MÉTAUX BLACKROCK

Environmental and Social Impact Assessment Statement

Iron Ore Mine – Lac Doré Geological Complex

Volume 1

(Chapters 1 to 7)

ENTRACO
Conseillers en environnement

Greenfield Park, November 2011
P0919

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1. PROJECT PURPOSE AND DESCRIPTION

1.1 OVERVIEW

This environmental assessment relates to a mining project to produce iron ore concentrate from the Lac Doré Complex, near Chibougamau (see Figure 1.1). BlackRock Metals Inc. is the project proponent.

BlackRock Metals Inc. (BlackRock) plans to build an industrial complex to mine and process iron ore and produce iron ore concentrate. The deposit will be mined as an open pit, and primarily mechanical methods will be used to process the ore (crushing and grinding of the rock, concentration by magnetic separation). A final flotation stage is also required to produce a concentrate that can be used to make high-grade steel. Mine operation is scheduled to begin in 2013 and continue until 2028.

The iron ore concentrate will be trucked to a transfer point and transported by rail to the port of Quebec City or Saguenay. The ore will then be loaded onto cargo ships bound for steel plants in Asia. The project is justified by:

- the Asian market‟s strong interest in base metals and its long-term supply needs;
- the size of the deposit, which would ensure the Asian market a ~ 15-year supply of iron ore concentrate that meets the requirements of their metallurgical processes;
- the project‟s location in a mining area with services and infrastructure, particularly its proximity to the public CN railway and the Quebec City and Saguenay ports, which accommodate ships of 100,000 tonnes or more that can transport the ore overseas.

The project is subject to provincial and federal laws and regulations applying to mining projects. As such, the environmental assessment must address all pertaining factors and determine the effects of mine construction, mining and iron ore concentrate production. The elements of the project can be adjusted according to the principles of least impact and sustainable development in light of an understanding of the local environment and public opinion. An understanding of the local environment and the project can also be used to develop a monitoring and follow-up program tailored to the components affected by mining activities. It should be noted that the impact assessment is based on the technical feasibility study prepared by the engineering firm Breton, Banville & Associates (BBA, July 2011).

Figure 1.1 Location of the BlackRock Mining Project – Chibougamau Sector

1.2 PROJECT LOCATION AND SCOPE

The deposit is located approximately 30 km (as the crow flies) southeast of Chibougamau, Quebec, and some 10 km east of Lac Chibougamau (see Figure 1.2). The Chibougamau regions connects to the Abitibi region via Route 113 going southwest, and to the Saguenay–Lac-St-Jean region via Route 167 going southeast. The geographical coordinates for the centre of the pit are: 49°48‟30‟‟ North and 74°02‟45‟‟ West.

By land, the mine site lies some 60 kilometres from Chibougamau via provincial highway 167 going south, and then logging road 210 going north. The entire project lies within the boundaries of claims held by BlackRock and within the territory governed by the James Bay and Northern Quebec Agreement.

The pit, concentrator, shops and warehouses, tailings sites, waste rock pile, overburden stockpile and construction camp will all lie within the Chibougamau town limits (Lemoine Township). Most of the project support infrastructure (access road, rail line and power line) will cross the Municipality of James Bay and the town of Chibougamau (parts of Queylus and Dollier townships). The rail transfer point will be entirely located within the Municipality of James Bay (MBJ). It is important to mention from the outset that Hydro-Quebec is in charge of building the power line. The power line is mentioned in this assessment on a qualitative basis, for information purposes only, as it is a project-related installation that is likely to have an environmental impact.

BlackRock owns the rights to the Lac Doré Geological Complex deposit, holding 308 mining claims covering a total area of 5, 235.96 ha of Crown land. This area covers most of the portion of the deposit minable over the long term, as well as the land needed for the facilities. The claims are located within the Chibougamau town limits, the Municipality of James Bay and the regional county municipality of Domaine-du-Roy, including parts of the Lemoine, Rinfret, Dollier and Queylus townships (rail transfer point). A list of claims and their locations are presented in Appendix 1 (Appendix 1.1).

Several other companies hold claims in the vicinity of BlackRock‟s claims (see Figure 1.3), particularly *Cogitore Resources Inc.* in the southern sector, and *Corner Bay Inc.* and *Giglio Anna Rosa* to the north. The presence of other companies in the area influenced BlackRock‟s selection of infrastructure sites.

1.3 PROJECT PROPONENT

BlackRock Metals Inc. was created for the purpose of mining the Lac Doré Complex iron ore near Chibougamau. In order to develop this project, BlackRock is consulting various firms specialized in engineering, geology and the environment.

Proponent

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Administrative Structure

Chinese investors have majority stock ownership of BlackRock Metals, holding 80% of the shares. Company executives hold fifteen percent (15%) of the shares and other investors in Ontario and Quebec hold five percent (5%) of the shares.

BlackRock‟s Board of Directors is composed of:

- Jean Rainville, B. Eng., B. Comm., President and CEO
- Sean Cleary, MBA, Chairman of the Board of Directors
- Edward Yu, Vice Chairman of the Board of Directors
- Michael James Allen, M.Sc., B.Sc. Hon. Geology, Director, Vice President of Exploration
- Pierre-Marc Johnson, Director

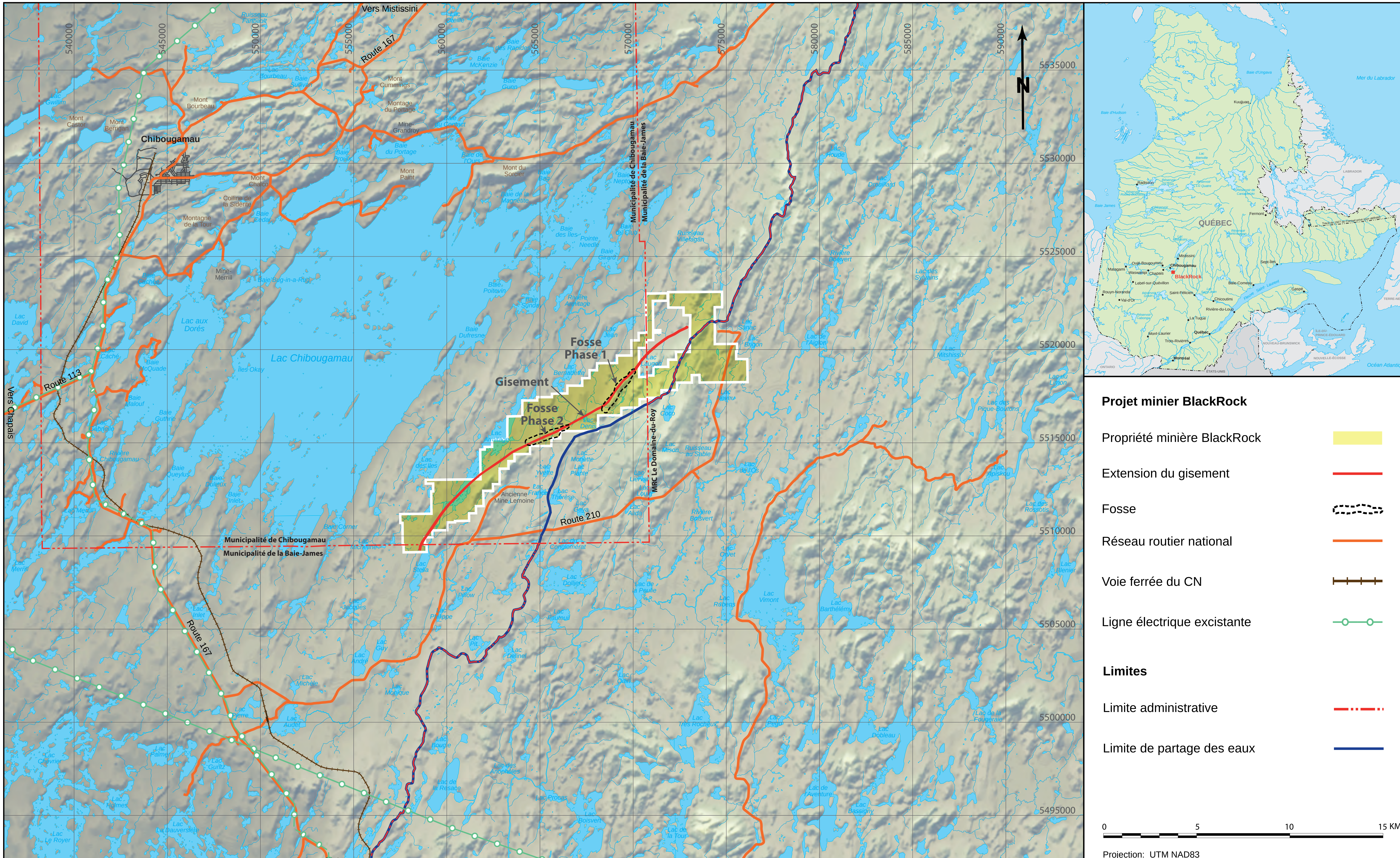

Figure 1.2 BlackRock Mining Project – Host Environment

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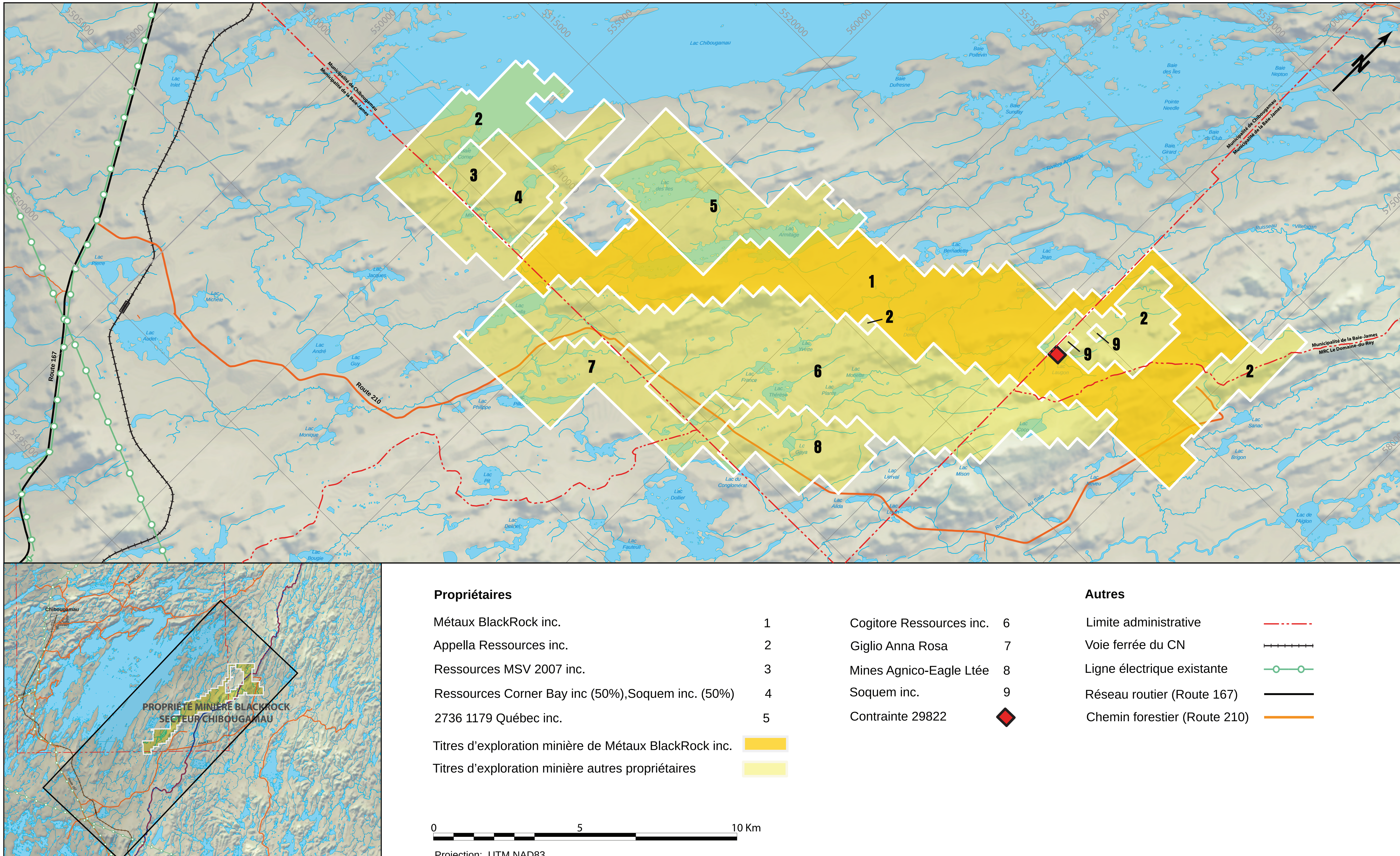


Figure 1.3 Claims Ownership

- Marc-André Lavoie, Director
- Louis Dionne, Ing., Director
- Robert Boisjoli, B. Com., D.I.A., C.A., C.B.V., Director
- Dave Cadwell, M.Sc. Geology, Director

The BlackRock management team consists of:

- Jean Rainville, President and CEO
- Robert P. Boisjoli, Chief Financial Officer
- René Scherrer, Vice President, Mine Development
- Michael Lam, Vice President, Finance
- Patrice Beaudry, Vice President, Projects
- Marie-Laurence Doré, Manager, Special Projects
- Michael Allen, Vice President, Exploration
- Richard Saint-Jean, Mine Manager
- Jacqueline Leroux, Environmental Superintendent
- Jacques Morasse, Purchasing Manager
- Steve Simard, Engineering Superintendent

The advisory board is composed of:

- Gilles Allard, Ph.D. Geology
- Dave Caldwell, M.Sc. Geology
- Denis Simoneau, B.Sc. Geology

Partners

BlackRock‟s partners are:

Strategic Alliances

- ICBC Bank - China
- Capital Market Global Limited, Hong Kong
- Prosperity Minerals Ltd.

Professional Services and Suppliers

- BBA, Montréal
- CN, Montréal
- Corem Laboratories, Quebec City
- Entreprise Maltais
- Forages Chibougamau
- Groupe-conseil Entraco Inc.
- Paul Roy, Surveyor
- Port of Québec, Quebec City
- Scierie Simard
- SGS Geostat, Montreal
- SGS Geostat, Lakefield
- James Bay Joint Action Mining Committee (TJCM)

Legal Advisors

- Heenan Blaikie, Montreal

Auditors

- PriceWaterhouseCoopers

1.4 LEGAL FRAMEWORK

1.4.1 Impact Assessment Procedure

Provincial

The project is subject to the environmental and social impact assessment and review procedure under Chapter I, Section 22 of the *Environment Quality Act* (RSQ, c Q-2) and under Chapter II (Provisions Applicable to the James Bay and Northern Quebec Region) of the same Act. The project must also comply with Chapter 22 of the James Bay and Northern Quebec Agreement (JBNQA). The JBNQA recognizes the hunting, fishing and trapping rights of Cree communities on the land of the project site.

Groupe-conseil Entraco Inc. filed a notice of project with the *Ministère du Développement durable, de l'Environnement et des Parcs* (MDDEP) on behalf of BlackRock Metals Inc. in July 2010. The minister issued its directives (reference number: 3214-14-50) in December 2010 based on the recommendation of the Evaluating Committee (COMEV) in compliance with Article 158 of the *Environment Quality Act*, indicating the nature, scope and extent of the environmental impact assessment statement pertaining to the James Bay and Northern Quebec region. These directives are valid until December 2013.

The project must also comply with MDDEP‟s Directive 019 relating to the mining industry and with the *Ministère des Ressources Naturelles et de la Faune* (MRNF)‟s *Mining Act*.

The *Agreement Concerning a New Relationship Between le Gouvernement du Québec and the Crees of Quebec* (commonly called *La Paix des Braves*, 2002) states in Sections 2.4 and 5.2 that Quebec will promote and facilitate the participation of Crees in mining development through partnerships, employment and contracts.

Federal

The federal framework requires compliance with the *Canadian Environmental Assessment Act* (CEAA). If the project affects fish habitat, it must comply with the *Fisheries Act* (c. F-14). The framework also includes the *Metal Mining Liquid Effluent Regulations* (CRC, c.819) and Fisheries and Oceans Canada‟s *Policy for the Management of Fish Habitat.*

Since iron ore mining will require on-site use and storage of explosives, the project must meet requirements set out by Natural Resources Canada (NRCan) under paragraph 7(1)a) of the *Explosives Act*.

The project is identified on the Comprehensive Study List, as it meets the definition of: *The proposed construction, decommissioning or abandonment of a metal mine, other than a gold mine with an ore production capacity of 3, 000 tonnes per day or more*. It is also a resource project that involves the Major Projects Management Office (MPMO).

The *Canadian Environmental Assessment Agency* sent the proponent guidelines for the comprehensive study in July 2011, in compliance with the CEAA (Canadian Environmental Assessment Registry Reference Number: 11-03-62105), which addresses the concerns of federal departments and organizations involved in the project.

1.4.2 Mining Act

In addition to the impact assessment procedure, the mining project must comply with the *Mining Act* (RSQ, c. M-13.1). When it begins mine development and construction, BlackRock Metals Inc. will have to officially apply for a mining lease from the *Ministère des Ressources Naturelles et de la Faune* (MRNF), under Sections 100 and 101 of the Act.

Without infringing upon implementation of the *Environment Quality Act*, the proponent must file a mine site rehabilitation plan with the MRNF that includes the description of a financial guarantee covering 70% of the cost of rehabilitation work. The plan must comply with the *Mining Act* and follow the MRNF‟s *Guidelines for Preparing a Mining Site Rehabilitation Plan and General Mining Site Rehabilitation Requirements*.

1.4.3 Other Requirements

The proponent must also respect the *Soil Protection and Contaminated Sites Rehabilitation Policy* and meet criteria set out in the *Regulation respecting the quality of the atmosphere* with respect to common contaminants. The proponent must design the project in such a way as to minimize sulphur dioxide, sulphur and nitrogen oxide emissions, and emissions of particulate matter or any other air pollution. Furthermore, as noise is covered by the *Environment Quality Act*, the proponent must assess the impact of noise generated by the project.

At the appropriate time, the proponent will have to submit a building permit application and obtain certificates of authorization from the municipalities and departments involved in mine construction and operation. Finally, the proponent must comply with the following project-specific regulations, namely:

- Regulation respecting the water property in the public domain of the State (c. R-13, r. 1);
- Regulation respecting wildlife habitats (c. C-61.1, r. 18);
- Regulation respecting hazardous materials (c. Q-2, r. 32);
- Petroleum Products Regulation (c. P-30.01, r. 1);
- Transportation of Dangerous Goods Regulations (DORS/2008-34);
- Regulation respecting waste water disposal systems for isolated dwellings (c. Q-2, r. 22);
- Regulation respecting the quality of drinking water (c. Q-2, r. 40);

- Regulation respecting pits and quarries (c. Q-2, r. 7);
- Regulation respecting sanitary conditions in industrial or other camps (c. Q-2, r.11);
- Groundwater Catchment Regulation (c. Q-2, r.6);
- Forest Act (RSQ, c. F-4.1);
- Municipal by-laws.

1.5 PROJECT HISTORY

In 1954, Dominion Gulf initiated exploration activities around the magnetite deposit near Chibougamau (Allard, 1967; Castonguay and Olivier, 1977). At the time, iron ore was the main mineral of interest.

In 1966, Dr. Gilles Allard, a geologist with the *Ministère des Ressources Naturelles* (MRN), discovered that the magnetite deposit contained appreciable amounts of vanadium. The ministry subsequently acquired the mining rights for the deposit. Several studies were conducted into the 1970s to determine whether the vanadium grade of the magnetite deposit was economic. However, the main obstacle to mining was the small number of plants able to process vanadium.

In the 1980s, the MRN, *Société québécoise d'exploration minière* (SOQUEM), the *Centre de recherche minérale* (CRM), Hydro-Québec and specialized firms turned their attention to the vanadium market and methods for mining the ore and for the beneficiation of its combined iron-titanium-vanadium content (Cambior, June 1999).

In 1997-1998, McKenzie Bay Resources Ltd. resumed exploration efforts and renewed interest in mining the deposit by investing $1.5 million to validate earlier work. The company acquired the property that had until then been under SOQUEM‟s ownership, although SOQUEM retained 20% of the value of the deposit (McKenzie Bay Resources Ltd., March 1999). From 1997 onwards, a series of geological, technical and economic studies focused on better defining the vanadium concentrations, deposit limits, mining methods and marketing (Cambior, McKenzie Bay Resources Ltd, SOQUEM, IOS Services Géoscientifiques, SNC-Lavalin).

At the turn of the millennium, depleted or uneconomic sources of vanadium elsewhere in the world (South Africa, China, Russia), growing demand and new market outlets generated new economic interest in the Lac Doré Complex deposit.

In 2004, financial considerations and fluctuations in worldwide vanadium demand led McKenzie Bay Resources Ltd. to abandon the vanadium mining project.

In 2008, BlackRock acquired a 100% interest in 17 of the 24 kilometres of the mineralized zone, the remaining 3 km being held by other companies. Several other companies also hold claims around the magnetite deposit (see Figure 1.3). Exploration work and laboratory analyses carried out since 2008 have further defined the deposit‟s mining potential. The company plans to start mining the iron ore in 2013. It is worth noting that BlackRock has diverged considerably from historical approaches to the project, aiming to produce a vanadium–titanium-bearing iron ore concentrate rather than attempting to separate out the vanadium by pyrometallurgy. A list of claims is provided in Appendix 1.1.

1.6 IRON ORE MARKET

Iron is a base metal that serves various domestic and industrial purposes. Due to its abundance, the iron ore market is subject to fluctuations and the industry is cyclical as a result (MRNF, 2009).

From 1980 to 2002, global iron production hovered between 800 and 1, 000 million tonnes (Mt) per year, mirroring the steel market (United Nations Conference of Trade and Development, UNCTAD, 2011). In 2005, global production was over 1,300 Mt and China accounted for one third of the global steel market. China absorbs half the global production of iron ore, using steel to meet domestic growth needs and for export (L‟Édito Matières premières, Devises et Émergents, 2007).

Despite the 2008 recession, a record of 1 billion 580 million tonnes of iron ore were traded in 2009, up 7.4% from 2008 (UNCTAD, 2011). This increase is attributable to a boost in China‟s imports due to economic growth coupled with declining domestic iron ore production. Outside of China, steel production jumped by 34.3% in the first half of 2010 compared to 2009 (Beijing Review, 2010). These figures illustrate that despite its cyclical nature, iron ore is a coveted commodity in an active market. The decrease in demand from the United States in the last few years has been offset by a rising demand in developing countries, and Asian countries in particular. In fact, global demand has exceeded supply since 2010. This market imbalance is expected to persist until 2015 despite a rise in production and mining of new deposits.

In a study entitled *Profile of the economic impact of mining sector activities and investments in Quebec*, the MRNF (2011) states that ore shipment figures for 2008 broke historical records at $6.2G, while mining investment reached $2G.

Purchases of goods and services, taxes and salaries account for two-thirds of this amount. The mining industry has contributed $4.8G to the Quebec economy, representing 1.6% of the province‟s GDP. The mining industry is also responsible for creating 34,000 jobs, both direct (16,400) and indirect (17,600).

In Quebec, iron ore mining is making a comeback, with multiple development projects planned in the vicinities of Port-Cartier, Fermont and Schefferville (MRNF, 2009, 2010). AcelorMittal‟s recent $2.1G investment will translate to a 50% increase in production at the Mont-Wright mine and the creation of many thousands of direct and indirect jobs (Union of Quebec Municipalities, 24 May 2011).

In the case of BlackRock, metallurgical testing shows that the Southwest Zone can yield a concentrate containing at least 62% iron. The spot market for this grade of concentrate is currently US$175/tonne CFR Tianjin port in China. In 2009, concentrate of equivalent grade traded at US$80/tonne. Prices were even lower in previous years. According to market analyses, prices should continue to climb in the coming years. Longer-term, prices should not fall below US$110/tonne.

Given this favourable context, BlackRock contacted several potential clients and obtained a firm commitment from Prosperity Minerals of Hong Kong to purchase 40% of BlackRock production in the first five years of mining. BlackRock has received a US$40 million advance as security. China currently imports 500 million tonnes of iron concentrate per year, which could double in the next five years due to its economic growth. China currently accounts for 60% of global steel production.

In addition to iron ore, the Lac Doré Complex deposit contains titanium and vanadium. Most of the titanium is associated with ilmenite. BlackRock is looking into the possibility of recovering the titanium contained in the ilmenite, which would give economic value to a significant portion of the tailings from magnetite mining. Preliminary metallurgical testing in China indicates that this possibility is technically and economically feasibility In practice, a 48% TiO_2 concentrate could be produced, currently valued at 400$/tonne on the market. Titanium demand is expected to exceed supply in the second half of this decade. Titanium is used in the production of specialized steels, as well as pigments, cosmetics and plastics.

