	25	21	18	22	26	40	21	12	41	16	17	15
Strontium	mg/kg	5		-	-	-	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Tellurium	mg/kg	0.5		-	-	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Thallium	mg/kg	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	<0.1
Thorium	mg/kg	4		-	-	-	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4
Titanium	mg/kg	2		-	-	-	120	130	99	120	63	95	87	150	44	47	90	130	150
Tungsten	mg/kg	1		-	-	-	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Uranium	mg/kg		23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Vanadium	mg/kg	2		-	-	-	40	50	30	30	36	32	34	29	27	13	34	27	25
Zinc	mg/kg	5	500	**110**	500	1500	34	39	17	16	17	40	47	31	15	7	25	35	28
Zirconium	mg/kg	2		-	-	-	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2

RDL = Reportable Detection Limit

A - Quebec Soil Standards - Residential/Commercial background levels for inorganic parameters in the Labrador Trough Region.

B - Quebec Soil Standards - Maximum acceptable limit residential, recreational land use.

C - Quebec Soil Standards - Maximum acceptable limit for Non-residential Commercial or Industrial.

Table 10 - Metal Concentrations in Howse Local Study Area Surface Water (ug/L)
AECOM, 2015

Parameter	Unit	Health Canada DWG[1]	Quebec DWG[2]	Pinette Lake											
				29-Sep-14	20-Aug-14	14-Jul-14	10-Jun-14	9-Oct-13	14-Aug-13	9-Jun-13	10-Sep-08	10-Jun-13	27-Jul-11	27-Jul-11	8-Aug-12
Aluminum	μg/L	–	–	17	13	12	17	17	32	17	118	53	10	10	70
Antimony		6	6	–	–	–	–	–	–	–	–	–	–	–	–
Arsenic	μg/L	10	10	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1	<1.0	<2
Barium		1000	1000	–	–	–	–	–	<0.002	–	–	–	–	–	–
Beryllium		–	–	–	–	–	–	–	<0.002	–	–	–	–	–	–
Bismuth		–	–	–	–	–	–	–	–	–	–	–	–	–	–
Boron		5000	5000	–	–	–	–	–	–	–	–	–	–	–	–
Cadmium	μg/L	5	5	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.129	<0.20	<0.2	<0.20	<1
Calcium	μg/L	–	–	<500	<500	<500	<300	<500	<500	<300	569	<300	2	2	1.9
Chromium		50	50	–	–	–	–	–	<0.005	–	–	–	–	–	–
Cobalt		–	–	–	–	–	–	–	–	–	–	–	–	–	–
Copper	μg/L	1000	–	<1.0	<1.0	<1.0	<0.50	<1.0	1.9	<0.50	1	<0.50	<0.5	<0.50	<3.0
Iron	μg/L	–	–	<60	84	62	<100	200	140	140	1080	<100	<100	<100	100
Lead	μg/L	10	10	<0.50	<0.50	<0.50	<0.10	<0.50	<0.50	<0.10	<1.0	<0.10	<0.1	<0.10	<1.0
Magnesium	μg/L	–	–	210	190	200	180	220	220	200	291	170	2	2	1.4
Manganese	μg/L	–	–	3.6	3	2.3	6.5	12	8	22	104	4.7	1	1	12
Mercury	μg/L	1	1	<0.01	<0.01	<0.1	<0.1	<0.1	<0.1	–	<0.02	–	<0.1	<0.1	<0.1
Molybdenum	μg/L	–	–	<1.0	<1.0	<1.0	<0.05	<1.0	<1.0	<0.05	<2	<0.50	<0.5	<0.50	<30
Nickel	μg/L	–	–	<2.0	<2.0	<2.0	<1.0	<2.0	<2.0	<1.0	<1	<1.0	<1	<1.0	<10
Phosphorus		–	–	–	–	–	–	–	–	–	–	–	–	–	–
Potassium	μg/L	–	–	<500	<500	<500	<100	<500	<500	<100	56	<100	330	330	<200
Radium (RA 226)	Becquerel/L	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Selenium	μg/L	50	10	<3.0	<3.0	<3.0	<1.0	<3.0	<3.0	<1.0	<1.0	<1.0	<1	<1.0	<1
Silicon		–	–	–	–	–	–	–	–	–	–	–	–	–	–
Silver		–	–	–	–	–	–	–	–	–	–	–	–	–	–
Sodium	μg/L	–	–	700	<500	<500	410	720	540	390	820	–	820	820	300
Strontium		–	–	–	–	–	–	–	–	–	–	–	–	–	–
Thallium		–	–	–	–	–	–	–	–	–	–	–	–	–	–
Tin		–	–	–	–	–	–	–	–	–	–	–	–	–	–
Titanium		–	–	–	–	–	–	–	–	–	–	–	–	–	–
Uranium	μg/L	20	20	<1.0	<1.0	<1.0	<1.0	24	–	–	<1.0	–	<0.02	<20	<20
Vanadium		–	–	–	–	–	–	–	–	–	–	–	–	–	–
Zinc	μg/L	–	–	<7.0	11	<7.0	<5.0	<7.0	<7.0	<5.0	6	<5.0	<5	<5.0	<5
Zirconium		–	–	–	–	–	–	–	–	–	–	–	–	–	–

1 - Health Canada Drinking Water Guidelines (Maximum Allowable Concentration)

2 - Quebec Drinking Water Guidelines - Ministre du Développement durable, de l'Environnement et de la Lutte contre les changements climatiques (MDDELCC).