In terms of vanadium production, three countries dominate the market: China, South Africa and Russia. Historically, supply from these producers has never been steady. Even though China is the third largest vanadium producer in the world, its producing mines have low vanadium grades. Furthermore, vanadium is generally associated with multiple contaminants that seriously affecting refiners‟ profit margins. BlackRock‟s Chinese partners are particularly interested in the vanadium content of the Lac Doré Complex magnetite. The concentrate produced by BlackRock contains more than 1% vanadium (in the form of V_2O_5) and only trace contaminants. Vanadium is particularly sought after for the manufacturing of high-resistance steel (ferrovanadium). The market price for ferrovanadium is currently on the order of $US30/kg.

1.7 ENVIRONMENTAL AND SOCIO-ECONOMIC SETTING

The Chibougamau area is known for its natural resources. The first mineral showings in the rocks of the Lac Doré Complex were discovered at the beginning of the last century. The first mine opened in 1952, and the town of Chibougamau was incorporated in 1954 (Chapais was incorporated the following year).

The area thrived due to natural resources development. However, the mining industry has suffered a marked downturn in the last few years following the closure of a number of mines, most notably the Troïlus mine north of Chibougamau in 2010. The BlackRock project is nonetheless in an area favourable to its development. The presence of many public and private bodies that work to develop the mining industry is a key asset.

The local population has a long history of mine development and operation, and local manpower is both skilled and available. Chibougamau and its surroundings offer the required services for workers (accommodation, school, hospital, tourism) and all the infrastructure required to support mine operation (provincial logging roads in good condition, railway, airport, power grid and power lines).

The construction of the mining facilities will have an impact on the physical environment. The project will directly disturb an area (soil, water, wildlife and vegetation) of in the order of 600 ha (6 km^2). Despite the proponent‟s willingness to develop the deposit with minimal environmental impact and a rehabilitation and monitoring plan that complies with the applicable laws and regulations, the effects on the environment will be felt long after the mine‟s closure (presence of the pit and tailings, linear infrastructure corridors). Given the project components, it is possible at this stage to anticipate the main environmental impacts:

1. land use along logging road 210, which will mostly be used for mining activities;
2. presence of the pit and tailings sites (surface and groundwater quality);
3. loss of natural environments, particularly wetlands and small water bodies (water network, fish habitat).

The access road and power line are not likely to have a significant environmental impact in the mining area since:

1. most of the access road is already built;
2. installation of the power line will only require minor and occasional field activities;
3. logging companies have already extensively logged the area in question.

The total investment for the project is on the order of $600M (BBA, July 2011). The base costs for mine development (processing plant, equipment, dams, crushers, electrical installations, labour) are estimated at $400M, to which are added $153M in indirect costs (studies, exploration, engineering) and $55M in operating costs over the life of the mine.

On a social level, the mining project will generate several hundred direct jobs during mine construction (1.5 years) and another hundred or so well-paid jobs during the some fifteen years of production. Worker transportation and accommodation and the purchase of goods and services will stimulate the local economy through indirect jobs.

One of the project‟s key issues relates to concerns expressed by Native people regarding the project‟s impact on their traditional activities and the possibility of being actively involved in project development. Talks are underway between BlackRock representatives and stakeholders, particularly the Ouje-Bougoumou Crees and the Grand Council of the Crees, to lay the groundwork for a partnership agreement.

The mining project is designed such that measures are taken at each step of the process to prevent, reduce or eliminate the disposal of waste into the environment, take local concerns into account and comply with the applicable laws and regulations.

1.8 CONSULTATIONS

BlackRock retained ENTRACO, an environmental consulting firm, to carry out the environmental impact assessment, including the consultation process. Since the filing of the notice of project with the MDDEP in July 2010, BlackRock and its representatives have had ongoing discussions with local stakeholders, mainly First Nations, the *Ministère des Ressources Naturelles et de la Faune*, the *Ministère du Développement durable, de l'Environnement et des Parcs*, the Canadian Environmental Assessment Agency, Fisheries and Oceans Canada, Environment Canada, municipal governments, and local and regional organizations for economic development and manpower training. This exercise will allow certain elements of the project to be adjusted to take into account knowledge of the environment and the concerns of the aforementioned stakeholders. BlackRock intends to continue communicating with the local stakeholders throughout the life of the project.

Individuals and organizations contacted since the project began in July 2010 and the concerns expressed are presented in Appendix 1.2.

1.8.1 Provincial and Federal Governments

The provincial and federal governments have issued their directives for the project, which include a section on public consultations. Governments and their representatives were contacted on many occasions to discuss regional issues and provide information on resources and the environment. Their involvement also includes technical support for the environmental assessment in the form of guidelines and standards relating to the inventorying and analysis of field data, as well as management techniques (Appendix 1.3).

<u>The provincial government</u>"s directives (December 2011) contain a chapter on communications with the individuals and organizations of the region, particularly the Ouje-Bougoumou Cree community, whose traditional territory is affected by the project (trap line O-59, Philip Wapachee, tallyman).

<u>The federal government</u> accords particular attention to public consultations and the concerns of the Ouje-Bougoumou Crees; the CEAA conducts its own consultations with stakeholders. Native concerns reported by the CEAA are listed in Appendix 6.3 of the comprehensive study (CEAA, July 2011). The following items are specifically mentioned:

- the community"s well-being (cultural, spiritual and emotional aspects); loss of heritage related to the deposit hill;
- repercussions on health; reduction of traditional food stocks, the food chain;
- transfer of knowledge, land use; poaching
- impact on values, the beauty of the landscape, hunting and fishing activities, fur trading;

- water quality and water use at the Rabbit camps (Wapachee family, logging road 210); dust pollution, toxicity, impact on spawning grounds, fish stocks;
- cumulative effects, mitigation and compensation measures;
- wildlife species (big game), fur-bearing species, species at risk (caribou).

BalckRock met with municipal representatives from Chibougamau and Chapais and other stakeholders at an information and consultation session in the winter of 2011. The municipal council, individuals and local and regional organizations attended the session to express their opinions. The concerns expressed related to the hiring of local labour and worker accommodations, as well as the project‟s impact on the environment (Appendix 1.3).

While the proponent requested a meeting with the government of the Municipality of James Bay, such a meeting did not take place; the town‟s urban planner agreed that information received in the fall of 2010 (notice of project, location map and technical components of the project) was sufficient to provide a basic understanding of the project.

The Municipality of James Bay and the town of Chibougamau are in favour of the project and have expressed their consent by adopting a resolution or issuing a certificate recognizing the project‟s compliance with municipal by-laws (Appendix 1.4).

1.8.2 Native Communities

Meetings with the Native communities of Ouje-Bougoumou and Mistissini were held at their Band Council office in the winter of 2011. The community of Oujé-Bougoumou is particularly sensitive to growing pressure on its trapping grounds from development, as there is a history of mining companies leaving behind a considerable quantity of waste. They hope BlackRock will behave differently, by following industry best practice and maintaining ongoing communications.

Several meetings have since taken place to discuss the project and lay the groundwork for a joint agreement on the hiring and training of Native workers and businesses. It should be noted that the community of Mistissini has mining expertise acquired from the Troïlus project.

BlackRock has also contacted the Innu of Lac-Saint-Jean. Hunting territory No.24 belonging to the Innu of Pekuakamiulnuatsh is adjacent to the project; consequently, they have been invited to participate in discussions and the establishment of mitigation measures. The Innu of Lac-Saint-Jean have skilled workers and contractors who were recently involved in large hydroelectric projects.

1.8.3 Tallyman

BlackRock is in regular contact with Philip Wapachee, tallyman for trap line O-59, as well as with Matthew Wapachee, the family patriarch. All mining activities will take place on trap line O-59. Matthew Wapachee had serious reservations about the project in the fall of 2010. Discussions presently underway with the Grand Council of the Crees and the Oujé-Bougoumou band council are expected to produce a partnership agreement, which will also address the concerns of the tallyman and his family and environmental protection.

Philip Wapachee and his father Matthew, the former tallyman, provided information on sensitive environments and hunting and fishing sites. They also voiced their concerns regarding fragmentation and deterioration of their trap line. They particularly asked that activities be kept as far away as possible from Lac Armitage and Rivière Armitage, a particularly productive hunting and fishing area. The camp on road 210 (near Lac Guy) was also the subject of discussions due to the harmful effects of heavy traffic (noise, dust, safety).

Meeting with the Wapachee Family, Summer 2011

Matthew and Philip Wapachee listed the many effects of heavy traffic on logging road 210 near their hunting and fishing camps (*Rabbit camp*), located east of Lac Guy: dust, noise, the safety of their family, safe travel hindered on road 210, protection of drinking water sources. They suggested that 2.5 to 3.5 km of the access road be relocated to the other side of Guy Lake and connect back to road 210 near Lac Roland (south of Ruisseau Wynne), thereby bypassing their camp. This option would mean that the access road would run about 700 m west of the Wapachee family camps.

The zone affected by this new segment of road would comprise Ruisseau Audet, several wetlands and swampy areas and irregular topography (hills and valleys). Building a new road (cut and fill, bridges or culverts to cross Ruisseau Audet, clearing) in an environmentally-sensitive area would cause more negative effects, as well as additional costs for construction and mitigation measures.

Following talks with Matthew and Philip Wapachee on the implications of building a new road in an environmentally-sensitive area and the creation of additional environmental effects, they agreed to consider the option of moving their camps and building a camp at a location of their choice.

1.8.4 Development Organizations

Local and regional economic development organizations have been contacted on many occasions since the summer of 2010 (see Appendix 1.2), including: the *Commission économique et touristique de Chibougamau* (CETC), the James Bay Joint Action Mining Committee (TJCM) and the *Société de développement économique Innu* (SDEI).

These organizations have actively collaborated with the proponent for the hiring and training of local manpower, and have granted access to their directory of specialized trades and companies related to the mining industry. A review of current documentation indicates that the Chibougamau area can supply the manpower required for project construction and mining.

1.8.5 Private Organizations

A few private organizations have been approached, including the *Chantiers Chibougamau* logging company and the *Canadian National* railway company. Information was gathered relating to various technical aspects of the project (rail use, rail transfer point, clearing, land use, traffic along access road 210). The proponent will have to reach an agreement with the MRNF and *Chantiers Chibougamau* concerning the use of logging road 210, which is the access road for the mine site and rail transfer point.

Owners of *Pourvoirie J.C. Bou* (south of Lac Chibougamau, Baie Queylus) do not anticipate that the project will have any negative effects on their business. Mr. Pomerleau, the owner of the Pomerleau fishing camp (north of Lac Chibougamau), is not in favour of the project; he does not want mine tailings to affect walleye fishing in Baie Girard and Rivière Armitage (spawning grounds for walleye). He is aware that mining activities located on the hill will be visible to tourists on Lac Chibougamau, but does not believe that business will be negatively affected by this change in the landscape.

1.8.6 Conclusion

The discussions and consultations that have taken place with Native and non-Native populations since the summer of 2010 appear to indicate positive sentiment toward the project. Many stakeholders hope to be involved in the project development.

BlackRock is taking the population‟s concerns into consideration. The company is also reassured that a diverse and skilled workforce is available, and that many economic and social development agencies will be involved in the construction and mining phases. BlackRock plans to hire the maximum number of local people for the project. In this regard, BlackRock has already employed a good number of local drilling and mining experts. These employees are involved in exploration and studies; the Crees and an Innu business are already participating in knowledge gathering. Crees are also working in exploration.

The area‟s long mining tradition and local expertise constitute clear assets for the proponent. The general public, in turn, hopes to enjoy economic benefits and job opportunities from the project. In this sense, the BlackRock Metals project has the potential to enhance the population‟s quality of life and support regional economic development efforts.

Quality of life and the environment are nevertheless the main topics of concern. The population does not want a project of this size to disturb the local environment, or threaten workers‟ health or other activities (tourism, hunting, fishing and traditional Native activities).

In terms of environmental impact and Cree concerns for their trap lines, the proponent has demonstrates its willingness to make the project an environmental and social success. Efforts are being made to choose appropriate sites and minimize the project footprint. Facilities will be entirely located within the James Bay watershed and a fair distance away from Lac Armitage and Rivière Armitage.

All phases of the project and related activities are government-regulated. The proponent will comply with the development standards set out in the regulations to reduce or eliminate all sources of pollution. BlackRock and its representatives plan to maintain the collaborative relationship established at the outset of the project, by promoting discussion and fostering the existing sentiment of trust, such that the project is socially acceptable and respects the environment.

REFERENCES

Canadian Environmental Assessment Agency (CEAA), July 2011. BlackRock Mining Project, Chibougamau by BlackRock Metals Inc., July 2011. *Portée de l'évaluation et lignes directrices de l'étude approfondie établies en vertu de la Loi canadienne sur l'évaluation environnementale*. CEAA Refernce Number 11-03-62105, 42 p.

Alard, G.-O., 1967. Quart Nord-Est du Canton de Rinfret, comté d'Abitibi-Est et de Roberval. Rapport préliminaire R.P. no 567.

Breton, Banville & Associés, July 2011. *BlackRock Project Feasibility Study NI 43-101 Technical Report*. In cooperation with SGS, ENTRACO and Journeaux Associés, 311 p. and appendices.

Cambior, June 1999. *Projet du Lac Doré ; sommaire du rapport d'évaluation*. By Robert Crépeau, Director, Mine Geology, Val-d'Or Technical Services.

Castonguay and Olivier, 1977. Gisement de vanadium du MRN.

Commission économique et touristique de Chibougamau (CETC), édition 2010. Répertoire minier Nord-du-Québec.

Commission économique et touristique de Chibougamau (CETC), édition 2011. Répertoire des entreprises de Chibougamau.

Commission économique et touristique de Chibougamau (CETC), édition 2011. Répertoire des entreprises de Chibougamau, édition minière.

United Nations Conference on Trade and Development (UNCTD), 2011. Metals Minerals. http://www.unctad.info/en/Infocomm/Metals_Minerals/IronSteel/Marche/

Entraco, June 2003. « Exploitation du dépôt de vanadium du Lac Doré et d'un complexe métallurgique, région de Chibougamau – Étude d'impact environnemental ». Volumes 1 and 2.

Gouvernement du Québec, 1975. James Bay and Northern Quebec Agreement. Secrétariat aux Affaires autochtones, édition mise à jour.

Gouvernement du Québec, February 2002. Agreement concerning a new relationship between Le Gouvernement du Québec and the Crees of Québec. Document also called La Paix des Braves, 108 p.

L'Édito Matières premières, Devises et Émergents, 2007. Les ressources naturelles et les devises enfin à la portée des investisseurs – Le prix du minerai de fer s'envole. http://www.edito-matieres-premieres.fr/0074/metaux/envol-prix-minerai-fer.html

McKenzie Bay International Ltd., March 1999. Lac Doré Vanadium Titanium Project, Chibougamau, Québec, Canada. Metal for the new millennium.

Nutshimit, October 2002. Exploitation d'un dépôt de vanadium dans la région de Chibougamau : description de l'utilisation du territoire et des droits des Innus et inventaire des entreprises et de la main d'œuvre de la communauté de Mashteuiatsh. Rapport P600009 presented to Entraco.

Québec, Ministère de l'Environnement, du développement durable et des Parcs (MDDEP), December 2010. Directives pour le projet minier BlackRock par Métaux BlackRock Inc. Reference Number 3214-14-50, 19 p.

Québec, Ministère des Ressources naturelles, 1997. Guidelines for preparing a mining site rehabilitation plan and general mining site rehabilitation requirements.

Québec, Ministère des Ressources naturelles et de la Faune, 2009. Quebec Mineral Strategy – Preparing for the Future of Quebec's Mineral Sector. Distribution code: 2009-5000, 48 p.

Québec, Ministère des Ressources naturelles et de la Faune, 2010. *Iron Mines and Projects in Québec.* Direction de l'information géologique du Québec, Quebec location map.

Québec, Ministère des Ressources naturelles et de la Faune, 2011. Study on the Economic Impact of the Mining Sector (in French). Direction des politiques, de la coordination et des affaires intergouvernementales, Direction générale du développement de l'industrie minérale : http://www.mrnf.gouv.qc.ca/mines/statistiques/index.jsp

Beijing Review, April 2010. L'importation du minerai de fer en baisse continuelle. http://french.beijingreview.com.cn/magazine/2010-08/26/content_294841.htm

SNC-Lavalin, April 2002. "Lac Doré Vanadium – Project Feasibility Study". Volume 1 and 2 and Appendiceset Appendices.

Union of Quebec Municipalities, May 2011. Investissement d'ArcelorMIttal au complexe minier de Mont-Wright. Actualités municipales de l'UMQ, 24 May 2011

2. DESCRIPTION OF THE BIOPHYSICAL AND SOCIAL ENVIRONMENT

2.1 STUDY AREA BOUNDARIES

Due to the nature and scope of the mining project, which will generate measurable effects on a vast territory and in very well-defined areas, the study area must include both the entire Chibougamau area and the mine site area. Consequently, environmental elements were inventoried, analyzed and mapped on regional and local scales (see Figure 2.1). The study areas straddle the watersheds of James Bay (west side) and the St. Lawrence River (east side).

2.1.1 Regional Study Area

The regional study area encompasses the town of Chibougamau, a portion of the Municipality of James Bay and the regional county municipality (RCM) of Domaine-du-Roy, as well as isolated municipalities and communities (Chapais, Ouje-Bougoumou, Mistissini).

At the 1:250,000 scale, the regional map numbers (NTS codes) are:

32 G (mine site and rail transfer point);
32 H (Municipality of James Bay and Domaine-du-Roy RCM).

Socio-economic data, human activity, transportation networks and key environmental elements that could affect or be affected by the project components will be presented at this scale.

2.1.2 Local Study Area

The local study area covers 700 km^2, encompassing an area between Route 167 and the northeastern part of Lac Chibougamau (Baie Girard). This area will be affected by iron ore mining and processing operations (site of the open pit, processing plant, garages, warehouses, waste rock pile, tailing sites, power line) and by shipping operations (access road, rail transfer point).

The working scales (1:50,000, 1:20,000 and 1:15,000) were sufficiently detailed to survey all the elements of the environment affected by the project (soil, fish habitat, water and air quality, groundwater, archaeological potential) and to reflect the state of the environment prior to mine start-up. Site options for the various facilities were assessed at these scales. Even larger-scale maps within the local study area cover the mine site and rail transfer point as needed.

At the 1:50,000 scale, the numbers (NTS codes) are:

32 G09 (rail transfer point, Route 167, logging road 210, workers‟ camp);
32 G16 (pit, mine site, mining installations);
32 H13 (NE part of the study area, no infrastructure).

At the 1:20,000 scale, the numbers (NTS codes) are:

32 G09-200-0201 (Municipality of James Bay, Lac Audet, rail transfer point);
32 G09-200-0202 (Municipality of James Bay, central area from Lac André to Lac Stella);
32 G16-200-0102 (town of Chibougamau, pit and mine site);

32 H13-200-0101 (Domaine-du-Roy RCM, NE part of the study area, Lac Mitshisso);
32 H13-200-0201 (Domaine-du-Roy RCM, NE part of the study area, Lac Drouillard).

2.2 METHODOLOGY FOR DATA COLLECTION

Elements of the human and natural environments were inventoried, analyzed and mapped at different scales, according to needs and available documentation. Maps were reduced or enlarged to facilitate the understanding of the elements studied and improve overall presentation. The report was prepared following the steps below for data collection:

- research, review of scientific documentation, knowledge of the environment and the project (project area, laws, regulations, study and development standards and criteria, policies, by-laws, development guidelines, etc.);
- discussions with Natives with traditional knowledge in the study area;
- discussions with organizations, communities and stakeholders to gain insight into the project environment and information on their concerns regarding the project;
- review of technical documentation: topographic maps (1:50,000 and 1:20,000), soil maps (1:50,000), forest ecology maps (1:20,000) and other thematic maps; black and white aerial photos (1:15,000; MRN, 1983, 1984, 1998), SPOT infrared images (2009), satellite images (Google Earth, 2011).

Field surveys and analyses help determine the state of the environment prior to construction and mining, and allow the project‟s effects on the environment to be monitored in both time and space. These activities include:

- field surveys and analyses conducted with traditional users of the land in 2010 and 2011;
- review of data acquired from surveys and analyses conducted between 1999 and 2003 for a mining project in the Lac Doré Geological Complex;
- updates of the environmental elements through consultations and discussions with communities and local stakeholders;
- water, sediment, host rock and ore sampling to characterize the host environment;
- scientific fishing, bathymetry, limnological and physicochemical characterization of lakes and streams;
- determination of flow profiles and flow rates in lakes and streams;
- sector surveys and analyses: noise levels, air quality and airborne emissions, hydrogeology, archaeology, Native community land use.

Figure 2.2 shows the survey results for the natural and human environments.

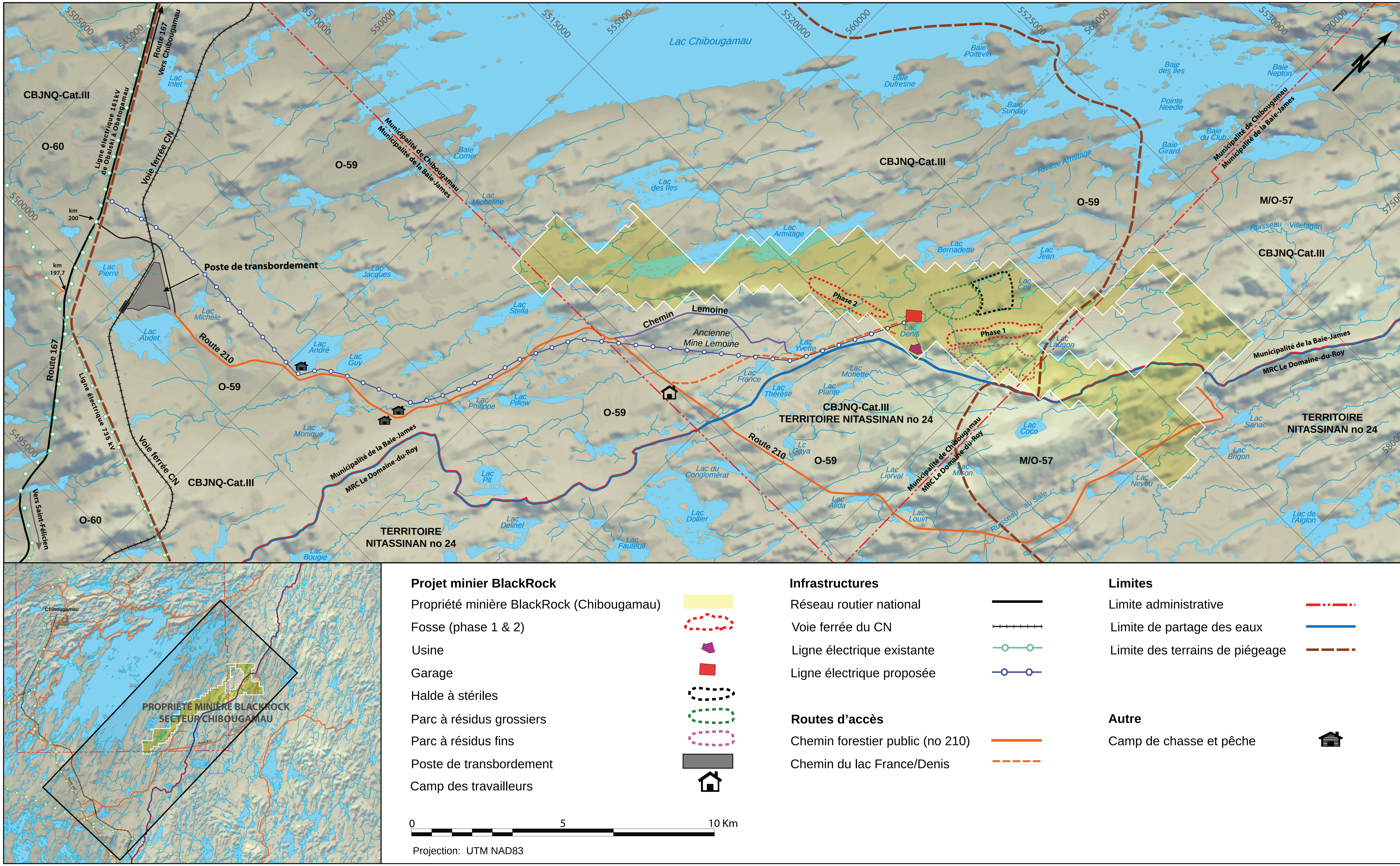


Figure 2.1 Study Area – BlackRock Mining Project – Chibougamau Sector

2.3 HUMAN ENVIRONMENT

2.3.1 Administration

BlackRock‟s mining project is located in administrative region No.10, Nord du Québec, and on land governed by the James Bay and Northern Quebec Agreement (JBNQA) (see Figure 2.2). This area is bound to the southeast by the Domaine-du-Roy RCM, whose border corresponds to the drainage divide between the James Bay and St. Lawrence River watersheds.

The project components affect two municipalities. The section from Route 167 to Lac Stella crosses Queylus and Dollier townships in the Municipality of James Bay. From the junction of logging road 210 and the old Lemoine mine road, Lemoine Township and the town of Chibougamau lie in the direction of the future mine site. Chibougamau is governed by, among other things, the *Cities and Towns Act* and the *Act respecting Land Use Planning and Development* (Chapter III onwards).

The territories of MBJ and Chibougamau are covered by the so-called *Paix des Braves*, an agreement signed between the Quebec government and the James Bay Crees in February 2002. This agreement provides for joint management of natural resources.

2.3.2 Land Use

The main sectors of activity in the study area are forestry, mining exploration, hunting, fishing and extensive tourism.

There are no permanent residences near the proposed site of the rail transfer point (only a sporadically-occupied trailer on the edge of Lac Audet). There are three hunting camp sites off logging road 210, in the Lac André sector. There are permanent residences and a logging camp (an MRNF lease to operate a commercial resort) on the shores of Lac Vimont, in the Domaine-du-Roy RCM, a dozen kilometres southeast of the future mine site.

Otherwise, the project area is regularly used for blueberry picking, as well as for partridge, waterfowl, bear and moose hunting. Fishing activities take place mainly on Lac Chibougamau and to a lesser extent on Lac Armitage.

In addition to tourism, conservation and logging activities, mining activities are permitted in the municipalities concerned, in compliance with municipal by-laws. This particular project has received certification in this regard (See Appendix 1.4):

- Municipality of James Bay: *certificat de non-contrevenance* (“certificate of non-violation”) (CER-2011-03);
- Chibougamau municipality: certificate of compliance (resolution 021-2011-01).

2.3.3 Native Land Use Rights

The territories of MBJ and the town of Chibougamau lie on Category III lands, as defined in the JBNQA. These municipalities are also subject to Quebec provincial laws and to general Crown land regulations. Cree hunting and fishing rights are enshrined in the JBNQA: any Native person may hunt, fish or trap any wildlife species, subject to certain restrictions specified in the JBNQA.

The project lies within the limits of the Mistissini Beaver Preserve trap lines operated by the James Bay Crees (Oujé-Bougoumou and Mistissini); the Cree trapping grounds border on the Lac Saint-Jean Innu trapping grounds to the southwest.

2.3.3.1 Cree Communities

There are three trap lines belonging the Ouje-Bougoumou and Mistissini Crees in the study area. The Ouje-Bougoumou O-59 trap line covers the largest part of the study area, whereas the area west of Route 167 falls within the Ouje-Bougoumou O-60 trap line. The mine and mining infrastructure lie on trap line O-59. The northeast edge of the mining area (Lac Laugon area) corresponds to trap line O-57/M-57, whose ownership is under discussion by the communities of Oujé-Bougoumou and Mistissini. The Oujé-Bougoumou tallyman is James Wapachee and the Mistissini tallyman is John Metabie.

Matthew Wapachee was tallyman for trap line O-59 for a long time before passing on the privileges to his son, Philip Wapachee. Members of the Wapachee family are the main users of the wildlife resources in the study area. Their moose hunting grounds are located east of Lac Armitage, near Lac Laugon. They trap many fur-bearing species: beaver, otter, muskrat, mink, weasel, fox, American marten and lynx. Beaver is abundant in the local lakes and streams. At present, the best spot for hare hunting is the sector between Lac Chibougamau and the deposit hill. The Wapachee family hunts goose and several species of duck along Rivière Armitage and Ruisseau Villefagnan. Fishing largely takes place on Lac Chibougamau, in winter as well as in summer. They fish very little in the lakes of the O-59 territory. There are also several spots for berry picking.

Philip"s father, Matthew Wapachee, mostly uses the Rabbit camp in fall and winter. It is his base camp and is located near Lac Guy. During the intense fall hunting season, he leaves and camps here and there throughout the territory. Mr. Wapachee pays a local contractor to plow logging road 210 so he can access the camp in winter. From there, he travels by snowmobile on logging roads.

Matthew and Philip Wapachee hope that the mine will provide jobs for members of their family. Philip Wapachee made positive comments on the agreement secured by the tallyman of the trap line at the Troilus mine, and would like to have the same type of agreement for the iron ore mining project.

A Cree member of the community of Mistissini has a camp that he uses from time to time, located on Lac André, off logging road 210.

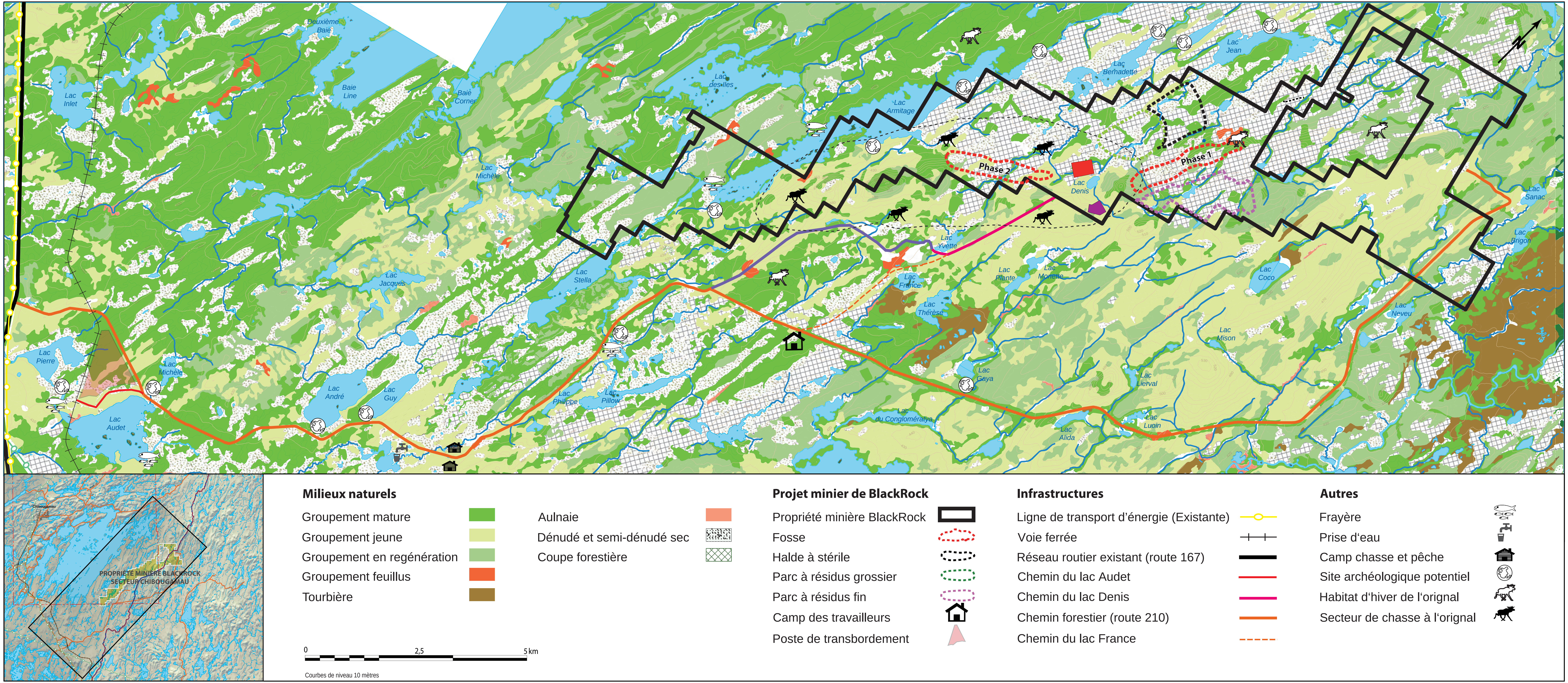


Figure 2.2 Survey of the Natural and Human Environments

Groupe-conseil Entraco Inc.

2.3.3.1 Innu Community

The Innu of Lac-Saint-Jean (Pekuakamiulnuatsh) have ancestral rights on part of the territory covered by the study area (St. Lawrence River watershed; trap line No. 24). These rights are the subject of global land negotiations between the Innu First Nations, represented by the Mamuitun (Mashteuiatsh, Betsiamites, Essipit) and Nutashkuan Tribal Councils, and the federal and provincial governments (CTM et *al*., 2002). In particular, these include the right to practice activities related to culture and wildlife, and the right to participate in the management of the land, resources and environment (Department of Indian Affairs and Northern Development, 2004).

Traditional rights are also recognized under the *Agreement-in-Principle of General Nature between the First Nations of Mamuitun and Nutashkuan and the Government of Quebec and the Government of Canada*, signed on 31 March 2004. The agreement-in-principle serves as the basis for drafting a treaty that will ensure the confirmation and continuation of the aboriginal rights of the First Nations of Mamuitun and the First Nation of Nutashkuan, including aboriginal title. The treaty will be a land claims agreement and a treaty within the meaning of sections 25 and 35 of the *Constitution Act*, 1982. Furthermore, the treaty is to provide that “aboriginal rights, including aboriginal title, of each First Nation shall be recognized, affirmed and continued on Nitassinan by the Treaty and the implementation legislation”.

The Lac-Saint-Jean Innu Council oversees administration of Mashteuiatsh, a community located in the administrative region of Saguenay–Lac-Saint-Jean. Over half the local study area for the mining project falls within the Nitassinan of the Pekuakamiulnuatsh and the Roberval beaver reserve. No mining activities are planned in the Innu territory; however, the effects of mining, including noise, particulate matter and air pollution, could be noticeable in Innu territory if appropriate measures are not taken. In the interest of transparency with the communities, they are updated on project developments on a regular basis.

There are no permanent trapping camps in the area. The Innu Council located three Innu tent sites, two of which are historical (Lac André and Lac Nabos; Nutshimit, October 2002). Information updates in 2011 confirm that trap line No. 24 has not been used for traditional activities for several years. To date, no sites of interest have been identified in this territory. No specific land use (heritage site, Innu park, private land) was identified in the study area during the land negotiations.

2.3.4 Resource Use

The main industry in the project area is logging of small stands and management of plantations and immature communities.

Infrastructure relics from Northgate (old Lemoine mine) and the old Gagnon & Frères sawmill have been identified in the southern sector. The old mine has been rehabilitated: the shaft is enclosed by a high fence and the tailing sites have been revegetated. The old sawmill has been dismantled and and the site rehabilitated. The transfer point rail siding has been dismantled, but the main CN rail line is still in use. Siding sleepers are in poor condition and the foundations need repair.

2.3.4.1 Logging

Logging is practiced in the area north of Lac Chibougamau, where *Chantiers Chibougamau Inc.* expects to operate for another twenty years or so. Commercial logging has practically ceased to the east and south of Lac Chibougamau.

Near the mining project (Forest Management Unit No. 02664), *Chantiers Chibougamau Inc.* is harvesting mature trees near Lac Pierre (rail transfer point); elsewhere in the study area, they are managing regrowth by pruning and thinning. Reforestation work was done in several locations between 1989 and 1996. The most frequently planted species is black spruce, followed by red pine and Jack pine. These species will be harvested when they reach maturity, around 2050.

Planting has taken place on land parcels north and northwest of the mine site, in the area between Lac Jenozeau and Lac Jean, and between Rivière Armitage and Lac Jean. There are also small parcels around Lac Laugon. According to field observations (2010 and 2011), there are also pine plantations, including near the Lac Denis road (which crosses the deposit), south of Lac France (old Lemoine mine) and at the rail transfer point.

The St-Félicien Forest Management Unit (No. 02551) juts into the Chibougamau Unit along an E-W axis, near Ruisseau Villefagnan and Lac Jean.

2.3.4.2 Mining

The mining industry has declined considerably in the last few years, with many mines slowing down or closing. The last operating mine (the Troïlus mine, INMET Mining Corporation) shut down in 2010. It was located about a hundred kilometres north of Chibougamau.

Mining activity in the area consists of exploration work by BlackRock and other claim holders. BlackRock will soon begin mining the Lac Doré Geological Complex iron ore deposit. The Corner Bay project, located southeast of Lac Chibougamau (Corner Bay), has been put on hold following the dissolution of Campbell Resources Inc. due to financial difficulties.

The old Lemoine mine lies seven kilometres southwest of the BlackRock project, in the same Rivière Armitage and Lac Chibougamau watershed. The Rouyn-based Cogitore Resources has the mining rights in this area. According to the MRNF (Patrick Houle, resident geologist, personal communication, 24 April 2011), the ground around the Lemoine mine is stable.

According to information from the MRNF Chibougamau office, the old Lemoine underground mine produced polymetallic ore: zinc, copper, gold and silver. In total, 758,000 tonnes of massive sulphides were extracted. Waste rock was buried in the old mine, and could contain small amounts of lead, zinc, copper, gold, silver and possibly arsenic. The site was restored by Westminer (Northgate acquisition) in the early 1990s.

2.3.5 Tourism

Activities related to tourism and vacationing are focused north of Lac Chibougamau and along Route 167. According to the last survey conducted by the Quebec government between 1999 and 2000, recreational fishing is a major tourism activity in Lac Chibougamau. At the time, fishing activity represented more than 8,500 rods/day, representing a high-density fishing rate of 0.42 rods/day per hectare for a lake with a total area of 20,616 hectares. For Chibougamau, annual economic benefits from fishing were in the order of $3 million. Yellow walleye, northern pike, lake trout and brook trout statistics were mainly considered. Reported catches are estimated at 48,000; with a quota of eight catches per person (*Société de la faune et des parcs du Québec*, Chibougamau area), this translates into 6,000 fishing enthusiasts for the 1999-2000 season.

Local outfitter *Pourvoirie Pomerleau* is currently involved in wildlife harvesting. They are located on the north shore of Lac Chibougamau, in Baie du Portage, about 15 kilometres as the crow flies from the BlackRock mine site. Fishing camps were fully booked for the 2011 summer; walleye is the most sought-after species in Lac Chibougamau (Baie du Portage, Baie des Îles and Baie Dufresne). At *Pourvoirie J.C. Bou*, a local outfitter in southern Lac Chibougamau (Baie Queylus, about 25 kilometres as the crow flies from the mining project), fishing takes place on Lac Chibougamau, as well as on other lakes in the area or around the outfitter.

Table 2.1, obtained from *Pourvoirie J.C. Bou*, demonstrates that yellow walleye and northern pike account for most catches in Lac Chibougamau and in lakes around the outfitter (Route 167, Baie Queylus). Since 2006, catches have exceeded 3,000 per year. Over 880 rods/day were counted in 2010, on top of 1,486 days devoted to other tourist activities, for a total of 2,366 tourism-days.

Table 2.1 Wildlife Harvest - Fishing (Pourvoirie J.C. Bou, Chibougamau, 2011

SPECIES / YEAR	BROOK TROUT	LAKE TROUT	YELLOW WALLEYE	NORTHERN PIKE	TOTAL / YEAR
2010: number of fish	132	121	2,895	1,037	**4,85**
2009: number of fish	122	137	2,794	956	**4,009**
2008: number of fish	7	111	2,289	779	**3,276**
2007: number of fish	109	123	2,570	875	**3,677**
2006: number of fish	119	134	2,675	915	**3,843**
TOTAL / SPECIES	**579**	**626**	**13,223**	**4,562**	**18,990**

For information purposes, 30 or so users were encountered between the rail transfer point and the deposit in June 2011. They were either bear hunting or fishing in Lac Armitage. During the same period, accommodation at Chibougamau hotels and outfitters were hard to come by, illustrating the popularity of wildlife harvesting in the area.

In the Domaine-du-Roy RCM (regional study area), 16 leases to operate a commercial resort were issued for the area around Lac Vimont, which is the quota for this area. Eight hunting and fishing camps have already been built and eight more are under construction. The Route 167 turn-off near Lac Aigremont is the Lac Vimont access road, approximately 50 km southeast of the BlackRock project access road (logging road 210 to Lac Audet and Lac Pierre).

2.3.6 Transportation Infrastructure

2.3.6.1 Road Network

Route 167 is the only road with significant traffic in the study area (paved road south of Chibougamau). This road connects Lac-St-Jean (in a southeast direction) to Mistissini (in a northeast direction), passing through Chibougamau. The government of Quebec"s near-term plans include extending Route 167 northward as part of the “Plan Nord”. South of Chibougamau, Route 167 intersects Route 113, which extends westward to the municipality of Chapais and the Abitibi region. An extensive network of logging roads crisscrosses the study area, and requires the use of full-time all-wheel drive vehicles, especially in the vicinity of the mine site.

The turn-off for logging road 210 (Class 2: 10-m wide driving surface) that crosses the study area is about 30 kilometres south of Chibougamau along Route 167 going south (kilometre 200). Located in the MBJ, it is administered by the MRNF and is maintained by users. This public gravel road is fit for driving and in good condition.

To reach the mine site, the proponent plans to use logging road 210 before turning onto the old Lemoine mine road, and then onto the Lac Denis road. These last two segments of road (about 10 kilometres) are located in the town of Chibougamau and must be built and/or upgraded.

2.3.6.2 Other Transportation Infrastructure

A CN railway linking Lac-St-Jean to the town of Chibougamau crosses the southern edge of the study area in a SE-NW direction. Along this line, to the west of Lac Audet, the railway crosses old transfer points that belonged to Gagnon & Frères and the old Lemoine mine.

An airport (the Chapais-Chibougamau regional airport) services the area and is located off Route 113, about 15 kilometres southwest of Chibougamau. There are daily flights to major cities and northern communities, at least on weekdays.

A 161-kV power line runs parallel to Route 167 and connects the Obalski substation in the north to the Obatogamau substation in the south. A 735-kV power line crosses the study area south of Lac Audet.

2.3.7 Socio-Economic Data

The socio-economic data shown in Table 2.2 gives a general picture of the Chibougamau area population. Much of this data affects the project (Statistics Canada, 2006 census; the 2011 census results will be available in 2013).

Chibougamau and Chapais residents are for the most part the children and grandchildren of the first settlers who came in the last century to exploit the resources; they want to continue to live and work in the area. Despite efforts to keep people in the area, Chibougamau and Chapais have seen their population drop by 4.5% to 9.2% from 2001 and 2006. The population of Mashteuiatsh also declined by 6% during this period, whereas the overall population of Quebec increased by 4.3%. Meanwhile, Ouje-Bougoumou and Mistissini saw their population climb by 10%.

The total population for municipalities in the area (excluding Mashteuiatsh) decreased slightly from 2001 (12,867 inhabitants) to 2006 (12,696 inhabitants). Chibougamau accounts for 59% of the total population, followed in decreasing order by Mistissini (23%), Chapais (13%) and Ouje-Bougoumou (5%). According to 2010 population forecasts by the *Institut de la statistique du Québec* (2011), the Chibougamau population continues to decline whereas other municipalities are seeing their population rise, except for Mashteuiatsh, whose population supposedly remained stable between 2006 and 2010.

In June 2011, the Chibougamau housing occupancy rate neared 95% according to information obtained from James Bay Joint Action Mining Committee personnel. Housing availability has remained low (5%) over the years. On the other hand, during the January 2011 consultations, the Chapais municipal council claimed that hundreds of workers could be accommodated in their residential developments that offer basic services (aqueduct, sewers, electricity). Chapais is located some 80 kilometres from the mine site.

Average annual income is higher in Chibougamau ($71,683) and Chapais ($61,949) than in other municipalities or the rest of Quebec. Mashteuiatsh has the lowest average annual income ($39,765).

Table 2.2 Socio-Economic Data

Municipality / Characteristics	Chibougamau	Chapais	Ouje-Bougoumou (Native Community)	Mistissini (Reserve Lands)	Mashteuiatsh (Lac-Saint-Jean)	Province of Quebec
Area (km^2)	699.16	63.64	2.54	865.76	14.5	1,356,366.78
Population in 2001	7,922	1,795	553	2,597	1,861	7,237,479
Population in 2006	7,563	1,630	606	2,897	1,749	7,546,131
Change 2001-2006 (%)	-4.5	-9.2	9.6	11.6	-6.0	+4.3
% of the total pop. in 2006 (14,445 inh.)	52.3	11.3	4.2	20.1	12.1	0.2
*Estimate of the 2010 population **	*7,482*	*1,639*	*699*	*3,192*	*1,749*	*7,907,375*
Median age	38.0	39.2	24.2	24.5	33.4	41.0
% population 15+	80.3	79.4	62.8	66.2	74.3	83.4
% population 25+ with an education	44.2	39.3	27.2	22.8	36.9	46.6
Average annual income (2005)	71,683	61,949	54,400	58,496	39,765	58,678
Unemployment rate (%)	9.5	14.5	20.4	18.9	16.2	7.0
Employment rate (%)	66.2	50.7	72.0	62.5	46.1	60.4
Labour force participation rate (%)	73.1	59.3	57.3	77.1	55.5	64.9
All sectors (number of workers)	4,375	790	265	1,450	660	3,929,675
Primary sector (% of workers)	12.0	21.5	7.5	18.9	6.8	3.7
Secondary sector (% of workers)	20.7	24.0	7.5	6.8	15.9	19.8
Tertiary sector (% of workers)	43.7	37.9	47.2	47.9	37.8	57.1
Other services (% of workers)	23.2	16.45	37.8	26.9	40.1	19.4

Sources: Statistics Canada, 2006 census * Institut de la statistique du Québec, 2011

2.3.7.1 Human and Economic Activity

Economic activity in the Chibougamau area is based on resource exploitation (primary industry), which accounts for five times as many jobs (Chapais) as in the rest of Quebec (3.7%). Unemployment rates and general economic activity (secondary and tertiary industries) depend on the mining and logging industries.

The median age for the non-Native population is 38 years, whereas it is 24 for Crees and 33 for the Innu. The population of 15 years of age and over (able and willing to work, day and seasonal work) represents 80% of the non-Native population, which it is in the order of 68% of the Native population. The percentage of the population aged 25 years and over that has received schooling is notably higher in Chibougamau (44.2%) and Chapais (39.3%) than in

Ouje-Bougoumou (27.2%) and Mistissini (22.8%). The level of education in Mashteuiastsh (36.9%) is closer to that of Chibougamau and Chapais.

The unemployment rate, i.e., the percentage of unemployed individuals within the labour force (15 years of age and over), ranges from 9.5% to 20.4% in the communities studied, and is higher than the overall unemployment rate in Quebec (7%). Unemployment is particularly high among Native people. The labour force participation rate, i.e., the ratio of the labour force (employed and unemployed individuals) to the total population, ranges from 56% to 77%, close to the average for Quebec (65%). The employment rate, or the proportion of employed individuals within the labour force (15 years of age and over), is between 51% and 72%, except for Mashteuiatsh (46%).

2.3.7.2 Manpower Availability

The regional economy has been resource-based for the past 60 years or so. Local manpower is clearly skilled in mining project construction and development. The size of the labour force and unemployment/employment rates demonstrate that the area‟s population is available and willing to work.

Each community has a manpower centre and training programs tailored to the job market. The communities involved in the project have updated a database of workers and businesses that would be available for project development. The *Commission économique et touristique de Chibougamau* (CETC) has a directory of companies that work in the mining industry (CETC, 2010, 2011). The main categories are:

- concrete, concrete construction
- bulk trucking
- road construction
- tree clearing
- soil sampling
- hydraulic equipment
- excavation
- mine drilling and blasting
- gas, propane, oil, fuel
- sand and gravel pits
- helicopters
- engineering
- machine rental
- machinist, welding, repairs
- equipment maintenance
- recruiting
- telecommunications
- mineral processing
- heavy transport, road transport
- forestry
- machining

The Cree community‟s mining expertise comes mainly from the operation of the Troïlus mine over a period of about 15 years (contractors, drillers, truck drivers, heavy equipment operators, materials handlers, mechanics and journeymen); local expertise is well documented in the report entitled *Implementing The Troïlus Agreement* (2008; see also *Cree Nation Mining Policy 2010*). The Grand Council of the Crees and the Cree communities are in the process of preparing a profile of Cree manpower and contractors.

For the Innu, a business directory is available online at www.sdei.ca. Under the *Publications* tab, skilled manpower can be found for construction, building and land management, plumbing and electricity, forestry and accounting.

2.3.8 Archaeology

In the regional study area, the firm Archéos (July 2002) identified several known archaeological sites north of Lac Chibougamau and on the banks of Lac Obatogamau, far southwest of Route

167. All the known archaeological sites indicate the prehistoric presence of Amerindians, without indicating a precise cultural period (Archéos, July 2002).

The only archeological site known of in the local study area (DkFn-1) is on the eastern shore of Lac Chibougamau, south of Île des Commissaires (Archéos, July 2002), about eight kilometres from the mine site. This is a surface site that may have been occupied from 7,000 to 450 BCE (Archéos, July 2002; Archéo-08, 2011).

The archaeological potential for the entire local study area was determined during the summer of 2002 by the firm Archéos (July 2002). This work was based on a literature review and a field study (interpretation of black and white aerial photos at the 1:15,000 scale and of topographic maps at 1:50,000 and 1:20,000). The goal was to use environmental criteria to identify and prioritize potential zones likely to contain evidence of human occupation.