Table 10 - Metal Concentrations in Howse Local Study Area Surface Water (ug/L)
AECOM, 2015

Parameter	Unit	Health Canada DWG[1]	Goodream Creek						Triangle Lake	Burnetta Creek	DS03-14
			14-Aug-13	9-Oct-13	23-Oct-13	10-Jun-14	14-Jul-14	29-Sep-14	2-Sep-13	3-Sep-13	10-Sep-08
Aluminum	µg/L	–	76	<10	33	75	38	120	18	130	57
Antimony		6	–	–	–	–	–	–	–	–	–
Arsenic	µg/L	10	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Barium		1000	–	–	–	–	–	–	–	–	–
Beryllium		–	–	–	–	–	–	–	–	–	–
Bismuth		–	–	–	–	–	–	–	–	–	–
Boron		5000	–	–	–	–	–	–	–	–	–
Cadmium	µg/L	5	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.2	0.129
Calcium	µg/L	–	<500	2300	<500	450	<500	<500	2700	<500	685
Chromium		50	–	–	–	–	–	–	–	–	–
Cobalt		–	–	–	–	–	–	–	–	–	–
Copper	µg/L	1000	1	<1.0	<1.0	<0.50	<1.0	<1.0	<1.0	<1.0	4
Iron	µg/L	–	160	<60	240	<100	66	310	75	220	1640
Lead	µg/L	10	<0.50	<0.50	<0.50	<0.10	<0.50	<0.50	<0.50	<0.50	<1.0
Magnesium	µg/L	–	<100	1300	230	180	220	210	2300	290	195
Manganese	µg/L	–	33	3.2	7.3	4.2	1.9	18	6.5	23	64
Mercury	µg/L	1	<0.1	<0.1	<0.10	<0.1	<0.1	<0.01	<0.10	<0.10	<0.02
Molybdenum	µg/L	–	1	<1.0	<1.0	<0.50	<1.0	<1.0	<1.0	<1.0	<2
Nickel	µg/L	–	3.5	<2.0	<2.0	1.2	<2.0	<2.0	<2.0	<2.0	<1
Phosphorus		–	–	–	–	–	–	–	–	–	–
Potassium	µg/L	–	<500	<500	–	<100	<500	<500	<500	<500	20
Radium (RA 226)	Becquerel/L	–	–	–	0.002	–	–	–	–	–	–
Selenium	µg/L	50	<3.0	<3.0	<3.0	<1.0	<3.0	<3.0	<3.0	<3.0	<1.0
Silicon		–	–	–	–	–	–	–	–	–	–
Silver		–	–	–	–	–	–	–	–	–	–
Sodium	µg/L	–	–	–	610	–	–	–	580	<500	<500
Strontium		–	–	–	–	–	–	–	–	–	–
Thallium		–	–	–	–	–	–	–	–	–	–
Tin		–	–	–	–	–	–	–	–	–	–
Titanium		–	–	–	–	–	–	–	–	–	–
Uranium	µg/L	20	–	<10	–	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Vanadium		–	–	–	–	–	–	–	–	–	–
Zinc	µg/L	–	<7.0	11	<7.0	25	<7.0	7.3	<7.0	<7.0	8
Zirconium		–	–	–	–	–	–	–	–	–	–

1 - Health Canada Drinking Water Guidelines (Maximum Allowa
Concentration)

2 - Quebec Drinking Water Guidelines - Ministre du Développen
de l'Environnement et de la Lutte contre les changements clima
(MDDELCC).

Table 11 - Metals Concentrations in Sediment (mg/kg ww) from Pinette Lake and Triange Lake
AECOM, 2015