Some 15 potential zones were identified between Route 167 and Lac Chibougamau (Baie Girard, north of the mine site; Archéos, 2002). These high-potential zones are located along logging road 210, in the Rivière Armitage and Lac Armitage drainage basin, and around Lac Jean and Lac Bernadette, directly within the area affected by mining activities. All zones of archaeological potential that could be affected by mining activities were surveyed in 2003 and again in the summer of 2011.

The survey was done by Archéo-08, a firm that specializes in local archaeological studies. The 550 surveys conducted produced negative results (Archéo-08, 2003, 2011). Despite the high fish and wildlife potential near the mine site, steep, rocky banks and abundant wetlands are cited to explain the absence of human occupation. The only vestiges found date back to the late historic period. According to Archéo-08 (2011): "*Mining activities can be undertaken by BlackRock Metals in the surveyed sectors with no risk to the archaeological heritage.*"

Nonetheless, to comply with the Cultural Property Act (RSQ, c. B-4), the proponent and construction contractors should cease activity and advise the *Direction régionale du ministère de la Culture et des Communications et de la Condition féminine* (MCCCF) should they happen across any archaeological evidence. A site survey would then be required.

2.4 PHYSICAL ENVIRONMENT

2.4.1 Climate

The Chibougamau area is characterized by a subpolar and subhumid continental climate. The nearest available source of monthly meteorological statistics is the Chapais station, located approximately 60 kilometres west of the study area, at an elevation of 396 metres. Statistics were compiled by Environment Canada (2011) and span the years 1971-2000.

The average annual temperature was 0°C with an average maximum of 16.3°C in July and an average minimum of -18.6°C in January. Total annual precipitations recorded at the station were of 961.3 mm per unit area. Rain accounted for 659.7 mm of precipitation, and snowfall for

301.7 mm. Environment Canada climate normals, based on Chibougamau meteorological data from 1971 to 2000, indicated 182.2 days (49.35%) per year of 0.2 mm (trace precipitation) of precipitation or more. Compared to 1951-1980 statistics (Environment Canada, 1982), the average annual temperature increased by 0.1ºC, while averages for January and July increased by a little more than one degree. Similarly, total annual precipitation increased by 41 mm.

Between 1 January 2006 and 31 December 2010, wind roses at the Chibougamau-Chapais airport meteorological station indicated prevailing winds from the northwest, east and south-southwest, with an average speed of about 10.9 km/h. During the same period, a frequency of 6.11% was recorded for calm winds.

Winds blow especially from the west (northwest and southwest included) with an annual frequency of 52.7% (Environment Canada, 1982). Their speed is relatively low (12 to 13 km/h on average) but gusts can exceed 100 km/h.

2.4.2 Physiography and Regional Geology

The study area is undulating, with a low-amplitude relief. The eastern part is within the Laurentian Highlands physiographic division and the western part is within the Abitibi Uplands physiographic division (James Region). The study area straddles the drainage divide between the James Bay watershed (west) and St. Lawrence River watershed (east).

Except for a few hills in the vicinity of the mine site, the study area is characterized by flat topography with a fairly continuous cover of unconsolidated material. The average elevation is 420 m above sea level. The surface of Lac Chibougamau lies at an elevation of 378 m, and the deposit hill peaks at 533 m. There are many lakes of all sizes, streams, wetlands and waterholes due to the gentle slope of the terrain and low surface permeability.

The bedrock straddles the Precambrian-age Superior (mine site) and Grenville (Domaine-du-Roy RCM) structural provinces, and consists of metasedimentary and igneous rocks. The rock formations strike NE-SW. Landforms, as often seen in the shape of the lakes and stream flow, are also aligned in this direction. Topography and hydrographic morphology result from bedrock structure and the alignment of the unconsolidated material.

The whole region is located in the 0 seismic zone, for which the “K” coefficient is equal to zero (MRN, 1997; Appendix 1 - Stability Criteria), which signifies that the area is relatively stable. Earthquakes are rare and of low magnitude.

2.4.3 Surficial Geology

Surficial mapping (1:20,000) and surficial material descriptions are available for the local study area. The data is from the *Ministère de l’Énergie et des Ressources* (MER, 1991, surficial mapping at the 1:50,000 scale), topographic maps at the 1:20,000 scale, interpretation of aerial photos at the 1:15,000 scale, 2002 and 2011 field surveys (ENTRACO, 2003 and 2011) and preliminary geotechnical investigation report by Golder Associates Ltd. (November 2001).

Mapping and characterization of surficial material were used to identify mine tailings deposition sites and borrow pits. Figures 2.3 and 2.4 show the regional geology and distribution of surficial materials.

2.4.3.1 Bedrock

The bedrock is composed of weakly metamorphosed volcano-sedimentary rocks of the Lac Doré Complex and igneous rocks of the Lac Chibougamau Complex (Allard, 1967; Daigneault and Allard, 1987). The Lac Doré Complex consists of a large anticline (elongated dome). Outcrops are bedded, aligned in a NE-SW orientation, steeply dipping (50-90°) to the SE and affected by a system of NNE-SSW faults. From the north to the south, the following units are encountered:

- the Lac Chibougamau Complex (north of Ruisseau Villefagnan) characterized by intrusive or igneous rocks (diorite);
- the Lac Doré Complex (south of Ruisseau Villefagnan) characterized by anorthosite, gabbro, magnetite and granophyre.

These rocks are generally hard, massive, impermeable and barely weathered; water infiltration occurs along fractures and faults. Outcrops are mostly found in the area around the mine site, and in the deposit hills.

2.4.3.2 Glacial Deposits

Most of the study area is covered by glacial till directly overlying the bedrock. The till lacks bedding structure, and forms a compact mix with components of various sizes (rock dust to boulders). The proportion of fine particles (clay, silt) can be significant. The till corresponds to a ground moraine. Drainage is often hindered by the compact nature of the deposit and the presence of fine particles, but the bearing capacity is very good. In this type of deposit, the water table is often close to surface (1 metre or less).

The thickness of till deposits exceeds 1 m in low-lying areas, where terrain gradient is low. In certain areas along road 210, the moraine can be up to 30 m thick (Golder Ass., November 2001). In the deposit hills, the thickness is often less than 1 m and hillside gradient is around 10%.

The glacial till includes drumlins, NE-SW elongated hills up to 1 km long and some 10 m high. Deposit components are coarse (boulders, pebbles, sand and gravel) and less compacted than the ground moraine till. Drainage is good. Drumlins are smoothly rounded and have steep hillside gradients (10%).

Glacial deposits can be used as borrow material for basic fill but are problematic due to poor drainage and the presence of water and boulders. Drumlin till is a suitable source of granular material and can be found throughout the area.

2.4.3.3 Glaciofluvial Deposits

Glaciofluvial deposits cover only a small portion of the local study area. This type of surficial deposit is typically composed of bedded sand and gravel, including pebbles and small boulders. It is well drained and loose, with good bearing capacity. Glaciofluvial deposits are good sources of granular material. The average thickness of these deposits is estimated at 15 m. They are found in the northeastern part of the study area as an elongated, N-S esker along Ruisseau Villefagnan, and as outwash in the Lac André area (logging road 210) and off Route 167 (km 203), south of Lac Inlet.

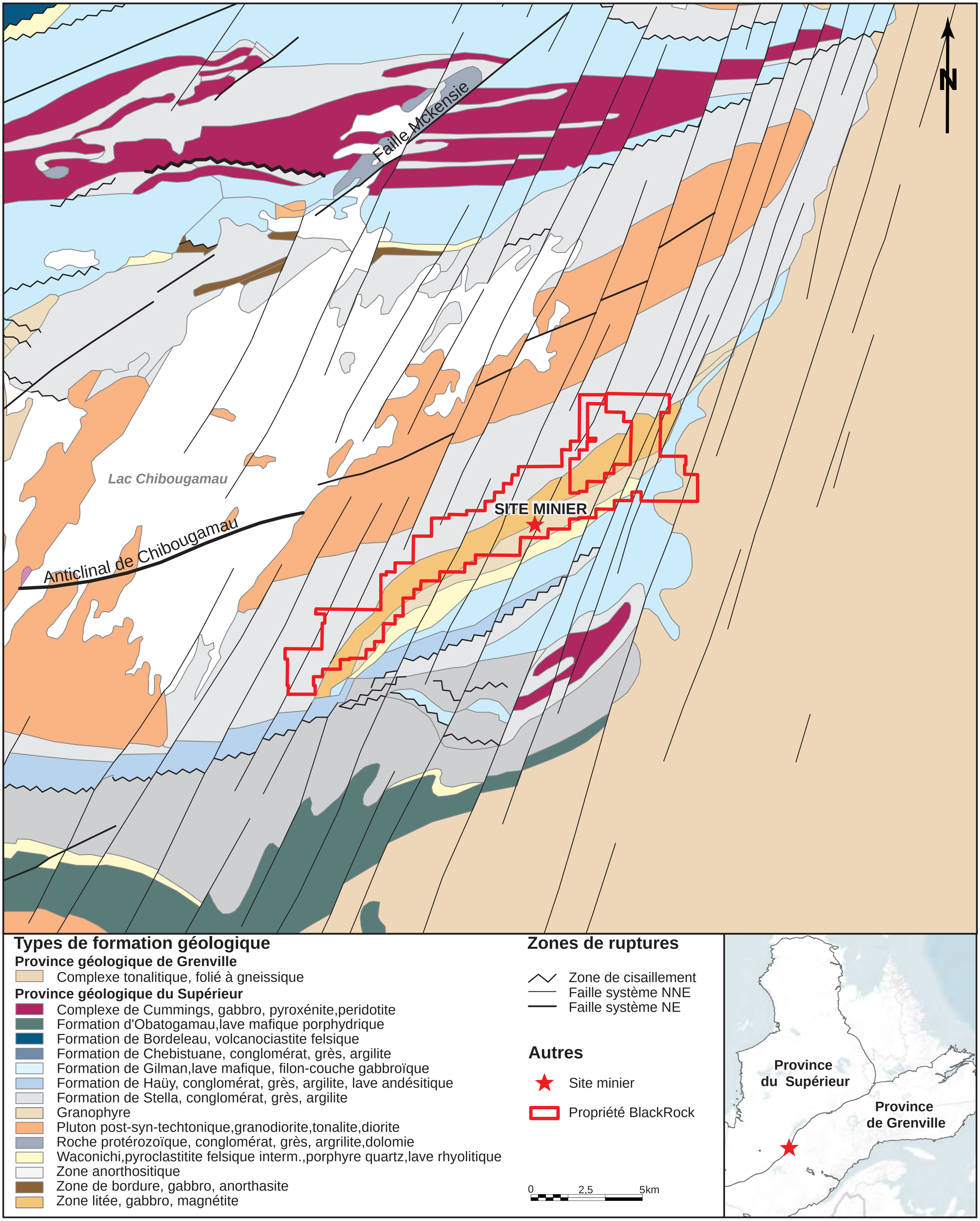


Figure 2.3 Regional Geology – BlackRock Mining Project – Chibougamau Sector

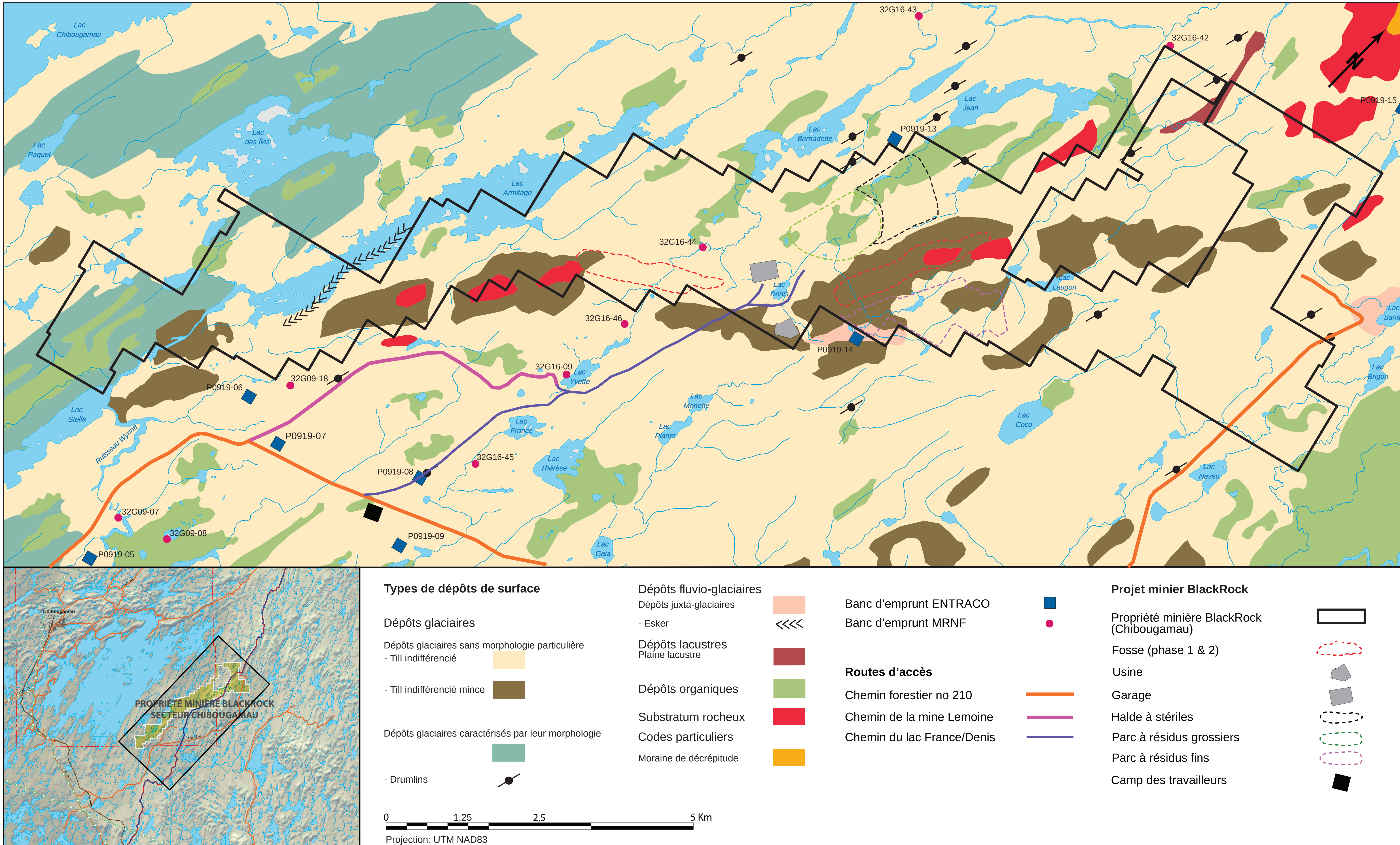


Figure 2.4 Surficial Materials - BlackRock Mining Project – Chibougamau Sector

2.4.3.4 Organic Deposits

Organic deposits are found in flat terrains and topographic depressions, often on the edge of streams and lakes. These deposits are made up of somewhat decomposed organic matter and are scattered throughout the study area. They often overly till or alluvial deposits at the edge of streams and lakes undergoing eutrophication.

The largest areas of organic deposits are found around Lac Jean and Lac Bernadette (mine site), a few kilometres west of logging road 210, between Lac Stella and Lac André, and in the southeastern part of the local study area, around Lac Pierre and Lac Audet. The deposits are water-saturated and 1 to 3 metres thick, with high compressibility.

2.4.3.5 Borrow Pits

An inventory of partially mined or unmined borrow pits was done based on 1998 aerial photos, government topographic maps from 1980-1990, Google Earth satellite images and the MRNF GESTIM website (ENTRACO, March 2011). The inventory was updated following field visits in June and July 2011. The identified borrow pits are located in the James Bay watershed (Municipality of James Bay and town of Chibougamau).

The firm BBA (July 2011) estimates that the required volume of granular material for the entire project is in the order of 7.7 Mm^3 (access road, concentrator, dams, etc. - see Chapter 4 for more details), as follows:

- rock material from a pit or quarry (site of the processing plant): 6.4 Mm^3;
- granular material from borrow pits: 1.3 Mm^3.

The potential volume identified by ENTRACO is in the order of 31 Mm^3. This volume clearly exceeds supply needs for construction and mining (see Table 2.3). Any one of the borrow pits listed below can meet the needs of the project at any stage in its development.

Table 2.3 Basic Borrow Pit Inventory (March-July 2011)

Borrow Pit #*	1:50,000-Scale Map Number (NTS) and Location	UTM Coordinates (geographic coordinates)	Deposit Type	Potential Volume, m^3
1-P0919-01 (32G09/01-02-17)*	32G09: 4 km NW of Lac Pierre, Route 167	5503500 N – 546500 E (49°41'00'' N/74°21'00'' W)	Fluvial-glacial/esker: sand and gravel, cobbles	Open, 5,000,000
2-P0919-02 (32G09-19)*	32G09: 3.5 km SE of Lac Pierre, Route 167	5497000 N – 550300 E (49°37'30'' N/74°18'30'' W)	Moraine: coarse deposit, sand, gravel, boulders	Mined out
3-P0919-03 (32G09-14)*	32G09: 2.2 km W of Lac André	5503000 N – 554000 E (49°40'30'' N/74°15'30'' W)	Moraine: very coarse deposit, abundant boulders	Not open, 7,500,000
4-P0919-04	32G09: road 210, E of Lac Guy (200 m *Rabbit camp*)	5503300 N – 558000 E (49°40'40'' N/74°12'00'' W)	Moraine: sand, gravel, cobbles, boulders	Open 250,000
5-P0919-05 (32G09/07-08)*	32G9: W of Lac Pillow, along road 210	55065000 N – 560000 E (49°42'45'' N/74°10'00'' W)	Moraine: coarse deposit	Mined out
6-P0919-06 (32G09-18)*	32G09: road to the west of the Lemoine road	5510300 N – 560600 E (49°44'40'' N/74°09'45'' W)	Moraine: coarse deposit	Not open, 30,000
7-P0919-07 (32G09-09)*	32G09: Chibougamau, road 210 / Lemoine road	5509500 N – 561500 E (49°44'25'' N/74°09'00'' W)	Moraine: very coarse deposit, abundant boulders	Open 5,000
8-P0919-08 (32G16-45)*	32G09: between road 210 and Lac France (Chib.)	5510300 N – 564000 E (49°44'30'' N/74°07'00'' W)	Moraine: coarse deposit	Mined out
9-P0919-09	32G09: S of road 210, NE of Lac Dollier (MBJ-Chib.)	5509300 N – 564300 E (49°44'00'' N/74°06'45'' W)	Moraine: coarse deposit	Part. open 450,000
10-P0919-10 (32G16-09)*	32G16: W of Lac Yvette (Chibougamau)	5513300 N – 565000 E (49°46'15'' N/74°05'35'' W)	Moraine: coarse deposit	Mined out
11-P0919-11 (32G16-46)*	32G16: N of Lac Yvette (Chibougamau)	5514400 N – 565500 E (49°46'30'' N/74°05'10'' W)	Moraine: coarse deposit	1,250,000
12-P0919-12 (32G16-44)	32G16: upstream from Yvette Lake, 1.5 km W of Denis Lake	5516000 N – 565500 E (49°46'45'' N/74°05'00'' W)	Moraine: coarse and loose deposit	1,250,000
13-P0919-13	32G16: Lac Jean and Lac Bernadette area	5519500 N – 567700 E (49°49'30'' N/74°03'20'' W)	Moraine/drumlin: coarse deposit	4,000,000
14-P0919-14	32G16: E of Lac Denis (pit)	5516300 N – 568900 E (49°47'45'' N/74°02'15'' W)	Fluvial-glacial: sand and gravel, organic	200,000
15-P0919-15	32 H13: 5 km NE of Lac Denis, Ruisseau Villefagnan, lakes, road	5525500 N – 271500 E (49°52'00'' N/73°58'00'' W)	Moraine/esker: coarse deposit, sand, gravel (the esker holds the lake in)	Part. open Esker: 1,500,000 Till: 1,000,000
16-P0919-16	32 H13: 17 km NE of Lac Denis	5538000 N – 273500 E (49°48'55'' N/73°56'00'' W)	Fluvial-glacial: sand and gravel, cobbles	Partially Open 5,000,000
17-P0919-17	32 H13: 15 km NE of Lac Denis	5535350 N – 275000 E (49°57'00'' N/73°55'00'' W)	Fluvial-glacial: sand and gravels, pebbles	Partially Open 7,500,000
18-(32G16-42) 19-(32G16-43)	32G16: near Ruisseau Villefagnan	Not recorded by ENTRACO 5523027 N – 570335 E	Moraine: sand, gravel, boulders	See MRNF record (not recorded)
Subtotal Open Borrow Pits				**6,505,000**
Subtotal Pot. Borrow Pits				**24,400,000**
TOTAL				**30,905,000**

***Numbers assigned to borrow pits by the MRNF (GESTIM) are in brackets.**

Green: open borrow pit – Black: not open, potential borrow pit – Red: mined out and borrow pit, rehabilitated – Blue: potential; not visited

Permit Application

To date (September 2011), permit applications for borrow pits in operation (see Table 2.4) have been submitted to the MRNF for exploration purposes. Borrow pits will be operated and rehabilitated in accordance with the *Regulation respecting pits and quarries* (RRQ, c Q-2, r 7).

Table 2.4 Borrow Pits for Which Permit Applications Have Been Submitted

MRNF BORRROW PIT NUMBER	TOWNSHIP	MATERIAL	EXPECTED ANNUAL EXTRACTION (m^3)
32G09-01	Queylus (CQ 020)	Sand and gravel	21,000
32G09-17	Queylus (CQ 020)	Sand and gravel	21,000
32G09-18 (north of P-0919-06)	Lemoine (CL 665)	Moraine	125,000
32G16-44	Lemoine (CL 665)	Moraine-crushed stone	125,000

2.4.4 Drainage Network

2.4.4.1 Regional Scale

The study area is drained by two large systems: the James Bay watershed to the west and the St. Lawrence River watershed to the east. The drainage divide coincides with the border between the Domaine-du-Roy RCM and the Municipality of James Bay, and crosses the southwestern part of the town of Chibougamau.

In the St. Lawrence River watershed, waters run into Rivière Boisvert before joining Rivière Ashuapmushuan, Lac Saint-Jean and the St. Lawrence River. In the James Bay watershed, waters flow towards Lac Chibougamau (deposit) and Lac Chevrier (rail transfer point), part of the Rivière Nottaway subsystem.

2.4.4.2 Local Scale

In the northern part of the local study area, the Lac Chibougamau subsystems were outlined using 1:50,000-scale maps (see Figure 2.5). With the exception of the explosives plant and related buildings, all the mine infrastructure (pit, processing plant, tailing pond, piles, access road) are located in the Lac Jean subsystem. Water from Lac Jean flows into Ruisseau Villefagnan before reaching Rivière Armitage and Lac Chibougamau. The explosives plant is located in the Lac Bernadette subsystem. Lac Bernadette flows directly into Rivière Armitage.

Small headwater lakes and the upstream reaches of creeks flowing into Lac Jean will be lost when the mining facilities and pit are developed. Lac Denis will be raised and used as a source of process water. Excess water from Lac Denis will be released into the environment at lake B-1. Lake B-1 water flows through lake A-1 before joining Ruisseau Villefagnan. Chapter 8 contains a detailed description of the lakes and streams, as well as their halieutic potential.

2.4.5 Hydrogeology

Generally speaking, underground runoff is affected by the relatively steep topography around the mine site and the type of surficial material present, which is characterized by poor drainage and low permeability (glacial till). The bedrock surface directly underlying surficial deposits is fissured, and its hydraulic conductivity decreases significantly with depth.

Underground runoff occurs radially from the rocky ridges into the James Bay and St. Lawrence River watersheds, through fissures and large breaks in the bedrock. Piezometry is well adapted to the topography. Water recharge occurs mainly through infiltration from precipitation and headwater lakes like Lac Coco and Lac Laugon. Groundwater in the Chibougamau area is characterized by a neutral pH, and a low dissolved solids and metals content. The assessment of mine facility site options with regard to hydrogeological conditions is presented in Chapter 3.

2.5 BIOLOGICAL ENVIRONMENT

The map of the natural and human environments in Figure 2.2 shows the main plant and wildlife elements. Chapter 7 deals more specifically with wetlands, rare and threatened species, species at risk and migratory birds. Chapter 8 provides detailed descriptions of the aquatic environment and related flora and fauna.

2.5.1 Vegetation

A plant inventory was done based on 1:20,000-scale MRNF forest ecology maps last updated in 2011, and on 2010-2011 field surveys conducted specifically for this study. The entire study area is in black spruce-moss forest (Thibault and Hotte, 1985), which is the largest bioclimatic domain in Quebec. Black spruce-moss forests as well as black spruce-fir-moss forests are the most common types of forests in mesic areas of this domain. Forests are typically dense and dominated by black spruce. Hydric sites are colonized by the black spruce-speckled alder and black spruce-sphagnum stands typical of organic deposits. Black and mossy spruce stands can also be found in mesic and xeric areas.