		HOS 1	HOS 2	HOS 3	HOS 4	HOS 5	TR-S1	TR-S2	TR-S3	TR-S4	TR-S5	RDL
Sampling Date		5-Aug-15	5-Aug-15	5-Aug-15	5-Aug-15	5-Aug-15	5-Aug-15	5-Aug-15	5-Aug-15	5-Aug-15	5-Aug-15	
Physical Properties	**UNITS**											
Soluble (2:1) pH	pH	5.34 (1)	5.82 (1)	5.70 (1)	5.40 (2)	5.31 (1)	5.21	5.55	5.50	5.47	5.26	N/A
Total Metals by ICPMS												
Total Aluminum (Al)	mg/kg	14600	12100	12000	12200	12400	13400	13400	15500	14800	16200	100
Total Antimony (Sb)	mg/kg	0.41	0.47	0.46	0.43	0.49	0.52	0.41	0.57	0.55	0.6	0.1
Total Arsenic (As)	mg/kg	3.8	3.19	3.09	3.06	5.44	10	7.52	7.7	7.75	9.5	0.5
Total Barium (Ba)	mg/kg	43.3	41.3	41.5	59.4	62.4	112	93.8	88.6	83.5	110	0.1
Total Beryllium (Be)	mg/kg	0.68	0.68	0.82	0.64	0.93	0.99	0.94	1.08	1.09	1.12	0.4
Total Bismuth (Bi)	mg/kg	0.16	0.12	0.12	0.19	0.1	0.15	0.14	0.18	0.16	0.17	0.1
Total Cadmium (Cd)	mg/kg	0.592	1.58	1.67	0.938	2.1	1.01	0.916	1.09	1	0.8	0.05
Total Calcium (Ca)	mg/kg	703	740	873	1230	1260	1430	1510	1520	1370	1380	100
Total Chromium (Cr)	mg/kg	26.4	20.2	20.3	20.7	22.8	26.5	25.5	29	27.6	30.3	1
Total Cobalt (Co)	mg/kg	3.83	3.43	3.52	3.69	4.58	13.6	11.5	12.4	11.8	14.4	0.3
Total Copper (Cu)	mg/kg	25.2	19.5	20.1	24.1	50.9	23	22.1	25.7	24.7	27.7	0.5
Total Iron (Fe)	mg/kg	33100	20600	21000	21500	22800	75500	54400	57100	52100	79900	100
Total Lead (Pb)	mg/kg	14	11.3	11.7	18.8	9.12	15.5	13.5	16.2	14.4	15.4	0.1
Total Magnesium (Mg)	mg/kg	2980	2450	2500	2210	2160	4310	3760	4460	4110	4410	100
Total Manganese (Mn)	mg/kg	153	161	163	224	143	870	538	343	299	857	0.2
Total Mercury (Hg)	mg/kg	0.115	0.074	0.065	0.112	0.129	0.091	0.113	0.117	0.116	0.137	0.05
Total Molybdenum (Mo)	mg/kg	2.59	2.82	2.86	2.59	3.65	1.87	1.43	1.77	1.6	1.94	0.1
Total Nickel (Ni)	mg/kg	21	19	19.6	19	36.7	27.3	26	28.4	29	28.2	0.8
Total Phosphorus (P)	mg/kg	1090	728	747	749	682	637	477	497	471	984	10
Total Potassium (K)	mg/kg	1050	741	688	942	798	1200	1370	1500	1450	1520	100
Total Selenium (Se)	mg/kg	0.97	0.86	0.78	1.02	1.78	2.23	2.61	2.74	2.65	3.19	0.5
Total Silver (Ag)	mg/kg	0.788	0.662	0.661	0.737	0.835	0.236	0.291	0.307	0.314	0.413	0.05
Total Sodium (Na)	mg/kg	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	100
Total Strontium (Sr)	mg/kg	6.46	7.37	7.37	9.04	11.6	4.97	5	5.61	5.33	5.61	0.1
Total Thallium (Tl)	mg/kg	0.113	0.07	0.073	0.089	0.126	0.157	0.135	0.18	0.174	0.159	0.05
Total Tin (Sn)	mg/kg	0.34	0.29	0.27	0.51	0.22	0.34	0.31	0.4	0.34	0.3	0.1
Total Titanium (Ti)	mg/kg	150	118	107	108	94.8	250	220	260	255	246	1
Total Vanadium (V)	mg/kg	25.5	19.6	19.2	21.1	18.1	30.8	29.2	33.8	31.7	34.3	2
Total Zinc (Zn)	mg/kg	102	137	141	102	326	134	153	159	150	143	1
Total Zirconium (Zr)	mg/kg	<0.50	<0.50	<0.50	<0.50	0.8	2.85	1.66	2.12	1.92	2.67	0.5

RDL = Reportable Detection Limit
N/A = Not Applicable
(1) Due to insufficient sample water:soil extraction ratio has changed from 2:1 to 4:1 in order to analyse sample.
(2) Due to insufficient sample water:soil extraction ratio has changed from 2:1 to 5:1 in order to analyse sample.

Appendix F

Uncertainty Analysis

Appendix F
Uncertainty Analysis

Parameters for which uncertainties have been identified, the sensitivity of risk estimates, and the potential degree and influence of these uncertainties is presented in Table 1. Uncertainties are assessed relative to their influence on the baseline, project, or cumulative scenario (or a combination thereof). Parameters which are addressed in the probabilistic risk assessment are discussed relative to the cumulative scenario.

Table 1: Summary of Key Uncertainties in the HHRA and Implications for Estimates

<table>
<tr><th>Parameter</th><th>Baseline</th><th>Project</th><th>Cumulative</th></tr>
<tr><td>Country Food Ingestion Rates</td><td colspan="3">AECOM have assumed the 90th percentile of compiled country food ingestion rates collected from the Howse Country Food Survey, as well as literature sources for northern Canadian peoples.
Ingestion rates were available for country food categories which appropriately capture the likely spectrum of country foods collected from the LSA.
Ingestion rates for toddler receptors were scaled from adult ingestion rates based on per capita (mg/kg bw/day) ingestion rates for equivalent age groups.

Sensitivity of risk estimates: High - Ingestion of country foods is a primary controlling parameter of the predicted dose under all exposure scenarios.
Degree of Uncertainty: Moderate - Literature derived ingestion rates for northern peoples of Quebec and Labrador have been integrated into our assessment. It is the AECOM's position that this provides a decreased level of uncertainty relative to the use of the Health Canada (2010a) PQRA default ingestion rates for Aboriginal and Indigenous populations.</td></tr>
<tr><td>Proportion of Diet Originating from the Area of Interest</td><td colspan="3">AECOM have allowed for 100% of fish, small game, and game fowl to be sourced from the area of interest to satisfy daily ingestion rates for the entire year. This is considered to be a highly conservative assumption, as it is considered unlikely that an individual or family group would collect a years' worth of country foods from one location year after year. This is considered adequately protective of those individuals that may collect a high proportion of their country foods from the area of interest.

Sensitivity of risk estimates: Moderate - Ingestion of country foods is a primary controlling parameter of the predicted dose under all exposure scenarios.
Degree of Uncertainty: High - The available site specific dietary use survey provides insufficient evidence to adjust ingestion rates for food derived from areas other than the project area. AECOM have therefore relied on a conservative assumption of 100% of country foods.</td></tr>
<tr><td>Game Species - Relative Time in Affected Zone</td><td colspan="3">Fish, small game, and game fowl are assumed to spend 100% of their tim e in the affected area.
Caribou tissue quality is assumed to not be influenced by the project area due minimal interaction time and diet derived from the mine or surrounding area by caribou.

Sensitivity of risk estimates: Low - Ingestion of country foods is a primary controlling parameter of the predicted dose under all exposure scenarios, however caribou (not influenced by the site) represent a significant portion of the traditional diet..
Degree of Uncertainty: Low - The small mammals and game fowl species modelled have reasonable small home ranges relative to the LSA. 100% time on site is assumed to accurately capture the expected exposure time for these species. Caribou are known to be migratory species with very large home ranges. Literature derived tissues provide the lowest uncertainty, integrating exposures over the animals life and home range.</td></tr>
<tr><td>Toxicity Reference Values</td><td colspan="3">TRVs were sourced from recommended sources. Sources for TRVs in order of preference were
Health Canada
US EPA IRIS
Sensitivity of Risk Estimates: High - Toxicity reference values are a principal controlling parameter in the calculation of risk estimates.
Degree of Uncertainty: Low - TRVs were sourced from the most up-to date recommended sources. Risks are unlikely to be over or under-estimated.</td></tr>
</table>

<table>
<tr><th>Parameter</th><th>Baseline</th><th>Project</th><th>Cumulative</th></tr>
<tr><td>Soil Exposure Point Concentrations</td><td>UCLM95 of Site Specific Soil Data

Sensitivity of Risk Estimates: Low - Soil does not exert significant influence on the predicted risk estimates.

Degree of Uncertainty: Low - Site specific information. Risk estimates are unlikely to be over or under-estimated.</td><td colspan="2">Soil concentration modelled based on scenario specific maximum annual dust fall and particulate chemistry.
Upper tolerance limit of the predicted soil concentrations at 41 receptor locations selected as representative of the LSA.

Sensitivity of Risk Estimates: Low - Soil direct contact and food web transfer of COPCs do not exert significant influence on the predicted risk estimates.
Degree of Uncertainty: Low - Conservative upper bounds of modeled results were selected as exposure point concentrations. Risk estimates are unlikely to be over or under-estimated.</td></tr>
<tr><td>Fish Exposure Point Concentrations</td><td colspan="3">Maximum concentration measured in fish tissue from Pinette or Triangle Lake.

Sensitivity of Risk Estimates: High - Fish consumption is the driving factor for risk estimates of some COPCs (eg. Hg).
Degree of Uncertainty: Moderate - Risk estimates as a result of fish ingestion are likely to be over-predicted, particularly in consideration of the fact that the HHRA assumes 100% of fish is sourced from these two small lakes.</td></tr>
<tr><td>Caribou Exposure Point Concentrations</td><td colspan="3">Average concentration in muscle tissue calculated from meta-analysis of reported tissue concentrations from literature sources. Caribou are known to be migratory species with very large home ranges. Literature derived tissues provide the lowest uncertainty, integrating exposures over the animals life and home range.

Sensitivity of Risk Estimates: High - Caribou ingestion is significant contributor to the calculated dose.
Degree of Uncertainty: Low - Literature derived tissue concentrations from multiple studies.</td></tr>
<tr><td>Project Influenced Game Exposure Point Concentrations</td><td>Maximum measured concentrations of COPCs in Spruce Grouse collected from the LSA.

Tissue quality for Hare modelled based on baseline soil, and food web transfer using literature derived transfer factors from reputable sources (See Appendix D1).</td><td colspan="2">Tissue quality modelled based on soil deposition model, and food web transfer using literature derived transfer factors.
Transfer factors sourced from recommended, reputable sources (See Appendix D1).

Sensitivity of Risk Estimates: High - Ingestion of country food is a primary driver of risk estimates.

Degree of Uncertainty - High - Prediction of tissue from transfer factors contains a high degree of uncertainty. There is a possibility for over or under-estimation of risks.</td></tr>
<tr><td>Particulate Chemistry</td><td>Dust assumed to be composed of surficial soil. Chemistry assumed to be equal to UCLM95 of surficial soil from LSA.

Sensitivity of Risk Estimates: Low
Degree of Uncertainty: Low - Particulate chemistry derived from site specific soil data. Predicted risks are unlikely to be over or under-estimated.</td><td colspan="2">Dust assumed to be composed of mined ore. Chemistry assumed to be equal to UCLM95 of drill core dataset.

Sensitivity of Risk Estimates: Moderate - - Particulate inhalation is not a significant contributor to overall dose, but is considered the only uncontrolled release media from the site.
Degree of Uncertainty: Low - Particulate chemistry derived from drill core data for the material to be mined.

Probabilistic Cumulative Assessment: Log-normal probability distributions for each COPC included as stochastic elements. Variability of rock chemistry propagated through assessment. Sensitivity analysis indicates moderate contribution of dust chemistry (importance score <0.1).</td></tr>
</table>

Parameter	Baseline	Project	Cumulative
Fugitive Dust	Assumed to be Quebec regional background PM10 concentration (4 ug/m3). **Sensitivity of Risk Estimates: Low** - Particulate inhalation not a significant contributor to baseline dose. **Degree of Uncertainty: Low** - Risk estimates unlikely to be over-predicted.	Assumed to be equal to 90^{th} percentile of the maximum 24-hour predicted PM10 concentration at 41 receptor locations, assuming blasting occurs 1 day per week. **Sensitivity of Risk Estimates: High** - the overall dose is not heavily influenced by particulate inhalation, but particulate concentration (PM10) exerts a high degree of influence on the dose associated with the inhalation route of exposure. **Degree of uncertainty: Low** - PM10 concentration derived from detailed particulate dispersion models conducted for a retrospective period of 5 years. ***Probabilistic Cumulative Assessment***: Cumulative probability distributions for each receptor location derived from hourly predicted PM10 concentrations over 5 year period. Variability of meteorological conditions and predicted PM10 concentration propagated through assessment. Sensitivity analysis indicates major influence of PM10 on predicted risk estimates (Importance Score <0.38).	