In black spruce-moss forests, the main species are black spruce, fir, trembling aspen, balsam poplar, tamarack, jack pine, white birch and white spruce. Deciduous trees are often found as isolated patches and along roads, dominated by trembling aspen and white birch.

The area"s vegetative cover has been somewhat disturbed by logging over the years. Since the 1950s, the extent of cutting has steadily increased, and is today the main cause of environmental disturbance.

2.5.1.1 Mature Communities

Mature communities consist of stands 80 years old or more. These may have been partially harvested. These communities cover large areas south of the mine site.

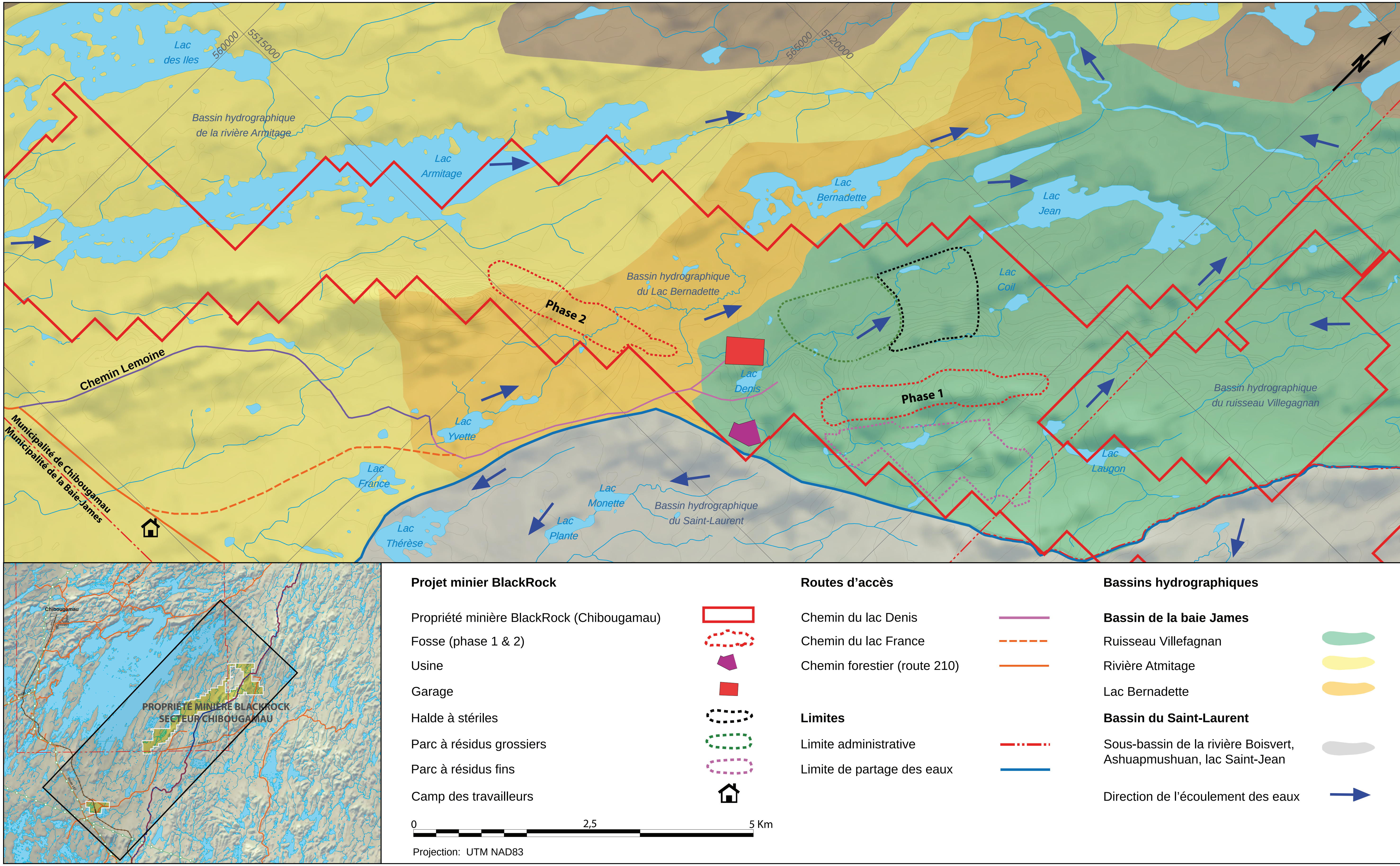


Figure 2.5 Drainage Basins

2.5.1.2 Immature and Regeneration Communities

Immature communities comprise trees in the 30-year and 50-year age categories. They largely consist of immature coniferous or mixed forests, in areas of regeneration for the most part resulting from logging or fires. They are mostly located southwest of the mine site.

Regeneration communities occur in old cutover areas dating back to the period from 1979 to 1989. Strip cutting or harvesting with regeneration protection may have been done.

2.5.1.3 Harvesting and Plantations

Harvesting includes cutover areas and areas with regeneration protection. These operations were carried out between 1990 and 2000, and around 2008. Large harvested areas occur around and to the west of the deposit, in the central part of the study area (Lac France/Lac Stella) and in the Lac Audet area.

Plantations comprise all areas reforested over the years, regardless of when planting took place. Red pine plantations were identified at the old transfer point and south of Lac France.

2.5.1.4 Alder Groves

Alder groves occur largely as riparian shrubbery bordering streams and logging roads throughout the study area. Their very low ground coverage makes them difficult to map.

2.5.1.5 Peatland

Peatland corresponds to flat areas and wetlands dominated by sphagnum moss. Organic matter is abundant. Peatland is found here and there throughout the study area, covering large areas in the vicinity of Lac Bernadette and Lac Jean (mine site), north of Lac André and west of Lac Audet. It is important to note that mapping did not distinguish between ombrotrophic peatland (bogs) and minerotrophic peatland (fens).

2.5.1.6 Wetlands

The mining project entails activities that affect wetlands in general, including the alder groves and peatland areas mentioned above. Wetlands were assessed to determine their abundance at different landscape scales. Chapter 7 deals with this topic in detail.

2.5.2 Fauna

2.5.2.1 Mammals

Wildlife in the study area is composed of species commonly found in boreal forest. According to Philip Wapachee, tallyman of the O-59 trap line affected by the project, and his father, Matthew Wapachee, the territory hosts big game (moose and bear) and many species of fur-bearing animals. In June 2011, several bear hunters targeted the area along logging road 210; a mother and her two cubs were reported near the intersection of logging road 210 and the Lemoine road. Moose is the most sought-after of the large mammals.

Many moose winter habitats were identified near the mine site. In wintertime, moose sometimes occupy the deposit hill north of Lac Laugon, the northwestern flank of the pit, an area between

Lac Denis and Lac Monette, another area north of Lac Yvette and further south along the stretch of the Lemoine road that leads to Lac Yvette. These areas will be affected by mining activities.

Earlier wildlife habitats have been somewhat disturbed by intense logging in certain sectors, including the future mine site. According to Philip and Matthew Wapachee, moose was much more frequent in the mine site area prior to logging. In the short term, moose will return to immature communities undergoing regeneration looking for food, as will the snowshoe hare and its predators.

Snowshoe hare is probably the most abundant kind of game in the study area and constitutes prey for numerous predators. Hares are frequently spotted along road 210 and on other logging roads around the project (June to August 2011).

According to data from 1:20,000-scale topographic maps, supported by summer 2011 field work, beaver dams have been erected in most creeks. Aside from the aforementioned hare and beaver, the following mammals were observed in the field between March and August 2011:

- moose
- American black bear
- eastern chipmunk
- wolf
- porcupine
- groundhog
- red fox
- red squirrel
- river otter

Philip and Matthew Wapachee have also spotted lynx just west of Lac Armitage.

Other mammal species likely to be encountered in the area and sought after by traditional users of the land are the muskrat, American marten, American mink, fisher and ermine, as well as skunk, other small mammals (mouse, vole, shrew) and a few bat species.

2.5.2.2 Birds

Sinuous creeks, fens rich in herbaceous vegetation and small, shallow ponds provide food, shelter and nesting sites for waterfowl, pelagic birds and shorebirds. The following species were observed in the field area in the summer of 2011:

- Canada goose (Lac Jean)
- common merganser (Rivière Armitage)
- great blue heron (flying over road 210)
- green-winged teal (Lac Denis)
- common goldeneye (Rivière Armitage)
- herring gull (Lac Chibougamau)
- American black duck (outlet of lake B-6)
- common loon (Lac Bernadette, Lac Laugon and Lac Jean)
- greater yellowlegs (lakes B-13 and B14)

Forest birds consist mostly of Galliformes and several species of Passeriformes. Galliformes, such as spruce grouse and ruffed grouse, are prized by hunters. The following species were repeatedly observed along access roads and throughout the study area:

- spruce grouse
- ruffed grouse
- Canada jay
- common raven
- black-capped chickadee
- common yellowthroat
- thrushes
- white-throated sparrow
- northern flicker (seen at the Lac Bernadette tributary)

Birds of prey in the study area include the osprey, American kestrel, red-tailed hawk and golden eagle. A bald eagle was spotted during 2001 fieldwork, near the mouth of Ruisseau Villefagnan (ENTRACO, 2003).

In July 2011, an osprey hunting for food on Lac Coil was observed for over an hour (near the future mine site). A red-tailed hawk was also seen in the summer of 2011 near Ruisseau Villefagnan.

2.5.2.3 Amphibians and Reptiles

The study area"s numerous lakes and other wetlands constitute favourable habitats for a number of amphibian and reptile species. These include the northern two-lined salamander, the American toad, the spring peeper, the green frog, the wood frog and the common garter snake. The following species were observed in the study area during the summer of 2011:

- wood frog
- leopard frog
- American toad
- eastern newt

The eastern newt is widespread in Quebec; however, to the best of our knowledge, it had not previously been reported from the Chibougamau area.

2.5.2.4 Fish

There are several species of fish in the area of the mine site (ENTRACO, 2003 and 2011). The main ones are: northern pike, brook trout, white sucker, burbot and fallfish. A yellow perch was also caught during inventory work in the summer of 2011. Several small species are also present, such as longnose dace, northern redbelly dace, pearl dace, trout-perch, brook stickleback and mottled sculpin.

Limnology and ichtology work was carried out at many lakes and streams in the mining area between 1999 and 2011 (ENTRACO, 2003 and 2011). Results are presented in Chapter 8.

Following a 1999-2000 survey (Tremblay and Lévesque, 2001), the harvest potential of Lac Chibougamau was evaluated at 42,605 yellow walleye, equivalent to 2.1 walleye/ha. Catches amount to 1.2 kg/ha, suggesting the species is extensively harvested. This also applies to lake trout, for which catches are estimated at 2,437. The fishing pressure is not as great for the northern pike, even though 3,057 specimens were caught. Brook trout fishing is uncommon.

Results from the yellow walleye study in Lac Chibougamau indicate a high harvesting rate for this species. The low proportion of mature females could have a negative impact on fishing in the medium to long term (Belisle and Lévesque, 2001, cited in Tremblay and Lévesque, 2001).

2.5.2.5 Wildlife Habitats

No wildlife habitats, as defined by the *Act respecting the conservation and development of wildlife* (RSQ, c C-61.1), were identified in the study area.

Other than wildlife habitats mentioned above, the MDDEP identified a walleye spawning ground on Rivière Armitage, about 300 m upstream from its confluence with Ruisseau Villefagnan. Tallyman Philip Wapachee confirmed the location of the spawning ground (April 2011). Rapids located about 1.5 km upstream from the spawning ground are an insurmountable obstacle for walleye.

According to the same sources, there are two spawning grounds on either side of road 210 in Ruisseau Wynne, and another in Ruisseau Audet, in the section that connects Lac Audet to Lac Pierre, in the southern part of the study area (rail transfer site). Finally, one or more small spawning grounds for brook trout are located at the site of the future mine infrastructure.

2.6 LANDSCAPE

Information on landscape elements and visual analysis of the BlackRock project were obtained during a July 2011 field visit, from topographic map interpretation and from the 2003 environmental study conducted by ENTRACO for the McKenzie Bay Resources mining project. As the deposit is located on the same rocky ridge, descriptions of the environment, landscape components and visual impact were taken into account.

2.6.1 Context

The visual analysis covers a radius of some 20 kilometres around the project deposit. It emphasizes “sensitive” points of view, such as roads, particularly logging road 210, recreational sites and viewpoints from which the mining facilities might be visible.

The study area is part of the Laurentian Highlands and Abitibi Uplands regional landscape, which is undulating and low-amplitude. Ongoing mining and forestry activities since the 1950s have left their mark on the landscape (ENTRACO, 2003).

The defining features of the landscape are Lac Chibougamau and the central rocky ridge, which constitute important landmarks. On the local scale, the landscape features many lakes, rivers and bogs.

Generally speaking, the study area is affected by significant fragmentation of the natural environment by human activity. A campground and a number of hunting and fishing camps are located on the shores of Lac Vimont, Lac Chibougamau and Lac André, and close to Rivière Audet, on logging road 210.

2.6.2 Landscape Units

Three landscape units characterize the territory: the central rocky ridge, around which mining facilities will be built; Lac Chibougamau and Lac Vimont; and the forest, an environment that encompasses the other two visual elements and also contains peatland and streams. These visual elements, and the viewpoints from which the photos were taken, are presented in Figure 2.6.

2.6.2.1 Unit 1: Central Rocky Ridge

The rocky ridge, composed of a line of hills, occupies the central part of the study area. Several roads wind through this landscape unit, but no formal lookout has been identified in the area. However, the ridge is a structural element that can be seen from viewpoints associated with the other two landscape units.

As shown in Photo 2.1, the rocky ridge is strongly etched by logging. The planned mining facilities will only be visible through a few clearings along a logging road to the northwest of the ridge.

Photo 2.1: View of the rocky ridge from a logging road near Lac Jean, northwest of the deposit.

2.6.2.2 Unit 2: Lac Chibougamau and Lac Vimont

Lac Chibougamau is a defining feature of the landscape. The north shore offers the most views of the project site due to the presence of a recreational area (campground, cottages and an outfitter). The lake itself, popular with fishermen, is a key viewpoint on the landscape. The views from this visual unit, characterized by a wide horizon, would tend to include the rocky ridge in the background. However, the 15-kilometre distance that separates the lake‟s north shore from the ridge peak is likely large enough to blur the horizon details (Photo 2.2).

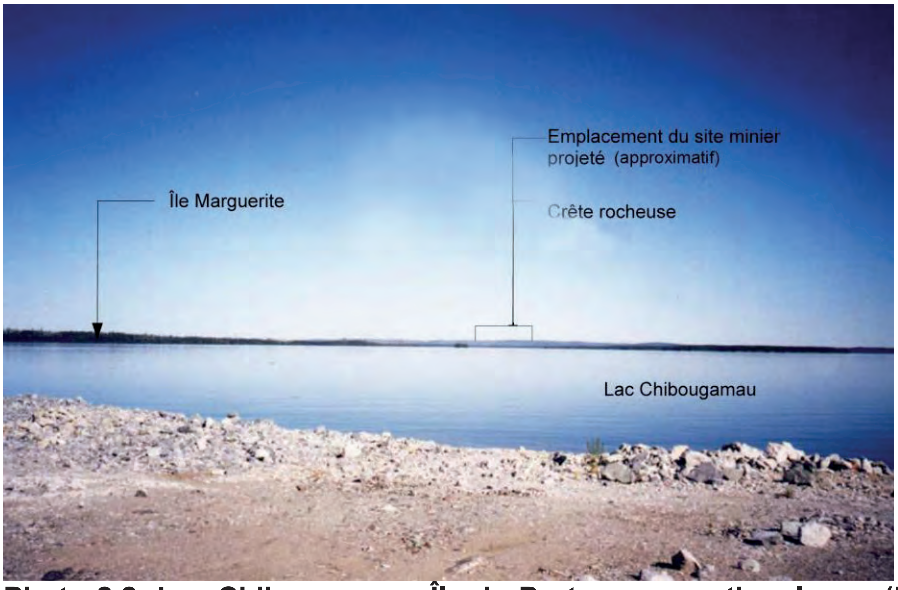


Photo 2.2: Lac Chibougamau, Île du Portage recreational area (Photo from: Entraco Inc., 2003. *Projet minier Ressources McKenzie Bay Ltée, Mine de vanadium, Volume 1)*.

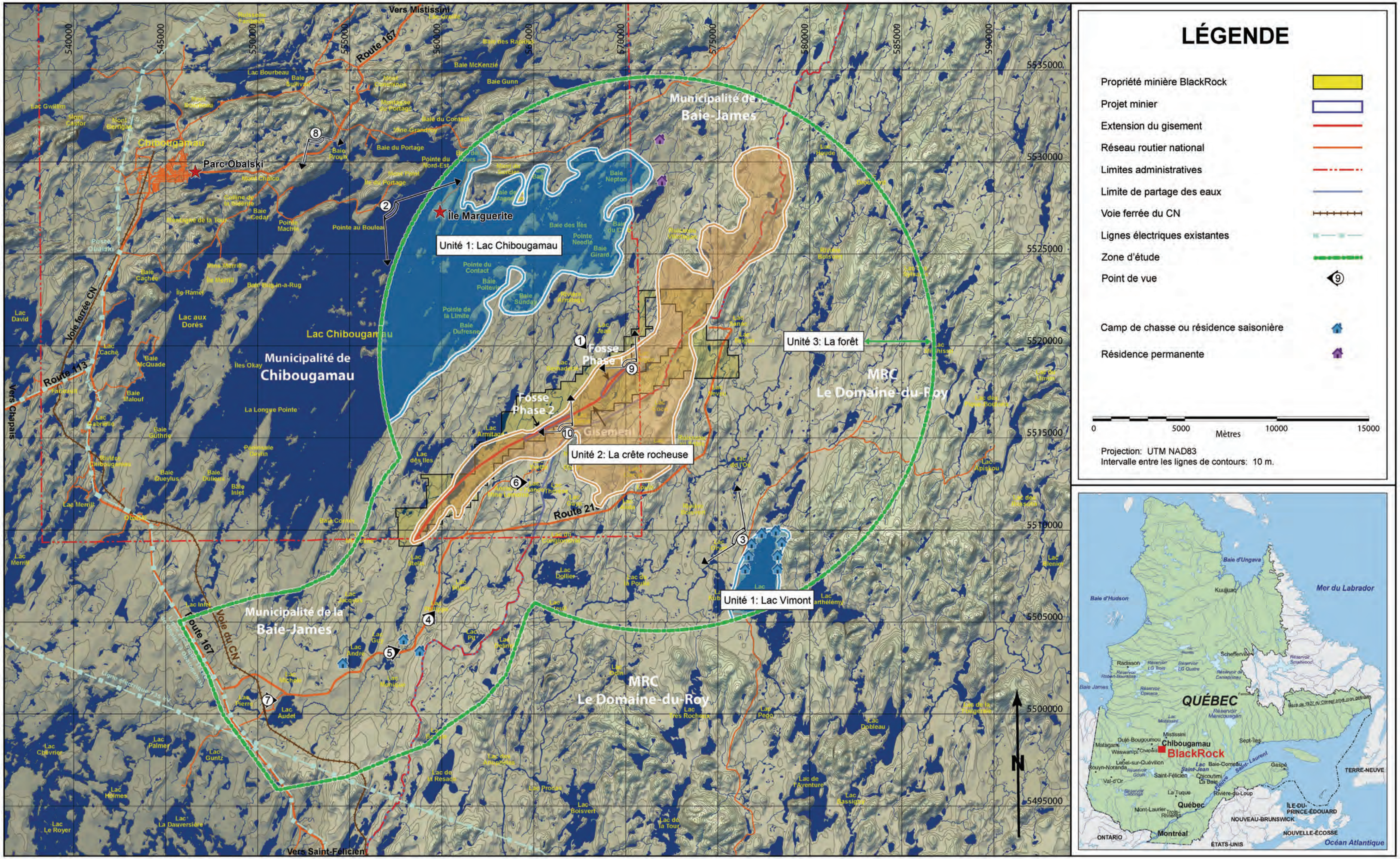


Figure 2.6 Visual Analysis

The shores of Vimont Lake are wooded and currently count eight seasonal residences. These residences look out onto the lake, however, and not onto the central rocky ridge. The access road west of Lac Vimont, however, offers a clear, unobstructed view of the planned mining facilities (Photo 2.3).

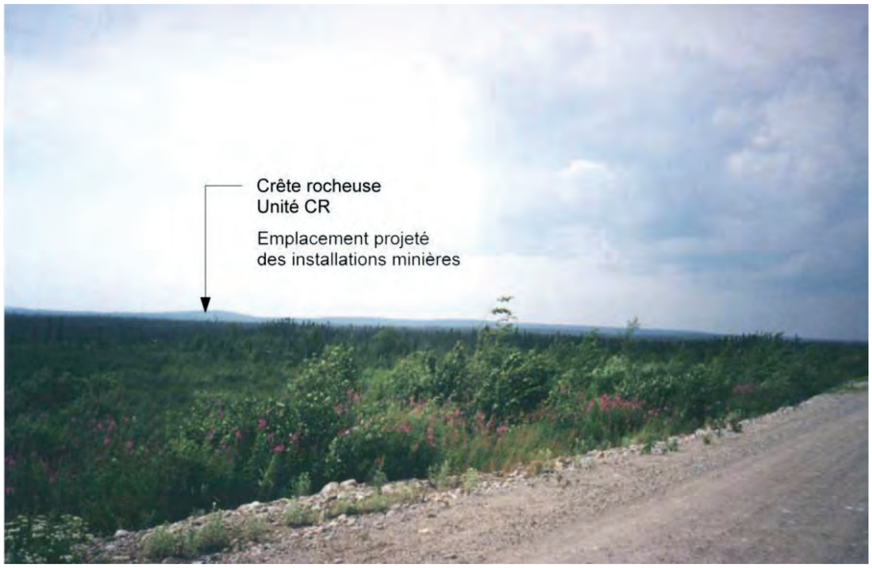


Photo 2.3: Logging road west of Vimont Lake (picture taken from: Entraco Inc., 2003. *Projet minier Ressources McKenzie Bay Ltée, Mine de vanadium, Volume 1)*.

2.6.2.3 Unit 3: Forest

The forest landscape unit encompasses the other two units (the rocky ridge, and Lac Chibougamau and Lac Vimont), which are in fact more local, structural landscape features. The forest is the largest, least homogeneous of the three visual units. It comprises a large number of small lakes, streams and peatland areas. The forest vegetation is composed mainly of coniferous trees. No permanent residences were inventoried in this unit; however, there are a few seasonal hunting camps.

Logging road 210 is the main access to the site, crossing this landscape unit from south to east (see Photo 2.4). Woody vegetation along the road frames most views, blocking visual access to planned mining facilities. Many logging roads also wind through the area, from which numerous landscape disturbances are visible (borrow pits, regeneration sites, old Lemoine mine: Photos 2.5 and 2.6).

Photo 2.4: Public road 210, view framed by trees along the side of the road

Photo 2.5: Road 210, landscape marked by human activity (borrow pits, hunting camps, logging roads)

Photo 2.6: Regeneration at the old mine site (Lemoine mine)

The forest unit also includes the old transfer point for the Gagnon & Frères sawmill, near Lac Audet. BlackRock plans to use this site for its project (see Photo 2.7). Classified in the 2003 ENTRACO study as a site accessible by logging road 210, it is now blocked by plant regrowth.

Photo 2.7: Regrowth at the old transfer point | Planned rail transfer point access

Observers at the hunting camps on the shore of Lac André and on Rivière Audet (Wapachee family camp) will not have visual access to the planned mining facilities, as vegetation along the access road and around the buildings screen the view.

Route 167, which connects Chibougamau to Lac-Saint-Jean, is used by a large number of motorists and constitutes the southwestern edge of the study area. The road is edged by forest in this area and provides framed, directed views. As a result, the rocky ridge and rail transfer point are not visible to motorists from the road.

The entire study area can also be seen from Obalski Park, which offers panoramic views of Lac Chibougamau and its surroundings. This park is located near Lac Gilman, east of the town of Chibougamau, and has several trails (hiking, cross-country skiing, snowshoeing, biking) that are used year-round (usage statistics were not available). As illustrated in Photo 2.8, taken from a *Centre d'intérêt minier* lookout some 10 km from the Chibougamau town centre, the mine site features in some panoramic views from Route 167 North. The mine site is, however, of little significance in the overall landscape. Furthermore, a view of a mine site is to some degree consistent with the regional landscape.

Photo 2.8: Panoramic view from the *Centre d'intérêt minier* lookout, looking towards the future mine site

Photos 2.9 and 2.10 were taken from the deposit ridge, looking west to show the panoramic view on landscape unit 1, Lac Chibougamau, and unit 2, the forest. In the centre of Photo 2.9, Lac Bernadette (left) and part of Lac Jean (right) can be seen below the horizon, which is the planned site for the coarse tailings and waste rock piles.

Photo 2.9: Panoramic view from the rocky ridge, northeast end of the pit (Phase 1).

Photo 2.10: Panoramic view from the rocky ridge; Lac Chibougamau in the horizon.

2.6.3 Summary

To summarize the visual analysis, the mine site will be seen from afar by a limited number of people, depending on whether they are on the north shore of Lac Chibougamau, on the lake itself or in the Lac Vimont area. Taking into account landscape fragmentation from mining and forestry activities, the omnipresence of all types of vegetation, the distance between the mine site and human activity and the population‟s attitude towards mines, the anticipated effects are not deemed to be very significant.

REFERENCES

Allard, G.-O., 1967. Quart Nord-Est du Canton de Rinfret, comté d‟Abitibi-Est et de Roberval. Rapport préliminaire R.P. n° 567.

Archéo-08, January 2003. Inventaire archéologique d‟un complexe minier, d‟une route d‟accès et d‟une ligne électrique à 161 kV dans la région de Chibougamau. Rapport d‟inventaire présenté à Entraco et au MCC.

Archéo-08, August 2011. Inventaire archéologique – juin 2011 : Projet minier BlackRock – secteur Chibougamau. Rapport d‟inventaire présenté à Entraco et au MCCCF, 32 p. and appendix.

Archéos Inc., July 2002. Étude de potentiel archéologique d‟un complexe minier, d‟une route d‟accès et d‟une ligne électrique à 161 kV, région de Chibougamau. Rapport 850-428 présenté à Entraco, 28 pages.

Beaulieu, H. 1992. Liste des espèces de la faune vertébrée susceptibles d‟être désignées menacées ou vulnérables. Ministère du Loisir, de la Chasse et de la Pêche, Québec.

Bider, J.R. and S. Matte, 1994. Atlas des amphibiens et des reptiles du Québec. Société d‟histoire naturelle de la vallée du Saint-Laurent et ministère de l‟Environnement et de la Faune du Québec, Direction de la faune et des habitats, Québec. 106 p.

Canada, Ministry of Indian and Northern Affairs, 2004. Agreement-in-Principle of a General Nature between the First Nations of Mamuitun and Nutashkuan and the Government of Quebec and the Government of Canada

Statistics Canada, 2011. Census and socio-economic data.

Commission économique et touristique de Chibougamau (CETC), édition 2011. Répertoire des entreprises de Chibougamau, édition minière.

Mamuitun Tribal Council (MTC) and First Nation of Nutashkuan, Gouvernement du Québec and Government of Canada, 2002. Agreement-in-Principle of a General Nature between the First Nations of Mamuitun and Nutashkuan and the Government of Quebec and the Government of Canada. 89 pages.

Cree Nation of Mistissini, Cree Regional Authority, Inmet Mining Corporation, July 2008. Implementing The Troïlus Agreement: A Joint Study of Cree Employment and Services Contracts in the Mining Sector. Prepared by Alan Penn, Science Advisor, and Vincent Roquet, Sociologist, 128 p. and appendices.

Cree Regional Authority, JJuly 2010. Cree Nation Mining Policy – Policy 2010.

Daigneault, R. and Allard, G.-O., 1987. Géologie de la région de Chibougamau, Québec. Ministère de l‟Énergie et des Ressources, Direction de l‟exploration géologique et minérale.

Entraco, June 2003. « Exploitation du dépôt de vanadium du Lac Doré et d‟un complexe métallurgique, région de Chibougamau – Étude d‟impact environnemental ». Volumes 1 and 2.

ENTRACO, March 2011. Projet minier BlackRock, secteur Chibougamau : les bancs d‟emprunt. Rapport interne P0919, inventaire de base.

ENTRACO, July 2011. Exploitation des bancs d‟emprunt – demande de bail non exclusif (BNE) pour les bancs d‟emprunt : P0919-01 (32G09/1-17, 32G09-18, 32G16-44). Rapport présenté au MRNF.

Environment Canada, 1982. Canadian Climate Normals, Wind, 1951-1980. Atmospheric Environmental Services, Vol. 5, 283 p.

Environment Canada, 1982. Canadian Climate Normals, Temperature and Precipitation, 1951-1980. Atmospheric Environmental Services, 216 p.

Environment Canada, May 2011. Canadian Climate Normals: 1971-2000. Station Results, National Climate Data and Information Archives.

Gauthier, J. and Y. Aubry, 1995. Les oiseaux nicheurs du Québec : Atlas des oiseaux nicheurs du Québec méridional. Association québécoise des groupes d‟ornithologues, Société québécoise de protection des oiseaux, Service canadien de la faune, région du Québec, 1,295 p.

Girard, R. and Allard, G.O., 1998. The Lac Doré Vanadium Deposits, Chibougamau. In: Geology and Metallogeny of the Chapais-Chibougamau Mining District: A New Vision of the Discovery Potential, Proceeding of the Chapais-Chibougamau 1998 Symposium, P. Pilote Ed., p. 99-102.

Golder Associates Ltd., November 2001. Investigation géotechnique préliminaire – Étude de faisabilité – Exploitation du dépôt de vanadium du Lac Doré. Rapport présenté à SNC-Lavalin.

Lavoie, G. 1992. Plantes vasculaires susceptibles d‟être désignées menacées ou vulnérables au Québec. Direction de la conservation et du patrimoine écologique, ministère de l‟Environnement du Québec, 180 p.

Lessard, S., 1996. Rapport sur la situation du Pygargue à tête blanche (Haliaeetus leucocephalus) au Québec. Ministère de l‟Environnement et de la Faune, Direction de la faune et des habitats, 73 p.

Nutshimit, October 2002. Exploitation d‟un dépôt de vanadium dans la région de Chibougamau : description de l‟utilisation du territoire et des droits des Innus et inventaire des entreprises et de la main d‟œuvre de la communauté de Mashteuiatsh. Rapport P600009 présenté à Entraco.

Parent, G. and Pineau, M., 1985. Intégration de quelques critères géomorphologiques et géotechniques dans le processus de planification écologique des milieux urbains et périurbains. Les cahiers du Centre de recherches en aménagement et en développement.

Québec, Institut de la statistique, 3 February 2011. Estimation de la population des municipalités du Québec. Direction des statistiques sociodémographiques.

Québec, Ministère de l‟Énergie et des Ressources, 1991. Cartes des dépôts meubles 32 G-9, 32 G-16 32 H-13 au 1 : 50 000. Document cartographique réalisé par la firme ROCHE.

Québec, Ministère des Ressources naturelles, 1997. Guidelines for Preparing a Mining Site Rehabilitation Plan and General Mining Site Rehabilitation Requirements. Direction des relations publiques, 66 pages.

Québec, Ministère des Ressources naturelles et de la Faune, 2007. Géologie – Lac Chibougamau. Géologie Québec, 1:20,000-scale map (32G16-200-02), by P. C. Roy *et al*.

Québec, Ministère des Ressources naturelles et de la Faune, February 1, 2011. AFMP 2011-2012 FMU 26-64, B01, CCL. 1:65,000-scale map showing environmental features and logging block.

Robert, M. 1989. Les oiseaux menacés du Québec. Association québécoise des groupes d"ornithologues and Environment Canada, Canadian Wildlife Service, Ottawa.

Thibault, M and D. Hotte, 1985. Les régions écologiques du Québec méridionales. Deuxième appr*oximation*. Ministère de l"Énergie et des Ressources, Québec. Carte au 1 : 1 250 000.

Tremblay, G. and Lévesque, F., 2001. *Enquête sur la pêche récréative au lac Chibougamau en 1999 et 2000*. Rapport présenté à Les Ressources intégrées de Chibougamau inc. et à la Société de la faune et des parcs du Québec, Direction de l"aménagement de la faune du Nord-du-Québec, par le Groupe conseil Génivar Inc.

3. ALTERNATIVE TECHNOLOGIES, SITE AND ROUTE SELECTION

3.1 UNIQUENESS OF THE TECHNOLOGY

Magnetite is by far the most magnetic of the iron ores. This physical property can be used to easily separate this highly magnetic rock from non-magnetic or less magnetic rock fractions. This is done by crushing and grinding the ore to dissociate the various mineral constituents as much as possible. Primary crushing is usually done dry, while subsequent attrition takes place in an aqueous medium. The resulting slurry is then sent to rotating magnets whose magnetic intensity is adjusted to selectively recover a magnetite concentrate.

This method is not only the most efficient and least costly, it also has the least environmental impact. Physical separation does not require any chemical reagents. Environment Canada (Guidance for the Reporting of Tailings and Waste Rock to the National Pollutant Release Inventory, December 2009) and the *Ministère des Ressources naturelles et de la Faune du Québec* (Mining Information Bulletin, *There's an Iron Rush On!* – June 2010) describe magnetic separation as the extraction method used for magnetite in Canada and Quebec; it is also the method universally used for magnetite concentration.

Depending on the type of steel to be produced, the magnetite concentrate can either be shipped as is or further processed. As an indication, high quality steel must be manufactured using raw material with a maximum sulphur concentration of 500 ppm. At the other end of the spectrum, cast iron can easily be produced from ore with much higher levels of sulphur. The literature indicates that some steel plants produce cast iron using ore with up to 5,000 ppm sulphur. Prior to the removal of pyrrhotite, the BlackRock concentrate has a sulphur concentration of less than 2,000 ppm; after flotation, the sulphur concentration is 500 ppm.

Depending on the requirements of the steel plants buying the BlackRock magnetite, the concentrate may be put through a subsequent refining process. Pyrrhotite is a magnetic iron sulphide that can be associated with magnetite in small quantities. Because its magnetic susceptibility is similar to that of magnetite, the pyrrhotite must be extracted from the magnetite concentrate by flotation. To do this, an activating agent with an affinity for pyrrhotite is fed into the slurry with air to cause the generation of air bubbles that rise to the surface. A frother picks up the particles of pyrrhotite in the froth it creates on the surface of the flotation cell. The flotation overflow or concentrate selectively carries away the pyrrhotite, thus increasing the percentage of magnetite in the concentrate. This second processing step is also common.

Only the frother is regulated by the CSST. These surfactants have been widely used for many years in Canada. Most notably, they were used for some fifteen years at the Troilus mine with no impact on water quality and aquatic life.

The sequence of processes described above is unmatched in terms of efficiency, economic viability and low environmental impact.

3.2 SITE AND ROUTE ALTERNATIVES

Knowledge of the elements of the biophysical and human environment, including the consultation results, are determining factors when it comes to selecting sites for the mine facilities and related infrastructure. The BlackRock project installations cover an area of about 600 hectares (see Figure 3.1). A plan view of the mine site and surrounding area is provided in Appendix 3.2 (see Photos 1A, 1B).

3.2.1 Host Environment and Infrastructure

Before identifying these factors, it is worth underscoring that the zone of influence of the project is relatively homogeneous:

- natural environment affected by large-scale logging (many logging roads and cutting areas) and mining (old Lemoine mine, Corner Bay project, BlackRock exploration);
- absence of a structured built environment and permanent residences along the access road except for hunting and fishing camps near Lac André; secondary residences more than 10 km from the pit (Lac Vimont area, Domaine-du-Roy RCM);
- JBNQA environmental regime, mining installations are on a single Cree trap line, O-59 (Philip Wapachee, tallyman);
- extensive, seasonal tourism (hunting and fishing);
- flat or gently undulating topography characterized by the omnipresence of poorly drained glacial deposits, wetlands, and lakes and streams flowing in parallel in a northeast-southwest direction;
- geological setting characterized by numerous shear zones;
- no identified threatened, endangered or special-status species of plants or wildlife;
- no archaeological sites in the direct area of influence of the project;
- visual environment closed or barely perceptible from the outside.

The planned infrastructure directly linked to the mining operation consists of:

- pit;
- crusher;
- processing plant;
- fine tailings pond, polishing pond, waste rock pile and coarse tailings pile;
- process water supply reservoir.

The supporting infrastructure for the project consists of:

- access and haulage roads;
- garage and work platforms;
- main power line and grid;
- rail transfer point;
- workers‟ camp for the construction phase.

As discussed below, no alternative sites were considered for the mining zone and power line route. However, the location of the production facilities, tailings management facilities and waste rock pile, process water intake, access road, rail transfer point and workers‟ camp were all given careful consideration.

BlackRock and Hydro-Quebec have agreed that Hydro-Québec will assume full responsibility for the 161-kV line that will supply power to the mine site (design, construction, engineering and environmental studies). The Deputy Minister of the MDDEP, Diane Jean, was informed of this agreement in a letter dated October 5, 2010. The power line has nevertheless been mapped to show the potential location of a power transmission corridor. The proposed route is from a Hydro-Quebec document entitled: *Étude préliminaire - Alimentation d'un site minier au Lac-aux-Dorés, mars 2000, Révision 1*.

3.2.2 Selection Criteria

Because of their characteristics and function in the production process, some facilities must be must be located near the pit, for both financial and environmental reasons. For example, the cost of hauling the ore to the crusher and the concentrator becomes difficult to justify in financial and environmental terms if the distance is more than two kilometres from the pit. The choice of the location of the mine infrastructure is also largely influenced by the concern of tallyman and his family not to encroach on the rich biological environment of the Lac Armitage area. This position is consistent with the logging restrictions that the MRNF and tallyman agreed to for the same area (MRNF 2011; Map AFMP 2011-2012, O-59).

The criteria and rationale surrounding site selection are also based on:

- The MDDEP directives for the BlackRock mining project (December 2010);
- Guidance for conducting environmental impact studies for a mining project (*Directive pour la réalisation d'une étude d'impact sur l'environnement d'un projet minier*) (September 2010);
- Directive 019 for mining projects in general (April 2005);
- Environment Canada‟s Guidelines for the Assessment of Alternatives for Mine Waste Disposal (May 2011).

In practice, site selection is dictated by the relationship of all the environmental elements and project components. A single selection criterion may be sufficient to eliminate an option from the outset; conversely, if no single criterion is decisive, all the criteria are used to justify site selection. The subsequent step, which is to qualify and quantify the environmental impact and the related mitigation measures, is covered in the chapter on impact assessment.

The site selection criteria for the BlackRock project are described below.

Minimize the project footprint:

- concentrate facilities within BlackRock‟s property boundaries;
- group mining activities within a single drainage basin;
- minimize the area affected by the project and the travel distances between the various facilities;
- maximize the use of existing infrastructure;
- use waste rock for mine site, road and dam construction;
- use the borrow pits within the project area.

Minimize social impact:

- prioritize traditional activities in terms of land use;
- limit the loss of productive land for other uses (forestry, commercial, tourism, hunting and fishing);
- take into consideration sites of cultural value (historical, archaeological);
- take into consideration the outcome of the consultation;
- limit pile height to the height of the surrounding hills.

Take into consideration the carrying capacity of the soil and sensitive environments:

- build the production facilities on competent ground;
- locate the tailings management facilities in less-permeable areas where groundwater is less likely to be affected;
- limit encroachment on sensitive environments (peatland, streams, lakes, wetlands), including wildlife habitats.

3.3 HIGH-PRIORITY SITES – PIT, CRUSHER AND PROCESSING PLANT

The siting criteria for the pit, crusher and processing plant must address specific geotechnical and geochemical characteristics. These criteria are decisive, as the study area does not offer multiple site options.

3.3.1 Pit

The pit location is fixed, as successive drilling and metallurgical testing programs by various mining companies in the past several decades have demonstrated the viability of the project based on the mining of the pit as outlined (see Figure 3.1, Appendix 3.2: Photo 2). The only other site that is sufficiently delineated for mining lies about two kilometres northeast of the current pit. However, the claims in this area are held by a variety of owners.

3.3.2 Crusher and Processing Plant

The crusher, concentrator and surrounding work sites occupy an area of 38 hectares. They must necessarily be located close to the pit and process water supply reservoir (Lac Denis) (see Appendix 3.2: Photo 1A). Moreover, the large size and operating conditions of the facilities (constant vibrations and shocks) dictate their positioning based on stringent geotechnical criteria. They must therefore be placed directly on rock with no structural anomalies. Extensive geotechnical surveys were therefore carried out in the summer of 2011 to determine rock competence (Laboratory Ville-Marie, BBA). Finally, these two facilities must be side by side, and the plant must be located away from the mine haulage traffic to facilitate loading and trucking of the concentrate to the rail transfer point.

For all these reasons, a site northeast of Lac Denis was selected for the crusher and a site southeast of the lake for the concentrator. The hillside bedrock will be blasted and levelled at both locations. Thus positioned, the two facilities meet all geotechnical, logistical and safely requirements. In this regard, it should be mentioned that the north-south access road corridor ends at the concentrator, which is the southernmost facility of the mining complex. This layout is such that the mine haulage trucks do not meet up with the semi-trailers used to haul the concentrate to the rail transfer point.

Areas with appropriate bearing capacity for the site of the crusher and concentrator, i.e., rock outcrops, are concentrated around the hill of the deposit. Four options close to the pit and around Lac Denis were considered (BBA, July 2011). Not all of these were mapped as they are all in the same area, on the east side of Lac Denis; only the selected option, D, is shown in Figure 3.1

Option A

The concentrator is located northeast of Lac Denis, near the crusher. This configuration was not selected for the concentrator for the following reasons:

- a large quantity of overburden must be removed to make way for these two facilities;
- this is also a good location for the waste rock and coarse tailings piles;
- the conveyors interfere with haulage truck traffic;
- the soil mechanics is inappropriate.

Option B

The concentrator is located southeast of Lac Denis. This configuration was not selected for the following reasons:

- inadequate soil bearing capacity (rock too deep);
- located above a potentially mineralized fault considered a high-priority target by another mining company;
- BlackRock does not own the claims.

Option C

The concentrator is located southeast of Lac Denis, just west of Option B. This configuration was not selected for the following reasons:

- very costly due to the large quantity of rock to be excavated;
- located in the extension of the same potentially-mineralized fault as option B;
- higher-risk operation because the concentrator is located at a lower elevation than the tailings management facilities (the tailings would have to be piped up a steep rise to reach the fine tailings pond).

Option D

The concentrator is located southeast of Lac Denis, just south of Option C. This configuration **was selected** for the following reasons:

- Far enough away so as not to affect the potentially-mineralized fault;
- Satisfactory soil bearing capacity;
- Minimal overburden removal;
- Minimal footprint, meaning less traffic and lower CO_2 emissions;
- Located on BlackRock claims.

The mine garage is located northwest of Lac Denis, away from the ore and waste haulage operations. It was positioned so as not to impede haulage truck traffic between the pit, the tailings management facility and the crusher.

3.4 PROCESS WATER SUPPLY OPTIONS

A preliminary process water supply study was conducted in April 2011 to identify favourable areas (*Recherche en eau souterraine – Projet minier BlackRock* – Entraco, April 2011). The target flow rate for concentrator supply was set at 4,800 m^3/day (56 L/sec).

This study indicated that the bedrock is generally relatively impermeable and does not have much potential for a water supply with a flow of 4,800 m^3/day. Such a flow is more apt to be generated by a highly permeable Quaternary unit like an esker that is saturated with water and in direct contact with a sufficiently large body of water to ensure its replenishment.

Eight sites were assessed as sources of surface water supply. Two of these met the selection criteria. The first is located about 8 km northeast of the mine site, in an esker located alongside Ruisseau Villefagnan. The second is located 5 km west of the study site, in the southern part of Lac Armitage. In fact, a string of islands in the lake has been identified as being an esker, and it would be possible to trace the extension of the esker at the southern end of the lake.

The installation of a water intake in a lake, river or reservoir is, however, conditional on the amount of water withdrawn not exceeding 20% of the low flow value for seven consecutive days for a predicted two-year return frequency ($Q_{2,7}$) (MDDEP, Fiche 14). This usage restriction is aimed at protecting life in aquatic environments and other water uses.

Table 3.1 presents the results of $Q_{2,7}$ flow calculations by transposition of the flow onto the catchments of the eight sites studied. It is apparent that only the sites located at the confluence of Ruisseau Villefagnan and Rivière Armitage and Lac Armitage itself can meet the low-flow criterion.

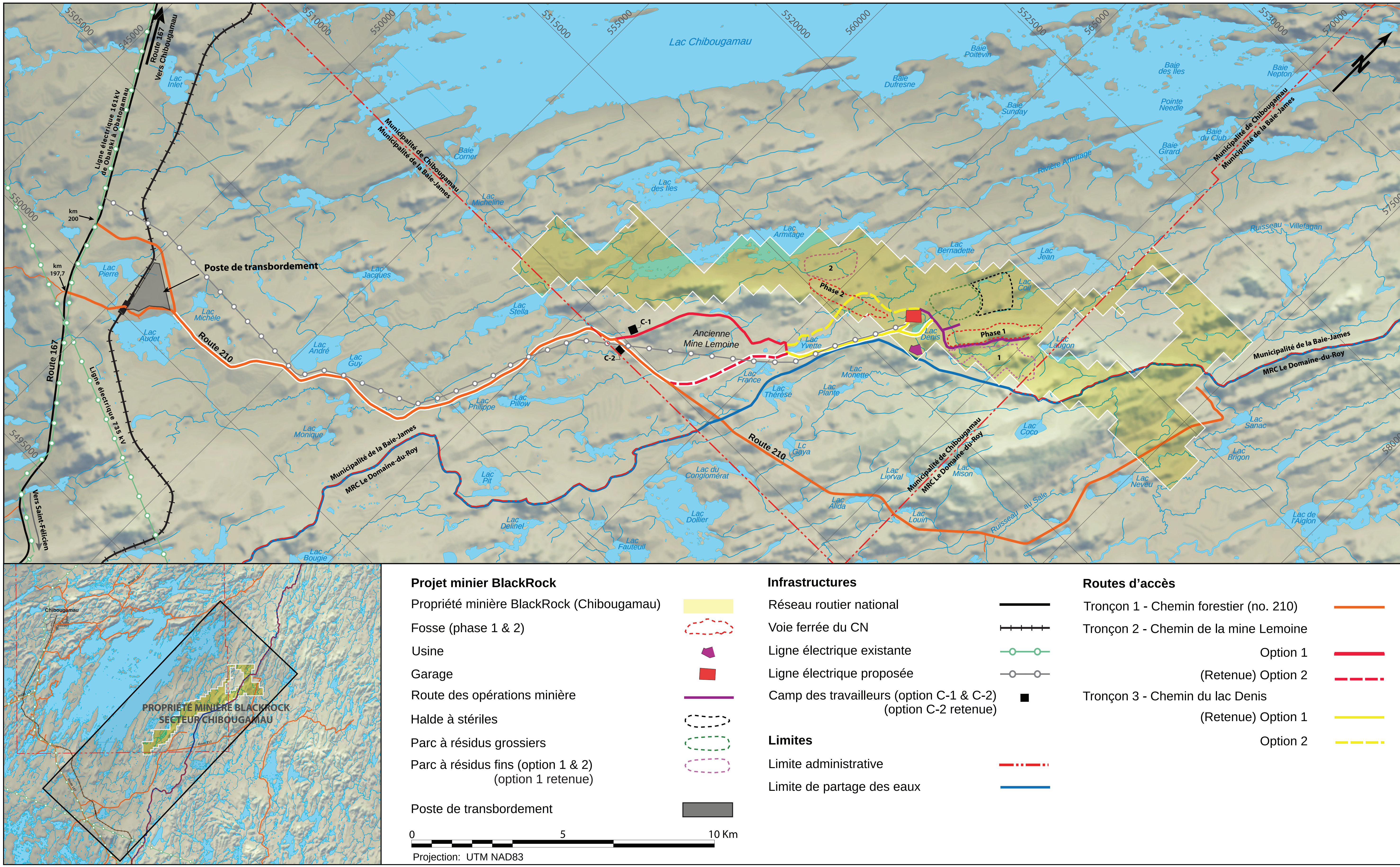


Figure 3.1 **Comparison of Options - Mine Infrastructure**

Table 3.1 Calculation of Flows Available for Process Water Supply

Name	Catchment (Km^2)	Low Flow $Q_{2,7}$ (L/s)	Available Flow (L/s)	Target Flow (L/s)
Confluence of Ruisseau Villefagnan and Rivière Armitage	112.6	555.1	111.0	56
Lac Armitage	95.6	471.3	94.3	56
Ruisseau Villefagnan	51.2	252.4	50.5	56
Lac Jean	14.2	70.1	14.0	56
Villefagnan upstream	10.8	53.2	10.6	56
Lac Laugon	4.5	22.2	4.4	56
Lac Yvette	2.5	12.4	2.5	56
Lake A-2	1.7	8.4	1.7	56
Lac Denis	1.5	7.4	1.5	56

Given the value assigned to the Armitage river basin by the tallyman and its importance for Lac Chibougamau walleye fry, the installation of an industrial water intake at the outlet of Lac Armitage or on the river of the same name was viewed as particularly delicate.