Baseline Country Food Survey – Howse Property Project

Date of survey:	Household Number:
Community:	Interviewer:

Introduction

- Presentation of the objectives of the study

1..1. Some concerns were expressed by your Council and the community regarding the potential impact of the project on the health of the population consuming country food in the vicinity of the project.

1..2. To properly assess this impact, HML decided to conduct a *Health Risk Assessment*.

1..3. The purpose of the *Health Risk Assessment* is:

- To identify the types of local foods collected and harvested near the Howse Property
- Identify the traditional foods eaten by the local population in the past year and determine <u>how often</u> country food is consumed
- Determine the pre-existing metal loadings in selected species consumed by residents in the area
- Assess the potential effect of mining activities on human health

1..4. In order to be able to complete this assessment, HML needs to collect detailed data on the country food collected and eaten by the population in the vicinity of the project.

1..5. This survey targets <u>the households</u> collecting and consuming country food in the vicinity of the project.

1..6. The reference period for the survey is the last 12 months (summer 2014 (June – September 2014) to winter (October 2014 –May 2015).

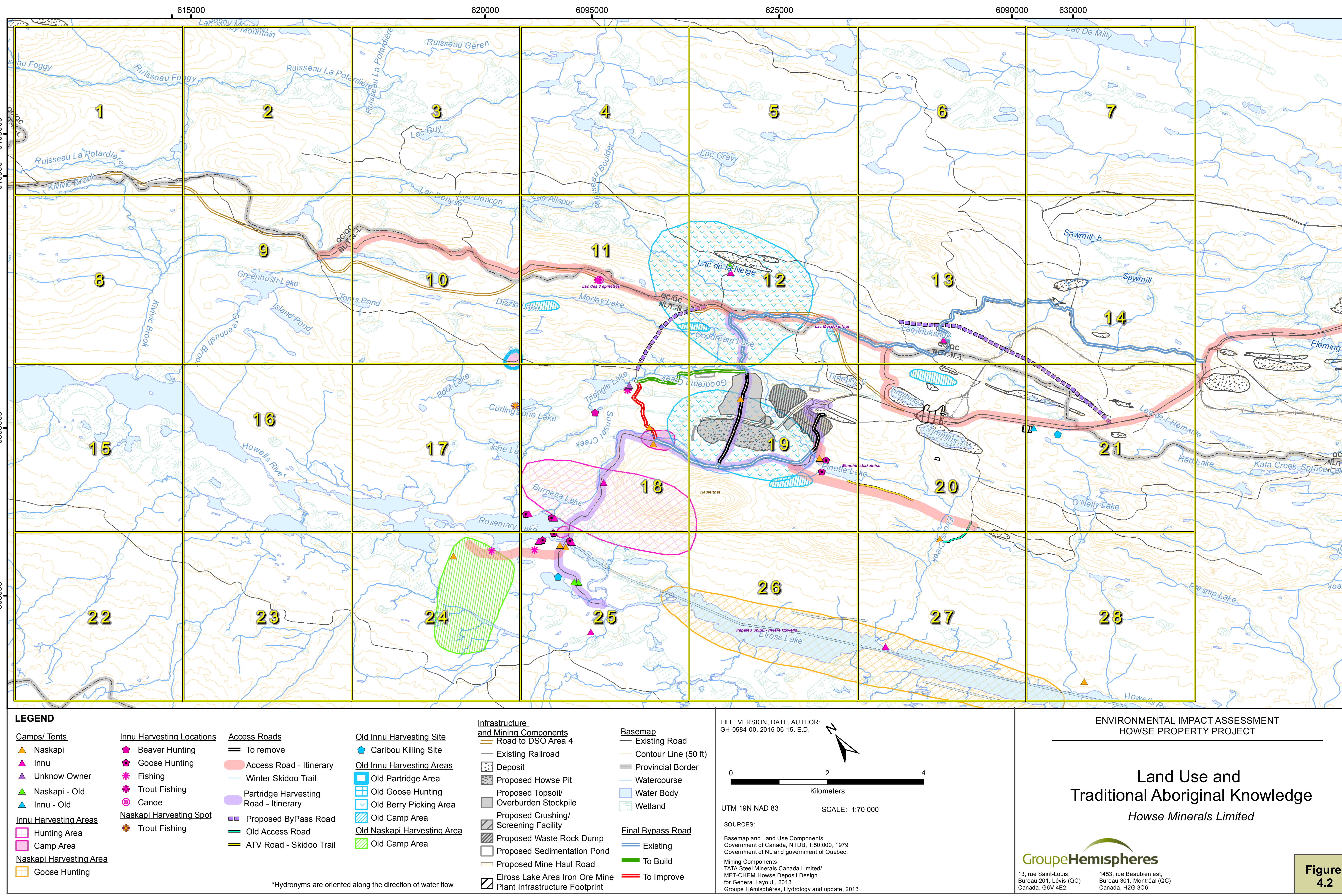
1..7. Information collected during this survey will remain confidential.

Baseline Country Food Survey – Howse Property Project

1. Do you or members of your household eat local meats and country foods, such as fish, large mammals, small mammals, waterfowl or berries that are hunted or harvested within the area on the attached map?

Yes: ____
No: _____

If yes pursue with the country food survey.