Given this, the option of building a dam to create a reservoir at Lac Denis was investigated. The proposed concept for Lac Denis is to minimize fresh water requirements by recycling process water. Three reservoirs would be used to store process water: the fine tailings pond and the polishing pond, both located on the east side of the pit, and Lac Denis. In addition to the inflow from the Lac Denis catchment, rainfall and water from pit dewatering will be fed into this closed circuit. The dams will be built at the beginning of the construction period, thus allowing the water needed for the processing plant closed circuit to accumulate. Once milling is underway, 90% of the water is expected to be recycled in a closed loop, with the remaining 10% supplied by precipitation. Any water released into Lac Denis will meet effluent quality standards. This was deemed the most viable option for process water supply.

3.5 TAILINGS MANAGEMENT FACILITIES AND WASTE ROCK PILE

The waste rock and concentrator tailings will be stored in specially-designed facilities. The surface area of the tailings management facilities are shown in Table 3.2. The facilities require a large area; however, the mine site setting contains shear zones, small streams and lakes, wetlands and peatlands, all of which are discriminating factors in site selection.

Table 3.2 Tailings Management Facility Surface Area

Facility (source: BBA, July 2011)	**Area** (Mm^2)	**Area** (ha)	**Volume**
Fine tailings pond and polishing pond (Option 1 pit)	1.76	176	29.3 Mm^3
Waste rock pile	1.10	110	264.3 Mt
Coarse tailings pile	1.09	109	42 Mm^3
Organic and overburden stockpile	0.27	27	7.4 Mm^3

Early in the project optimization process, two separate sites were considered for waste storage. The first option called for waste rock and overburden, including organic soil, to be deposited northeast of Lac Armitage, with the fine tailings and polishing ponds located southeast of the pit. The second option was to group all the storage sites on both sides of the pit. All the sites considered are located in the town of Chibougamau and on trap line O-59 (Philip Wapachee, tallyman). Assessment of all the advantages and disadvantages of these sites led to a decision to group all the waste near the pit.

3.5.1 Option 1: Tailings Sites near the Pit

Under this option, the fine tailings pond and polishing pond lie directly southeast of the future pit, and the fine tailings will need to be pumped less than two kilometres from the concentrator (see Appendix 3.2: Photos 5A and 5B).

The site covers an area of about 200 hectares and is made up of flat ground composed of moraine and gravel, surrounded by hills of massive, relatively unweathered rock. The in situ materials and the rocky edges constitute a technical and environmental advantage for the containment of fine tailings and the creation of impoundment works. Geological maps show that the axes of shear planes in the bedrock transect the site. In the field, the shear zone identified in the area of the fine tailings pond does not translate into anomalies identifiable by photo interpretation (talus, breccia, breaks in the rock, etc.); there is therefore no evidence of structural weakness. Furthermore, geological logs of drillholes that intersect this zone indicate that the shear zones are often injected with carbonates. There are similar zones throughout the region; they run parallel to each other about 500 to 1,000 metres apart, and cross the mine site in a northeast-southwest direction, from Lac Chibougamau eastward to Rivière Boisvert.

At the proposed site, the relatively sound bedrock is covered by a variable thickness of low-permeability till that protects against the infiltration of potential contaminants from surface. The impact of the geology on groundwater flow is discussed in Chapter 10. The conclusions are supported by drill results and modeling of groundwater behavior.

Based on this option of grouping the waste around the pit, the coarse tailings and waste rock piles (219 ha) are located north of Lac Denis and west of the pit. Here, the topography is relatively flat and surficial deposits consist of till averaging over one metre thick. The till is also frequently covered by organic deposits, due to an unstructured drainage network and slow runoff. The waste rock and coarse tailings piles connect, which reduces the overall footprint to about 40 ha. Because the coarse tailings contain titanium, they will be systematically deposited on a waste rock platform to allow for future reclamation, even though the technical and economic feasibility of titanium recovery has yet to be demonstrated. The coarse tailings and waste rock will be trucked to the storage site.

With respect to landscape quality, the tailings sites cannot be seen from Lac Chibougamau or Lac Armitage. In terms of the water network, the waste rock and coarse tailings piles encroach on small lakes B-3, B-6, B-7, B-8 and B-9 and their associated creeks and wetlands. The fine tailings pond and polishing pond encroach on lakes B-11, B-12 and B-14 and their associated creeks.

If need be, all the tailings sites to the east and west of the pit can be raised during the life of the mine without increasing their footprint.

3.5.2 Option 2: Tailings Sites at Lac Armitage

The Lac Armitage tailings site option lies some six kilometres from the pit and 440 m from the eastern shore of the lake. The land is undulating, consists of moraine and is crisscrossed by several intermittent streams (see Appendix 3.2: Photo 6). In this sector, the regenerating forest was logged in the 1990s and the bedrock is cut by shear zones, like the Option 1 site near the pit.

This option is five kilometres farther away from the pit than Option 1. In addition to increasing the footprint, the greater distances call for a larger fleet of trucks and consequently higher emissions of greenhouse gases, particulate matter and noise.

Furthermore, the entire Lac Armitage drainage basin is highly valued by the Wapachee family for their hunting and fishing activities. The tailings site itself would lie directly in a favourable area for small game and the harvesting of fur-bearing animals such as lynx, fox and marten (personal communication with Matthew and Philip Wapachee, May 2011). This is also the reason the tallyman and the MRNF have agreed to significantly restrict logging in the area.

The above findings led to a decision to group the tailings management facilities around the pit (Option 1).

The overburden stockpile will be located at the highest point of the fine tailings pond, at its northern end. The site is expected to cover an area of 270,000 m^2 (27 ha).

3.6 RAIL TRANSFER POINT

The rail transfer point is at a separate site in the southern part of the study area. It lies next to the Canadian National (CN) rail line, where the iron ore concentrate will be unloaded from the trucks and transferred to railroad cars for shipment to the Quebec City or Saguenay port. A siding about one kilometre long will be built parallel to the main CN line. An area of about 100 ha is available, more than sufficient to store and load the iron ore concentrate. This option was selected following a comparative analysis of various sites.

3.6.1 Comparative Analysis

Chibougamau site. This is the end of the CN track, north of the town of Chibougamau. The major problem with this option is that the heavy trucks transporting the concentrate must travel a distance of some 60 kilometres, half of it on Route 167, and drive through the town of Chibougamau. There are major implications in terms of public safety, travel time and fuel consumption. In addition, the intensive use of this transfer point for mining purposes would interfere with the logging activities of *Chantier Chibougamau Inc.*

Obalski site. This site is a few miles south of the town of Chibougamau off Route 167, some 60 km from the mine site. The loading surface is relatively small. This option was not selected for the same reasons as the Chibougamau site (distance and travel time, fuel consumption, safety on provincial highways).

The old Gagnon & Frères sawmill site (selected site). The old Gagnon & Frères sawmill site is next to the CN track between Route167 and logging road 210 (the mine site access road), and between Lac Pierre and Lac Audet (see Appendix 3.2: Photos 3 and 4). It is large (about 100 ha), open and easily accessible, and meets the needs of the BlackRock project. The site is about 30 km from the concentrator. However, the dismantled siding will have to be rebuillt to allow the rail cars to be loaded off the main track. The use of this site eliminates any heavy traffic arising from concentrate haulage on Route 167, minimizes fossil fuel emissions, and has no direct impact on regular users of Route 167.

For all these reasons, the old Gagnon & Frères sawmill site was selected as the rail transfer point.

3.6.2 Environmental Audit

A Phase 1 environmental audit was conducted in the context of the possible acquisition of the land at the old Gagnon & Frères sawmill. The property is located on blocks 2, 3, 4 and 5 of Queylus Township in the Chibougamau area. It belongs to the *Ministère des Ressources naturelles et de la Faune* (MRNF). It was occupied until 1994 by a sawmill that belonged to several owners.

3.6.2.1 Methodology

The objective of the audit is to express an opinion on the environmental condition of the property. It is aimed at determining, through historical research, surveys and visual inspection, whether earlier and/or existing factors may affect the environmental quality of the site. The approach used is based on standard environmental auditing methods.

More specifically, the method used is as follows:

- title search;
- review of aerial photographs from 1948, 1965, 1973, 1985, 1998 and 2003;

- property visit and visual inspection;
- Discussions with the *Ministère du Développement durable, de l'Environnement et des Parcs du Québec*;
- Discussions with the *Ministère des Ressources naturelles et de la Faune du Québec*;
- Discussions with the Environment and Urban Planning department of the Municipality of James Bay;
- Review the database of cases handled by the MDDEP as part of the *Soil Protection and Contaminated Sites Rehabilitation Policy*: Inventory of Contaminated Sites and Inventory of Soil and Industrial Waste Disposal Sites;
- Review the database of cases handled by the *Régie du bâtiment du Québec* (RBQ);
- Discussions with *Groupe RSM Gestion des Risques* regarding fire insurance.

The comments in the audit are based solely on information provided by those interviewed or contacted, observations made during the site visit and the review of available documents and aerial photographs.

The information presented below is taken from the "Phase 1" environmental audit document. The complete file, including property title reports, site photographs and correspondance with the relevant organizations, is the property of BlackRock Metals Inc. These documents are available on request.

3.6.2.2 Site Location and Description

Information on the location of the study site is as follows (see Figure 3.2):

- municipality: James Bay;
- lot numbers: blocks 2, 3, 4 and 5 of Queylus Township and part of undivided Range 11;
- between Lac Audet to the east and Lac Pierre to the west;
- owner: *Ministère des Ressources naturelles et de la Faune* (MRNF);
- geographic coordinates: 49°39'14" North, 74°18'08" West.

The site boundaries were determined from the preliminary site layout for the concentrate loading operation (Plan No. 30170003-0000000-41-D09-0002, "Feasibility Study, General Site Plan, Temporary Train Loading Station Layout", BBA, February 2011).

The site is currently occupied by the railway line (Saint-Félicien-Chibougamau line) that crosses the property from north to south and by a road that connects the railway right-of-way to logging road 210. The rest of the site is generally covered in woody vegetation. The southern part of the site, where old sawmill facility was located, was revegetated.

3.6.2.3 Results

The portion of the site under study, consisting of blocks 2, 3, 4 and 5 of Queylus Township, is shown in Figure 3.3. The summary of related land transactions since 1980 is given in Table 3.3.

It should be mentioned that the aforementioned lots cover the southern part of the study site. This area was occupied by the sawmill facilities. This is the area with the highest risk of contamination. The whole northern part of the site, which is occupied by the railway tracks and right-of-way and covered by forest vegetation on both sides, is not included in blocks 2, 3, 4 and 5. On the *Ministère des Terres et Forêts* 1979 map, it is designated as "Part of undivided Range 11".

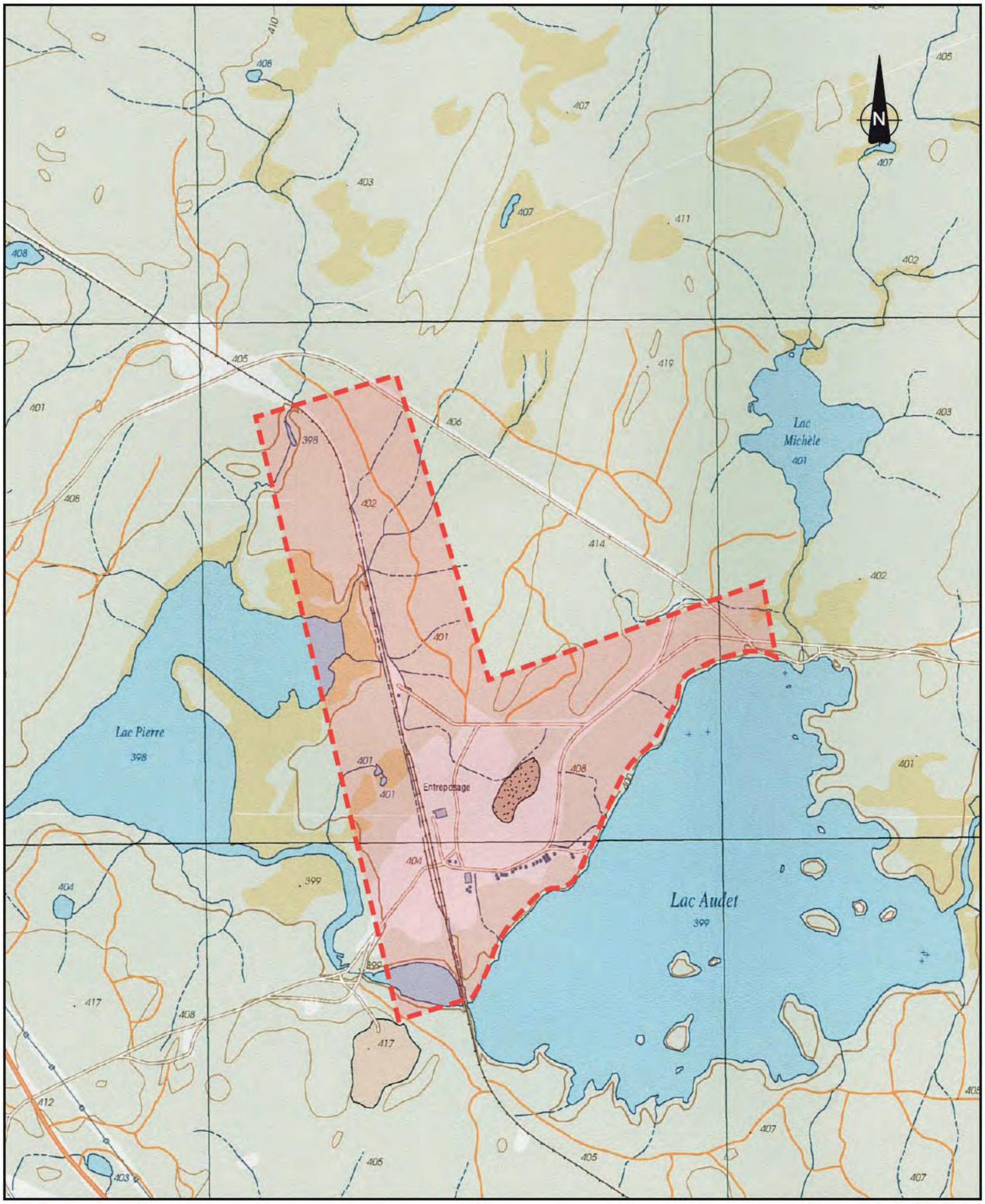
There is no record of a notice of use restriction for blocks 2, 3, 4 and 5 under Article 18 of *An Act to amend the Environment Quality Act and other legislative provisions with regard to land protection and rehabilitation* (L.Q. 2002, c.11) and Section 31.47 of the *Environmental Qualty Act* (L.R.Q. c.Q-2). No notarial lease and/or private agreement, commercial and/or residential and/or authorizing the sale of petroleum products or its derivatives, is recorded on the aforementioned property.

Prior to 1980, Gagnon & Frères built and operated the first sawmill on the site under study, although it was not the owner. The operations were transferred to the site from a plant in Roberval following the granting of a new logging concession.

Table 3.3 Property Ownership of Blocks 2, 3,4 & 5, Queylus Township

Date	Owner
Prior to 1980	Provincial Crown property
16 June 1980	Campeau Corporation acquired the blocks from the Ministère des Ressources Naturelles et de la Faune, under letters patent issued on 3 July 1980 under number 189236.
24 February 1986	Gagnon & Frères de Roberval Inc. acquired the blocks from “Campeau Corporation”, pursuant to a private agreement recorded on 6 February 1986 under number 225856.
20 June 1989	Consolidated-Bathurst Inc. acquired the blocks from logging company "Gagnon & Frères de Roberval Inc.", under an act of sale received by P. Roberge, in his minute 22129, recorded on 29 June 1989, under number 249428.
6 December 1993	Stone-Consolidated Corporation acquired the blocks from “Stone-Consolidated Inc.” acting on behalf of “Consolidated-Bathurst Inc.”, pursuant to a deed of transfer received by B. Ducharme, in his minute 7095, recorded on 8 December 1993, under number 273694.
8 December 2010	The Ministère des Ressources Naturelles et de la Faune acquired the blocks from “Abitibi-Consolidated Inc.” acting on behalf of “Stone-Consolidated Corporation”, pursuant to a private reassignment agreement recorded on 16 December 2010, under number 17794413.

Figure 3.2 Study Area Boundaries for the Phase 1 Environmental Audit of the Rail Transfer Point

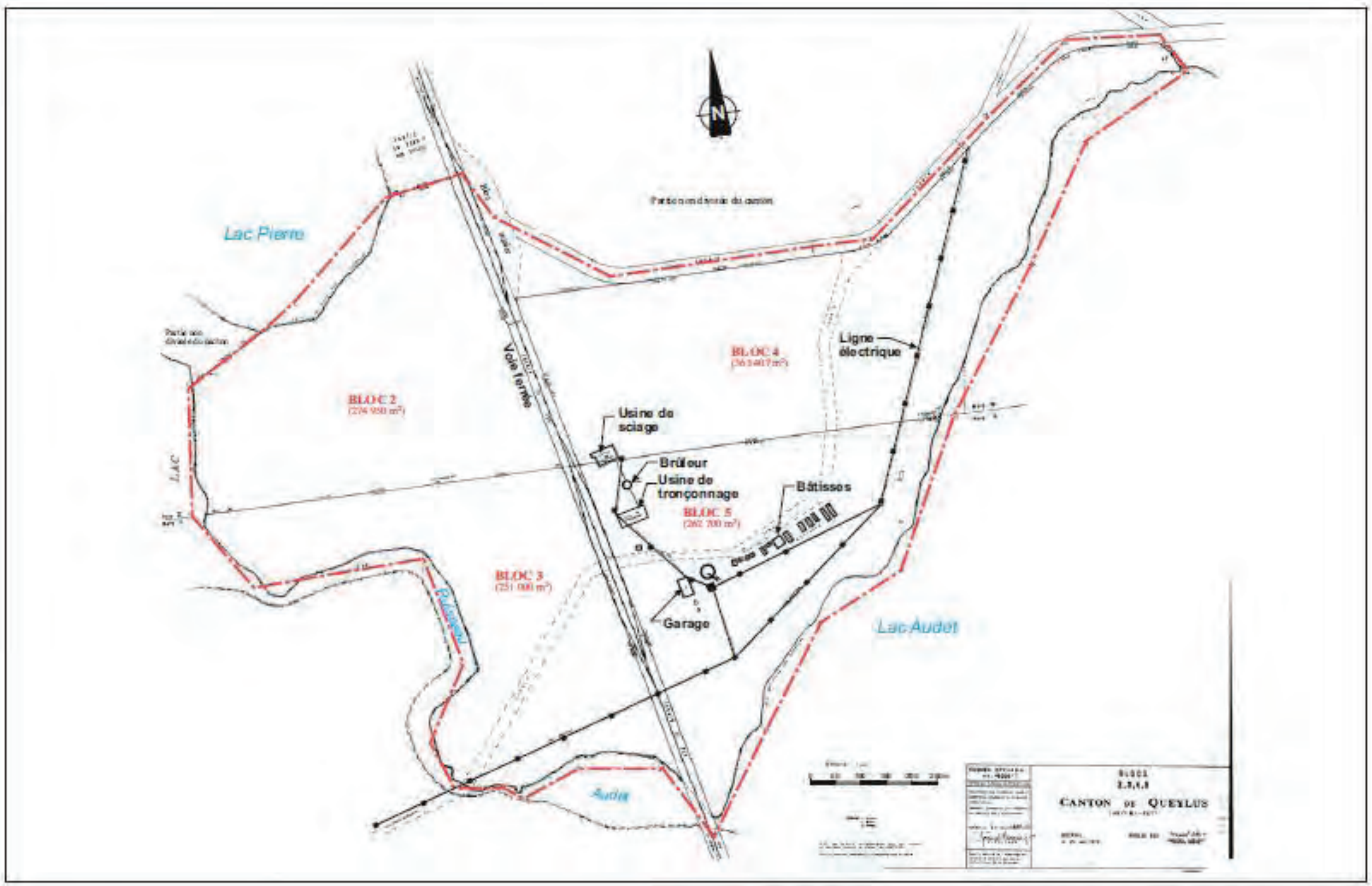


Échelle: 1: 20 000

Limite approximative de la propriété à l'étude

Source : Ressources naturelles et Faune, Québec Carte topographique 32G09-200-0201, Lac Chevrier. 2003.

Figure 3.3 Location Map for Blocks 2, 3, 4 and 5, Queylus Township



Source : Ministère des Terres et Forêts
Direction générale du domaine territorial, 1979
Dossier : 18771/49-A

3.6.2.4 Land Use History

The information on the history of the site and surrounding area was taken from the results of the property title search, the examination of aerial photographs (see Figures 3.4 to 3.5), the literature search and observations made during the site visit in 2010.

The following comments are based on the review of all information available on the site history.

The identified uses of the study area entailing environmental risk are the operation of a sawmill from 1956 to 1994 and the presence of the railway. These are activities covered by the *Land Protection and Rehabilitation Regulation* (LPRR) and Section IV.2.1 of the *Environmental Quality Act*, or the following NAICS categories:

- 321111: sawmills and wood preservation: this category includes "establishments primarily engaged in manufacturing boards, dimension lumber, timber, poles and ties, and siding".[1]
- 488210: Support Activities for Rail Transportation: this category includes "establishments primarily engaged in providing specialized services to the rail transport industry. Establishments engaged in the operation of railway terminals and stations, and the maintenance of railway rights-of-way and structures are included."[1] Examples include "railroad switching services", "loading and unloading rail freight cars", "railway maintenance services (i.e., rights-of-way, structures) and "maintenance of rights-of-way and structures, railway".[1]

The main elements of environmental risk associated with these uses are:

- hydrocarbon storage and handling;
- fill;
- septic tanks and septic fields;
- accumulation of wood residues;
- operation of a trench landfill for solid waste.

The sawmill and all associated facilities were dismantled in 1994 and 1995.

In 1996 and 1997, site rehabilitation work consisting of excavation and on-site treatment of hydrocarbon-contaminated soil was done to meet Criteria C of the *Ministère du Développement durable, de l'Environnement et des Parcs* (MDDEP). Contaminated soil from another sawmill was also treated at the site.

There is little data available on the question of site contamination and rehabilitation. No detailed reports could be found on the characterization and rehabilitation activities.

[1] North American Industry Classification (NAICS) - Canada, Statistics Canada, 2007.

3.6.2.5 Conclusions and Recommendations Regarding the Environmental Condition of the Property

The following conclusions are based on research and investigations, a review of the documents obtained and observations made during the site visit.

- The study site was occupied by a sawmill and related facilities from 1956 to 1994. Before 1956, the site was occupied by a railway and mostly covered by forest vegetation.
- Companies that have operated a sawmill on the site are "*Scierie Gagnon & Frères*", “*Campeau Corporation*", "*Consolidated Bathurst*" and "*Stone Consolidated Corporation*”, respectively. In 2010, the *Ministère des Ressources Naturelles et de la Faune* acquired the property belonging to "*Abitibi-Consolidated Inc.*" acting on behalf of "*Stone-Consolidated Corporation*".
- During the time that the sawmill was operated by various companies, activities entailing environmental risk took place, primarily consisting of the operation of a vehicle and machinery maintenance garage and production and management of wood residues, solid waste and hazardous waste.
- Some activities performed during this period resulted in contamination of the soil and possibly the groundwater and surface water. Site rehabilitation took place in 1996 and 1997. There is insufficient data to determine the degree of contamination at the end of operations or the effectiveness of the decontamination work carried out after decommissioning.
- During the inspection conducted as part of this environmental assessment, the southern part of the site, which was historically occupied by the sawmill facilities, was vacant and unused. However, a small amount of solid waste (demolition waste) and wood residues can still be seen. This part of the site was revegetated. The central and northern parts of the site are still covered with forest vegetation on either side of the railroad right-of-way. There are no visible signs of contamination.
- The data obtained is considered insufficient for conclusions to be drawn on the environmental condition of the site. Consequently, a Phase 2 environmental audit of the site is recommended in the event that this site is selected for the construction of a rail transfer point.