LEGEND
Camps/ Tents
Naskapi
Innu
Unknow Owner
Naskapi - Old
Innu - Old
Innu Harvesting Areas
Hunting Area
Camp Area
Naskapi Harvesting Area
Goose Hunting
Innu Harvesting Locations
Beaver Hunting
Goose Hunting
Fishing
Trout Fishing
Canoe
Naskapi Harvesting Spot
Trout Fishing
Access Roads
To remove
Access Road - Itinerary
Winter Skidoo Trail
Partridge Harvesting Road - Itinerary
Proposed ByPass Road
Old Access Road
ATV Road - Skidoo Trail
Old Innu Harvesting Site
Caribou Killing Site
Old Innu Harvesting Areas
Old Partridge Area
Old Goose Hunting
Old Berry Picking Area
Old Camp Area
Old Naskapi Harvesting Area
Old Camp Area
*Hydronyms are oriented along the direction of water flow
Infrastructure and Mining Components
Road to DSO Area 4
Existing Railroad
Deposit
Proposed Howse Pit
Proposed Topsoil/ Overburden Stockpile
Proposed Crushing/ Screening Facility
Proposed Waste Rock Dump
Proposed Sedimentation Pond
Proposed Mine Haul Road
Elross Lake Area Iron Ore Mine Plant Infrastructure Footprint
Basemap
Existing Road
Contour Line (50 ft)
Provincial Border
Watercourse
Water Body
Wetland
Final Bypass Road
Existing
To Build
To Improve
FILE, VERSION, DATE, AUTHOR:
GH-0584-00, 2015-06-15, E.D.
0 2 4
Kilometers
UTM 19N NAD 83
SCALE: 1:70 000
SOURCES:
Basemap and Land Use Components
Government of Canada, NTDB, 1:50,000, 1979
Government of NL and government of Quebec,
Mining Components
TATA Steel Minerals Canada Limited/
MET-CHEM Howse Deposit Design
for General Layout., 2013
Groupe Hémisphères, Hydrology and update, 2013
ENVIRONMENTAL IMPACT ASSESSMENT
HOWSE PROPERTY PROJECT
Land Use and
Traditional Aboriginal Knowledge
Howse Minerals Limited
GroupeHemispheres
13, rue Saint-Louis, Bureau 201, Lévis (QC) Canada, G6V 4E2
1453, rue Beaubien est, Bureau 301, Montréal (QC) Canada, H2G 3C6
Figure 4.2

Baseline Country Food Survey – Howse Property Project

PART 1 – PARTICIPANT DEMOGRAPHICS

1.1 Where do you currently live?	1.2 What is your gender?
a. Kawawachikamach b. Lac John c. Matimekush d. Schefferville e. Other: ____________________	a. Male ________ b. Female ________
1.3 What is your age group? a. 20-24 ________ b. 25-29 ________ c. 30-34 ________ d. 35-39 ________ e. 40-44 ________ f. 45-49 ________ g. 50-54 ________ h. 55-59 ________ i. 60-64 ________ j. 65-69 ________ k. 70 or older ________	1.4 How many people live in your household (including yourself)? a. 1 ________ b. 2 ________ c. 3 ________ d. 4 ________ e. 5 ________ f. 5 or more ________
1.5 What are the ages of the people in your household? (Please indicate the number of people in your household in each age category below.) a. Infant 0 to 6 months ________ b. Toddler 6 months to 4 years ________ c. Child 5 to 11 years ________ d. Teen 12 to 19 years ________ e. Adult 20+ years ________	

Baseline Country Food Survey – Howse Property Project

PART 2 – COUNTRY FOOD SURVEY

This section of the survey is about traditional/country food that is harvested within the local environment and within the study area. It can be in any form (dried, smoked, fresh, frozen, etc.).

2.1 Do you or members of your household <u>hunt</u> and/or <u>trap</u> wildlife for food within the area on the map?

a. Yes: ____
b. No: _____

2.2 Which of the following species do you hunt and/or trap <u>for food</u> within the area on the map?

Waterfowl and Game Birds	Innu name	Check if applies	Large /small mammals	Innu name	Check if applies
Goldeneye	Mishikushk^{u}		Caribou	Atik^{u}	
Canada goose	Nishk		Beaver	Amishk^{u}	
White-winged scoter	Umumuk$_{u}$		Snowshoe hare	Uapush	
Common loon	Muak^{u}		Americaion Porcupine	Kak^{u}	
American black duck	Inniship				
Long-tailed duck	N/A				
Common merganser	Ushik^{u}				
Spruce grouse	innineu				
Willow ptarmigan	Uapineu				
Rock ptarmigan	kashkanatshish				

Baseline Country Food Survey – Howse Property Project

2.3 Based on the map, for each of the species that you indicated you hunt and/or trap <u>for food</u> in the previous question – please indicate the zone(s) in which you hunt and/or trap these species. For example, if you hunt Common loon in the areas identified on the map as Zones 1, 16 and 24, please select 1, 16 and 24 for Common loon.

Waterfowl and Game Birds	**Innu name**	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
Goldeneye	Mishikushk^{u}																												
Canada goose	Nishk																												
White-winged scoter	Umumuk$_{u}$																												
Common loon	Muak^{u}																												
American black duck	Inniship																												
Long-tailed duck	N/A																												
Common merganster	Ushik^{u}																												
Spruce grouse	innineu																												
Willow ptarmigan	Uapineu																												
Rock ptarmigan	kashkanatshish																												

Baseline Country Food Survey – Howse Property Project

Large /small mammals	**Innu name**	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
Caribou	Atik^{u}																												
Beaver	Amishk^{u}																												
Snowshoe hare	Uapush																												
Porcupine	Kak^{u}																												

Baseline Country Food Survey – Howse Property Project

Large and Small Mammals

2.4 In the past year, have you or members of your household <u>eaten</u> any large or small mammals caught within the area on the map?

c. Yes _______
d. No _______

2.5 If yes, which of the following types of locally caught large or small mammals have you or members of your household <u>eaten</u> in the past year?

Large /small mammals	Innu name	**Check if applies**
Caribou	Atik^{u}	
Beaver	Amishk^{u}	
Snowshoe hare	Uapush	
Porcupine	Kak^{u}	

2.6 When did you have your last meal of locally caught large or small mammals?

a. This week _____
b. Last week _____
c. Last month _____
d. Before last month _____

2.7 In the WINTER (October 2014 – May 2015) approximately how many meals per month typically included locally caught large or small mammals?

Meals per month _____

Baseline Country Food Survey – Howse Property Project

2.8 In the SUMMER (June 2014 – September 2014) approximately how many meals per month typically included locally caught large or small mammals?
Meals per month _____

2.9 When eating large or small mammal meat, do you or members of your household eat the organs (such as heart, liver or kidney)?
Yes _____
No _____

Baseline Country Food Survey – Howse Property Project

Waterfowl and Game Birds

2.10 In the past year, have you or members of your household eaten any locally caught birds or waterfowl (such as partridge, grouse, ptarmigan, duck, etc.) within the area on the map?

a. Yes _______
b. No _______

2.11 If yes, which of the following types of locally caught birds or waterfowl have you or members of your household eaten in the past year?

Waterfowl and Game Birds	**Innu name**	**Check if applies**
Goldeneye	Mishikushk^{u}	
Canada goose	Nishk	
White-winged scoter	Umumuk$_{u}$	
Common loon	Muak^{u}	
American black duck	Inniship	
Long-tailed duck	N/A	
Common merganster	Ushik^{u}	
Spruce grouse	innineu	
Willow ptarmigan	Uapineu	
Rock ptarmigan	kashkanatshish	

Baseline Country Food Survey – Howse Property Project

2.12 When did you have your last meal of locally caught birds or waterfowl (such as partridge, grouse, ptarmigan, duck, etc.)?

a. This week _____
b. Last week _____
c. Last Month _____
d. Before last month _____

2.13 In the WINTER (October 2014 – May 2015) approximately how many meals per month typically included locally caught birds or waterfowl (such as partridge, grouse, ptarmigan, duck, etc.)?

a. Meals per month _____

2.14 In the SUMMER (June 2014 – September 2014) approximately how many meals per month typically included locally caught birds or waterfowl (such as partridge, grouse, ptarmigan, duck, etc.)?

a. Meals per month _____

2.15 When eating birds or waterfowl meat, do you or members of your household eat the organs (such as heart, liver or kidney)?

a. Yes _____
b. No _____

Baseline Country Food Survey – Howse Property Project

Fish

2.16 In the past year, have you or members of your household fished <u>for food</u> within the area on the map?

a. Yes _______
b. No _______

2.17 If yes, what fish species did you catch <u>for food</u>?

Fish	Innu name	Check if applies	In which lakes (refer to map)?
Brook trout	Matamek^{u}		
Lake trout	Kukamess		
Northern pike	Tshinushe^{u}		
Lake whitefish	Atikamek^{u}		
Sucker (white, longnose)	Makatshe^{u}		
Landlocked char	?? (Uanan = Landlocked Salmon)		
Burbot	Minai		

2.18 When did you have your last meal of locally caught fish?

a. This week _____
b. Last week _____
c. Last Month _____
d. Before last month _____

Baseline Country Food Survey – Howse Property Project

2.19 In the WINTER (October 2014 – May 2015) approximately how many meals per month typically included fish caught from the area?

a. Meals per month _____

2.20 In the SUMMER (June 2014 – September 2014) approximately how many meals per month typically included fish caught from the area??

a. Meals per month _____

2.21 When eating fish, do you or members of your household eat the organs (such as heart, liver or kidney)?

a. Yes _____
b. No _____

Baseline Country Food Survey – Howse Property Project

Berries

2.22 In the past year, have you or members of your household picked berries <u>for food</u> within the area on the map?

a. Yes ________
b. No ________

2.23 If yes, what local berries do you or your family typically <u>eat</u>?

Type	Innu name	Check if applies
Blueberries	innimin	
Cloudberries	shikuteu	
Raspberries	N/A	
Alpine cranberries	N/A	
lingonberry	uishatshimin	
Bog bilberry	nissimin	
Partridgeberry	N/A	

Baseline Country Food Survey – Howse Property Project

2.24 Based on the map below, please indicate the zone(s) in which you pick berries.

Type	Innu name	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
Blueberries	innimin																												
Cloudberries	shikuteu																												
Raspberries	N/A																												
Alpine cranberries	N/A																												
lingonberry	uishatshimin																												
Bog bilberry	nissimin																												
Partridgeberry	N/A																												

2.25 In the WINTER (October 2014 – May 2015) how many times per month would you or a member of your household typically consume a serving of local berries? Assume a serving is 1 cup of berries.

a. Times per month _____

2.26 In the SUMMER (June 2014 – September 2014) how many times per month would you or a member of your household typically consume a serving of local berries? Assume a serving is 1 cup of berries.

a. Times per month _____

2.27 When eating local berries, do you or members of your household wash the berries before eating them (berries that are eaten fresh off the plant when picked are considered not washed)?

Baseline Country Food Survey – Howse Property Project

a. Always
b. Often
c. Never

Thank you for your participation.

Reference:

Intrinsik Environmental Sciences Inc. (2013). Country Food Survey. Prepared for Alderon Iron Ore Corp for the Environmental Assessment for the Kami Iron Ore Project.

COUNTRY FOOD SURVEY RESULTS

1. Introduction

This survey was intended as a pragmatic investigation to help inform the risk assessment of traditional food use among known Area of Interest (AOI) users. It should not be viewed as an exhaustive and comprehensive population survey of local traditional food consumption.

2. Objective

The **main objective** of the Country Food survey is t*o collect data on the country food collected and eaten by the population in the vicinity of the project for the purpose of the Health Risk Assessment.* One of the secondary objectives is to use the results of the Country Food Survey to develop a sampling program for small game, fish and berries for the purpose of the Health Risk Assessment.

3. Methodology

Area of Interest (AOI)

The **Area of Interest (AOI)** covers the area where potential receptors are most likely to interact with the environment and traditional foods that may potentially be affected by the project plus an additional buffer of a minimum of 2 km. It also includes the existing DSO project (see attached map).

Population of Interest

The **population of interest** (statistical population) selected for the survey is: the number of households that potentially collect country food in the AOI (not the total population of the three local communities located near the project that consume country food in the entire region).

The households that don't collect country food in the AOI have not been considered for the survey. If the households that collect country food outside the AOI are included in the survey, the results will not be representative of the AOI and this data will not be relevant for the Howse project Health Risk Assessment. Two Naskapi Elders were however contacted to confirm that they don't use the AOI (this can also be confirmed by previous consultations and information provided by key informants). In addition, by respect for the community, it was deemed important to inform them of the survey and conduct the survey with their Elders.

Sampling strategy

The households that collect country food in the AOI are well known, through traditional Aboriginal and local knowledge, by members of the three communities. Key informants (land users, Band Councils, elders, etc.) were first contacted by phone or in person to identify households that potentially collect country food in the AOI and prepare an initial list of potential respondents. Starting from this initial list of potential respondents, a “snow ball” sampling strategy was applied during the survey. All surveyed households were asked to identify other potential land users in the AOI and these additional potential households where added to the sample. After a few surveys were completed, the same households previously identified on the initial list where mentioned again by participants, which is a good indication that the sample was adequate. This sampling strategy is especially appropriate considering the size of the communities and considering that the AOI users are quite familiar with each other’s harvesting practices and locations.

Based on this strategy, a list of 27 households that potentially collect country food in the AOI was established. We are confident that the majority of households that potentially collect country food in the AOI were captured.

Considering the small statistical population, a complete sample has been selected (random sampling is not appropriate in this case to avoid restraining the number of potential respondents). The approach has been to conduct the survey for all 27 households considering that some of them would probably not meet the survey criteria, and considering that some households would not be available for the survey or would not be interested in participating.

The 27 households were contacted by phone for the survey. When the contacted household didn’t meet the survey criteria (collect and/or eat local meats and country foods from the AOI), the country food survey was not pursued because it became irrelevant (3 households), while some households were not available because working or out of town (10 households). We have been able to reach 14 respondents that confirmed their use of the AOI. A total of 9 respondents confirmed that they collected country food in the reference year.

The survey <u>includes the largest known consumers of country food in the AOI</u>. With this approach we wanted to ensure that the highest potential ingestion rates of country food from the AOI were captured in the survey.

Considering the total population of the three communities, we understand that the sample number of households for the country food survey might appear low. However, three important points need to be taken into consideration in the current context:

1) The statistical population for this survey is the number of households that potentially collect country food in the AOI, and not the total population of the three communities who consume country food in the entire region.
2) Local residents in the Schefferville region (Innu, Naskapi and local non-Natives) have other preferred harvesting sites in the Schefferville region such as Iron Arm, Lac Vacher, Houston, Howells River South, Menihek etc.

3) The Naskapis (884 people) carry out very few activities in the AOI. They hunt, fish and collect berries outside the AOI at sites located near their community. Several key informants from Kawawachikamach confirmed that community members do not use this area and that the primary land users in the AOI are Innu families living in Matimekush.

4. Results

Highlights of the survey:

- ✓ Targeted population for the survey: recognized land use users by the communities
- ✓ Reference period for the survey is the last 12 months
- ✓ AOI: see map
- ✓ 16 surveys has been conducted- 14 of 16 usually use the AOI for collecting resources- 9 of 14 used the AOI last year
- ✓ Main destinations for hunting and fishing are zones 16, 17, 18, 24, 25, 26, 27 & 28 (through the access access to Rosemary Lake) (see attached map)
- ✓ Berries are usually picked in the previous zones and in the fall (for the patridgeberry - to most common picked berry). One survey mentionned also zones 3,4 & 5 for berry & Labrador tea picking.
- ✓ These areas are used most of the time on a daily basis (daily roundtrip).
- ✓ Occasionally the users will stay on site (tent) for 2 to 3 consecutive days (mainly in the fall).The longest stay mentioned is two weeks in May during goose hunting season (25 people).
- ✓ Zones 16, 17, 18, 24, 25, 26, 27 & 28 are less used in winter due to more difficult access by snowmobile. Very limited hunting activities (mainly Ptarmigan hunting) in the winter in the AOI.

Ingestion Rate - Country food from the AOI

	Meals/Month		
	Small mammals	Waterfowl	Fish
Average consumption of country food from the AOI among all surveyed household (last year)	0.3	1.8	1.7
Average consumption of country food from the AOI among hunters/fishers only (last year)	1.8	3.1	4.0
Largest consumer of country food last year in the AOI - in average	3.8	9.5	22.9
	Berries – CUPS/MONTHS (unprepared berries		
Average consumption of berries from the AOI among all surveyed	1.7		

household (last year)	
Average consumption of berries from the AOI among household that collected berries (last year)	6.9
Largest consumer of berries last year from the AOI - in average	13.0