Figure 3.4 Aerial Photographs of the Site: 1948 to 2003

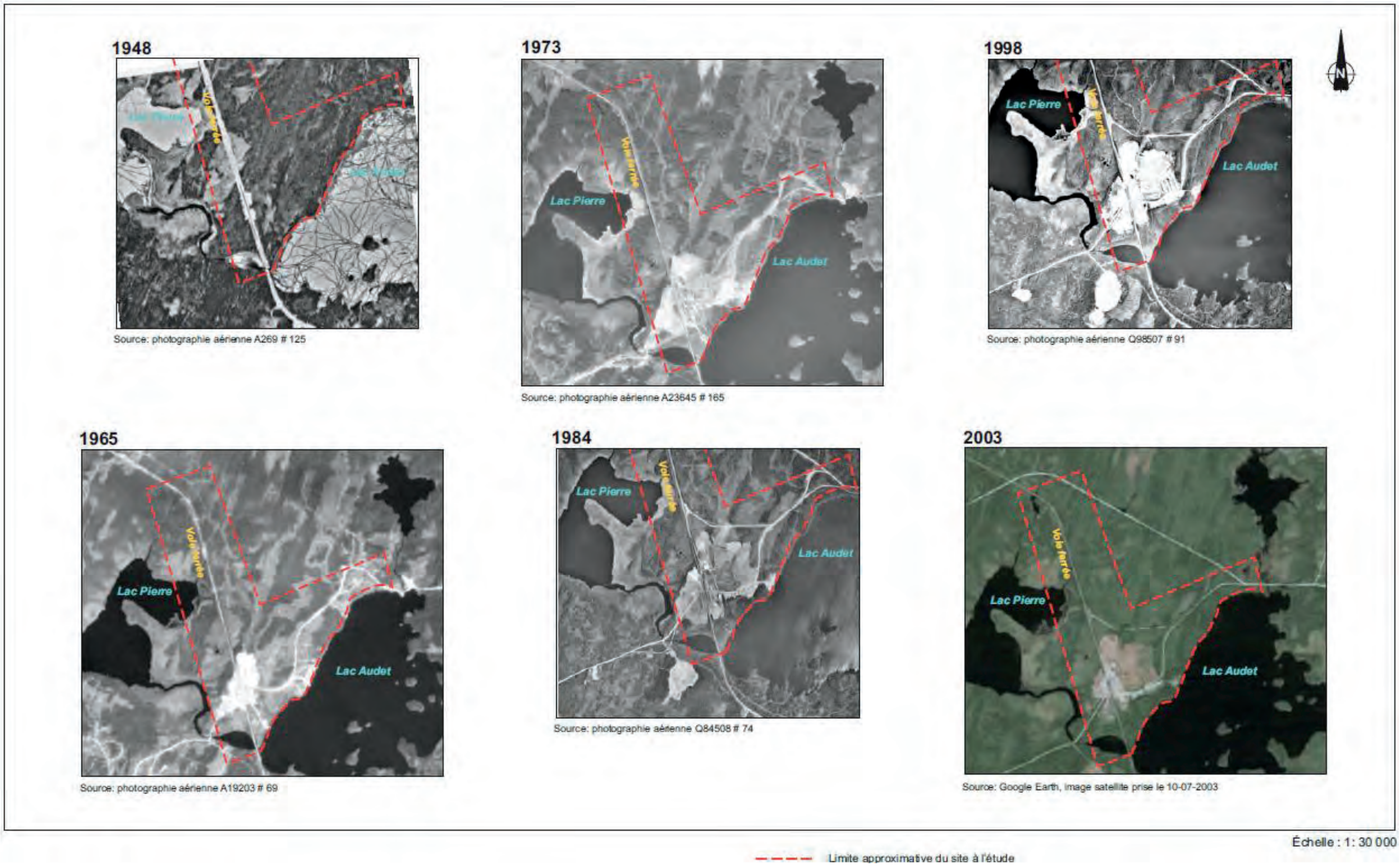


Figure 3.5 Photograph of the Study Site (looking northeast) in the 1970s

Source : Société historique de Chibougamau inc.
Année inconnue.

3.7 ACCESS ROAD

The road to the mine site branches off Route 167 about thirty kilometres south of the town of Chibougamau. The road is about 30 km long (see Figure 3.1). The technical characteristics of the access road are those of a logging road with a roadway 10 m wide, for a speed of 60 km/hour and road traffic signal standards that comply with the MRNF"s *Guide de signalisation routière sur les terres et dans les forêts du domaine de l'État* (2001).

The access road crosses the territories of the Municipality of James Bay and the town of Chibougamau, and has been divided into three sections to describe its technical characteristics and the features of the host environment (Appendix 3.1). In addition to the main route, various options have been considered to determine the optimal route. Most of the basic access road lies on gently sloping ground, on coarse deposits of glacial origin. In the area of Lac Denis, the ground consists of a thin glacial deposit and steep-sided rock outcrops. Borrow pits are scattered throughout the study area and can be used for road construction and repair (MRNF data, 2011; Entraco basic survey, March 2011).

3.7.1 Section 1: Logging Road 210

Section 1 of the mine site access road branches off Route 167 at Kilometre 200, west of Lac Pierre, and corresponds to logging road 210 (see Appendix 3.2: Photos 8A and 8B). It is 19 km or 21.9 km long, depending on whether it connects to Section 2 via the Lemoine road or Lac France. Section 1 includes a road about 1.8 km long that turns off road 210 north of Lac Audet and leads south to the rail transfer point.

The road has the required 10-m wide roadway and is in good condition. Aside from maintenance, occasional roadway repair work and the establishment of appropriate signage, no construction is planned on this part of the access road. The culverts are in good working order and allow for the free flow of water.

There are hunting camps near Lac André and Lac Guy (Philip Wapachee, tallyman, and Matthew Wapachee). At the level of Lac Stella and Lac Pillow, along road 210, about 17 km from Route 167, there are two spawning grounds in Ruisseau Wynne (MRNF, 2002 data, in Entraco, 2003); the 1.5-metre diameter culvert is in good working order.

Logging road 210 is public and is managed by the regional office of the MRNF (Public Lands), which issues construction and repair permits. The cost and responsibility of road repair and maintenance are shared with the users (MRNF integrated management plan scheduled for 2013). The road usage period must also be negotiated with the other users (including Chantiers Chibougamau Inc.).

3.7.2 Section 2: Lemoine Mine Road

There are two options for Section 2: the Lemoine Road option and the Lac France option. South of Lac Yvette, both options must skirt the old Lemoine mine facilities (restored tailings management facility, fenced-off old mine shaft) with standard curve radii before connecting to the third and final section.

Option 1: Lemoine Road

About 19 km from Route 167, as it enters the Chibougamau town limits, the access road turns off road 210 and follows the old Lemoine mine road northward for 6.4 km to Lac Yvette (see Appendix 3.2: Photos 9A and 9B). The existing road is winding and must be widened and repaired, but the terrain is easily accessible. The Lemoine road crosses three streams:

- 2.8 km along the Lemoine road, about 50 metres of roadway must be raised and a culvert (diameter to be defined) is required to allow excess water to flow out of a small pond (Appendix 3.2: Photo 10B);
- 3.8 km along the Lemoine road, the road crosses a narrow, low-flow stream that flows south to Lac Pillow;
- 4.6 km along the Lemoine road, about 50 metres of roadway must be raised and a culvert whose diameter remains to be calculated must be installed to manage a flood zone (Appendix 3.2: Photo 10C).

Option 2: Lac France Road (selected option)

The Lac France road turns off logging road 210 21.9 km from Route 167, 2.9 km farther along than Option 1 (Lemoine road). The Lac France section is 3.5 km long and must be built. It does not cross any streams (see Appendix 3.2: Photos 10A, 10B, 10C, 10D and 10E).

The terrain is smooth and higher than the surrounding wetlands, except along road 210, where the road crosses 100 metres of wetland. The Lac France road is straight and crosses a logged area, immature communities and areas of regeneration. There have been previous logging roads in this area, and a roadbed already exists.

The tailings and dismantled infrastructure of an old underground mine (Lemoine mine) lie south of Lac Yvette. The possible presence of near-surface drifts should be confirmed to ensure that the ground is geotechnically stable at the location of the access road corridor. The mineral rights in this sector are held by *Cogitore Resources*, based in Rouyn. According to the MRNF (communication April 24, 2011), the ground around the Lemoine mine is stable and can support the access road.

Comparison of Options 1 and 2

From an environmental perspective, the footprints and expected environmental effects of options 1 and 2 are equivalent; both options cross environments affected by past human activities (forestry and mining) and uses existing roads or old roadbeds that need to be repaired or rebuilt. No significant environmental effects are anticipated.

From a technical perspective, option 1 (Lemoine road) has four major curves before it reaches the third section of road (south of Lac Yvette). Option 2 (Lac France road) only has one, where it connects to road 210. Both routes must go around the old Lemoine mine site. On the other hand, the use of the Lac France route frees up the Lemoine road for other activities in the area.

For road safety and traffic flow reasons (straighter path), the Lac France road is the recommended option.

3.7.3 Section 3: Lac Denis Road

Section 3 also has two options: Lac Denis and Lac Bernadette.

Option 1: Lac Denis Road (selected option)

The Lac Denis road starts south of Lac Yvette and runs along its east side. The road extends about 4 km to the processing plant near Lac Denis (see Appendix 3.2: Photos 11A, 11B and 11C).

South of Lac Yvette, the stream that collects the water from the old Lemoine mine site flows into the lake through three 30-cm diameter culverts. From Lac Yvette, the route runs along the edge of the Domaine-du-Roy RCM, climbs gently and steadily and then redescends to the Lac Denis area, where the terrain is more rugged. The slopes here can have a gradient of up to 10%.

Approximately 0.8 km south of Lac Denis, the route branches off on the east side of Lac Denis toward the concentrator. This segment is 1.4 km long and must cross a small stream (1-2 m wide) that flows into Lac Denis. On the west side of Lac Denis, the road is also about 1.4 km long and leads to the site of the garage and warehouses.

Option 2: Lac Bernadette Road

The Lac Bernadette road lies in the extension of the Lemoine road (Section 2) and is 4.5 km long. It leads north from the west side of Lac Yvette to Lac Denis (see Appendix 3.2: Photos 1A and 11A).

Most of this road is in the Lac Bernadette subsystem. Before reaching Lac Denis, the route crosses three streams 2 to 5 metres wide. It crosses the southwestern part of the deposit that extends toward Lac Armitage (Phase 2).

The road passes over easily-accessible, gently-undulating terrain composed of glacial till; slope gradients are under 5% and borrow pits are available along the road corridor. Slopes in the Lac Denis area are steeper, and can reach up to 10% on the way to the concentrator. The Lac Bernadette road crosses an area of old logging sites and a moose winter habitat. The streams that it crosses are small and lined with organic deposits.

3.7.4 Description of Selected Acess Road Route

Thirty miles southeast of the town of Chibougamau, at Kilometre 200 km on Route 167, the access road turns onto logging road 210 and follows it for 21.9 km. It then turns toward the mine site along the Lac France road for 3.5 km and the Lac Denis road for a total distance of 29.4 km. With the additional 1.8 km from road 210 to the rail transfer point at Lac Audet, the access road is 31.2 km long in total. During the operation phase, the trucks transporting the concentrate will only travel between the concentrator and the rail transfer point, and will not use the section between Lac Audet and Route 167 (about 4 km). The concentrate transport trucks will therefore travel a total distance of 27.2 km.

3.7.5 Anticipated Impact on Each Section

Section 1: From Logging Road 210 to the Lac France Road:

- Logging road 210 will be intensely used by the concentrate transport trucks between the mine site and the rail transfer point; confirmed mining vocation in the area, usage conflict anticipated;
- Noise, dust and heavy traffic near the hunting camps at Lac André and Lac Guy;
- Road safety concerns raised by other users;
- Ruisseau Wynne spawning grounds to be protected.

Section 2: Lac France Road (old Lemoine mine area):

- Confirmed mining vocation in the area;
- Impact on the hunting and fishing area and on other potential uses (extensive tourism).

Section 3: Lac Denis Road:

- Confirmed mining vocation in the area;
- Impact on the hunting and fishing area and on other potential uses (extensive tourism, recreational activities).

3.8 WORKERS' CAMP

The workers" camp is designed to accommodate up to 500 people during the construction period. The camp covers an area of 215 m by 350 m, or 7.5 hectares. The selected site must be far enough away from the mine itself to ensure that workers can have downtime free of noise and dust while also ensuring their safety, which could be compromised by frequent back-and-forth trips by heavy trucks in the mining area. The grounds on which the camp is built must be large enough to provide for basic services like drinking water and septic systems.

Two options with about 16 ha of available land were assessed: the site at the edge of the Lemoine road and the site at the intersection of logging road 210 and the Lac France road. In both cases, the camp is located on recently cleared land within the Chibougamau town limits, but outside the claims held by BlackRock. The ground is poorly drained and features moraine whalebacks.

3.8.1 Option 1: Lemoine Road Site

This option sets the camp at the edge of Lemoine road, about 420 m from the junction with road 210 on a recently-cleared plot (see Appendix 3.2: Photo 9A). The relief is irregular and consists of moraine. A small stream, a tributary of Lac Stella (and Rivière Armitage), rises south of the camp site, and site levelling will encroach on a wetland.

The Lemoine road camp site is set back from road 210, which puts it some distance away from heavy traffic and the associated anticipated negative effects (noise, dust, road safety). The vehicles hired to transport workers can access the mine site by taking the Lemoine road northward to Lac Yvette, thus avoiding the 6 km of access road used by the semi-trailers. On the other hand, using the Lemoine road increases the environmental footprint and interferes to some degree with other potential uses of the road and the area.

3.8.2 Option 2: Logging Road 210 Site

The site on road 210 is about 3 km east of Option 1, at the junction of road 210 and the Lac France road that leads to the concentrator (see Appendix 3.2: Photos 10A and 12). The terrain is regular and has been cleared in recent years; it consists of moraine and is poorly drained. The surface is large enough to meet basic needs without encroaching on any sensitive environments. The site is 2 to 3 km closer than the other option, which is significant given that hundreds of workers must travel between the camp and the mine site on a daily basis.

Due to heavy truck traffic during construction, the main expected effects are noise, dust and public safety around the camp; however, these effects can be minimized or even eliminated by standard mitigation measures (such as noise-deflection berms and dust control).

Taking into account all the positive and negative points, Option 2, the logging road 210 site, is the recommended site for the camp.

The characteristics of the host environment affected by the mine infrastructure are summarized in Table 3.4. Tables 3.5 and 3.6 list the expected effects and key site selection criteria for the mining facilities.

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Table 3.4 Mine Infrastructure – Host Environment

MINE INFRASTRUCTURE	TOPOGRAPHY / SURFACE MATERIAL	HYDROGRAPHY	WILDLIFE AND VEGETATION	HUMAN ENVIRONMENT
PIT (112 hectares)	Elongated hill; rock and glacial till over rock; some shear zones	Lac Jean subsystem; crosses the emissary of lakes B-11 to B-14	Old logging area; several mature and immature communities	Town of Chibougamau (JBNQA-Category III land); Cree trap line O-59, encroaches on a moose winter habitat
PROCESSING PLANT AND CRUSHER (38 hectares) **GARAGE** (20 hectares)	Thin glacial till over rock and rock, 5% slope	Lac Jean subsystem; crosses Lac Denis effluent and affluent	Old logging area; several mature and immature communities, fish habitat	Town of Chibougamau (JBNQA-Category III land); Cree trap line O-59
TAILINGS POND AND POLISHING POND **Option 1, near the pit** (176 ha)	Depression surrounded by rocky hills; moraine and gravel, organic deposit; shear zones	Lac Jean subsystem; encroaches on lakes B-11, B-12, B-13 and B-14, and three creeks.	Old logging area; several mature and immature communities, peatlands; fish habitat	Town of Chibougamau (JBNQA-Category III land); Cree trap line O-59, moose hunting area
TAILINGS POND – **Option 2, Lac Armitage** (115 ha, variable)	Glacial till plain, organic deposit; shear zones	Rivière Armitage subsystem; affects two intermittent creeks, proximity to Lac Armitage	Old logging area; several mature and immature communities, peatlands at the edges of intermittent creeks; fish habitat	Town of Chibougamau (JBNQA-Category III land); Cree trap line O-59, moose hunting area; land prized by the tallyman
WASTE ROCK PILE (110 hectares)* **COARSE TAILINGS PILE** (109 hectares)*	Gentle slope; glacial till, organic deposit; shear zones	Lac Jean subsystem; encroaches on lakes B-3, B-6, B-7, B-8, B-9 and associated creeks.	Old logging area; several mature and immature communities	Town of Chibougamau (JBNQA-Category III land); Cree trap line O-59, moose hunting area
PROCESS WATER RESERVOIR **(Lac Denis)**	Rugged on east and south side of lake, glacial till	5 ha lake that will be raised with a dam	Fish habitat, immature communities.	Town of Chibougamau (JBNQA-Category III land); Cree trap line O-59, moose hunting area

Table 3.5 Mining Facilities – Key Site Selection Criteria

MINING INFRASTRUCTURE	ENVIRONMENT	SIGNIFICANT ANTICIPATED EFFECTS	SELECTION CRITERIA
PIT (Phase I) (112 hectares)	Hill; old logging area; mining exploration area; immature and mature community	Crosses the tributary of lakes B-6 and B-3 and Lac Jean; surface water quality; fish habitat	Footprint: open pit mine, no viable short- or mid-term alternative
PROCESSING PLANT AND CRUSHER (38 hectares) **GARAGE** (20 hectares)	Geotechnically competent ground; Lac Denis / Lac Jean catchment; old logging area; immature and mature community	Encroaches on a tributary and emissary of Lac Denis; surface water quality; fish habitat	Footprint: near Lac Denis Carrying capacity and sensitivity: adequate carrying capacity; lowest TPM and greenhouse gas emissions
TAILINGS POND AND POLISHING POND **Option 1 pit** (176 ha)	Depression surrounded by rock; Lac Jean catchment; old logging area; immature and mature community; lakes and streams	Surface water quality; loss of productive forestry land; impact on fish habitat and wetlands	Footprint: minimal Carrying capacity and sensitivity: adequate support, good capacity to contain tailings and process water; groundwater protection
TAILINGS POND – **Option 2 Lac Armitage** (115 ha, variable)	Glacial till plain; organic deposit; Rivière Armitage subsystem; old logging area; immature and mature community, peatland and stream; valued area for the tallyman	Surface water quality; negative visual aspect; loss of forestry land; loss of wildlife habitat; greater distance from the pit to the tailings facility; crosses four creeks, fish habitat	Footprint: max. footprint, 4 km from pit Carrying capacity and sensitivity: adequate support; sensitive environment (wildlife habitat); high TPM and greenhouse gas emissions
WASTE ROCK PILE (110 hectares)* **COARSE TAILINGS PILE** (109 hectares)*	Gentle slope; glacial till, organic deposit; Lac Jean catchment; old logging area; immature and mature community	Surface water quality; loss of forestry land; loss of fish habitat; loss of wetlands; diverted Lac Denis emissary; drop in Lac Jean water level	Footprint: minimal Carrying capacity and sensitivity: adequate geotechnical support; good capacity to contain tailings without risk of groundwater contamination
PROCESS WATER RESERVOIR **(Lac Denis)**	Logging and mining exploration area; extensive, seasonal hunting and fishing activity	Fish habitat, change in the lake level and flow rate at outlet	Footprint: minimal Impact social: avoid impact on Rivière Armitage Carrying capacity and sensitivity: adequate support, unproductive environment, compensation measure for fish

Table 3.6 Support Facilities – Key Site Selection Criteria

MINE INFRASTRUCTURE	ENVIRONMENT	SIGNIFICANT ANTICIPATED EFFECTS	SELECTION CRITERIA
ACCESS ROAD (27.2 km)	Till plain between Route 167 and Lac Yvette, till and till over rock in the Lac Denis area; logged area; Cree trap line O-59; Lac Audet and Lac Chevrier subsystem (Section 167 / Lac André); Villefagnan Lac Stella / Lac Denis subsystem)	New environmental footprint: construction of Lac France road. Extensive use of road 210 and the logging road for mining activities (confirmed mining vocation), usage conflict with safety	<u>Footprint</u>: road construction (3.5 ha) <u>Load-bearing capacity and sensitivity:</u> area of least impact, construction at site of old raod corridors, avoid aquatic environments
RAIL TRANSFER POINT (100 ha)	Surface adequate for reuse; regenerating plant community, plantings, alder; Lac Audet and Lac Chevrier subsystem	Loss of forestry land	<u>Footprint</u>: minimal footprint, a portion of the 100 ha of the property will not be used <u>Social impact</u>: revitalisation of the Chibougamau – Quebec City rail line <u>Carrying capacity and sensitivity</u>: adequate support, the 18 ha of wetlands will be spared, as well as most mature communities, old industrial site.
WORKERS' CAMP Option 1, Lemoine road (7.5 ha)	Recently cleared till plain; use of the Lemoine road; Rivière Armitage subsystem	Loss of productive forestry land; usage conflict, 3 ha of wetlands	<u>Footprint</u>: setting already cleared by logging <u>Carrying capacity and sensitivity</u>: adequate support <u>Concern</u>: streams affected
WORKERS' CAMP Option 2, Road 210 (7.5 ha)	Recently cleared till plain; farther from Rivière Armitage than Option 1	Short-term loss of forestry land; usage conflict on road 210, wetland	<u>Footprint</u>: setting already cleared <u>Carrying capacity and sensitivity</u>: adequate support, adequate quantity of groundwater for drinking water supply. Absence of sensitive environment for wastewater discharge.

REFERENCES

Breton, Banville et Associés (BBA), July 2011. BlackRock Project Feasibility Study NI 43-101 Technical Report. In cooperation with SGS, ENTRACO and Journeaux Associés, 311 p. plus appendices.

Entraco, April 2011. Recherches en eau souterraine, projet minier BlackRock.

Entraco, March 2011. Inventaire de base.

Entraco, June 2003. Exploitation du dépôt de vanadium du Lac Doré et d'un complexe métallurgique, région de Chibougamau – Étude d'impact environnemental. Volumes 1 and 2.

Environment Canada, May 2011. Guidelines for the Assessment of Alternatives for Mine Waste Disposal. Mining and Processing Division, 46 p. and Appendices.

Environment Canada, December 2009. Guidance for the Reporting of Tailings and Waste Rock to the National Pollutant Release Inventory.

Hydro-Québec, March 2000. Étude préliminaire - Alimentation d'un site minier au Lac-aux-Dorés

Québec, Ministère de l'Environnement, du Développement durable, de l'Environnement et des Parcs (MDDEP), December 2010. Directives pour le projet minier BlackRock par Métaux BlackRock Inc. Numéro de référence 3214-14-50, 19 p.

Québec, Ministère du Développement durable, de l'Environnement et des Parcs (MDDEP), Direction des évaluations environnementales, September 2010. Directive pour la réalisation d'une étude d'impact sur l'environnement d'un projet minier.

Québec, Ministère de l'Environnement, du Développement durable, de l'Environnement et des Parcs (MDDEP), avril 2005. Directive 019 sur l'industrie minière. Direction des politiques de l'eau, services des eaux industrielles, 66 pages plus appendices.

Québec, Ministère des Ressources naturelles, MRN 2001. Guide de signalisation routière sur les terres et dans les forêts du domaine de l'État.

Québec, Ministère des Ressources naturelles et de la Faune, 2007. Géologie de la région de Chibougamau. SIGÉOM

Québec, Ministère des Ressources naturelles et de la Faune, June 2010. Mining Information Bulletin, There's an Iron Rush On!

Québec, Ministère des Ressouces naturelles et de la Faune, February 1, 2011. AFMP 2011-2012 FMU 26-64, B01, CCL. 1:65,000-scale map showing environmental features and logging block.

4. PROJECT DESCRIPTION

4.1 OVERVIEW OF THE ORE AND THE MINE

The Lac Doré Complex that hosts the deposit extends northeast to southwest over a distance of 24 km, 17 km of which belongs to BlackRock (BBA, July 2011). The mineralized zone is a vanadium-titanium-rich magnetite-ilmenite formation alternating with layers of anorthosite. The Lake Doré Complex is located at the eastern edge of the Superior tectonic province, at the contact with the Grenville geological province.

The rock layers are 100 to 300 m thick and dip southeast at about 75^o. BlackRock intends to produce an iron ore concentrate containing vanadium and titanium. To do this, the ore is crushed, ground and concentrated at the mine site by magnetic separation and flotation to increase the grade of the concentrate.

The concentrate is then trucked to a rail transfer point and loaded into rail cars that can hold about 100 tonnes. These cars will be taken to port facilities in Quebec City or Grande-Anse on the Saguenay River. The concentrate will be shipped to its final destination, mainly in China, by 70,000 to 120,000-tonne bulk carriers. The Panama Canal is currently being improved to allow 120,000 to 150,000-tonne ships to go through the canal as of 2014. This new capability will have a significant impact on transport costs to Asia.

The Southwest Zone deposit will be mined from 2013 to 2028. This zone is a bed of rock 300 to 400 m wide and about 2.8 km long covering an area of 112 hectares. The pit could be up to 250 m deep. The target zone contains 152.2 Mt of reserves. The Armitage Zone, which lies a little farther south, could in mined in the longer term, thereby extending the mine life by six years, and the Lac Doré Complex may contain a number of other minable zones as well.

The facilities used for mining, mineral processing and tailings disposal are within the boundaries of the claims held by BlackRock (see Figure 4.1). The land for the rail transfer point (see Figure 4.2), from which the concentrate would be shipped by railway, is currently owned by the MRNF. The production and tailings disposal facilities are at the head of the James Bay watershed (Ruisseau Villefagnan subsystem) and within the Chibougamau town limits. The mine facilities are grouped around the deposit to be mined, and cover an area of about 5 km^2 (see Table 4.1).

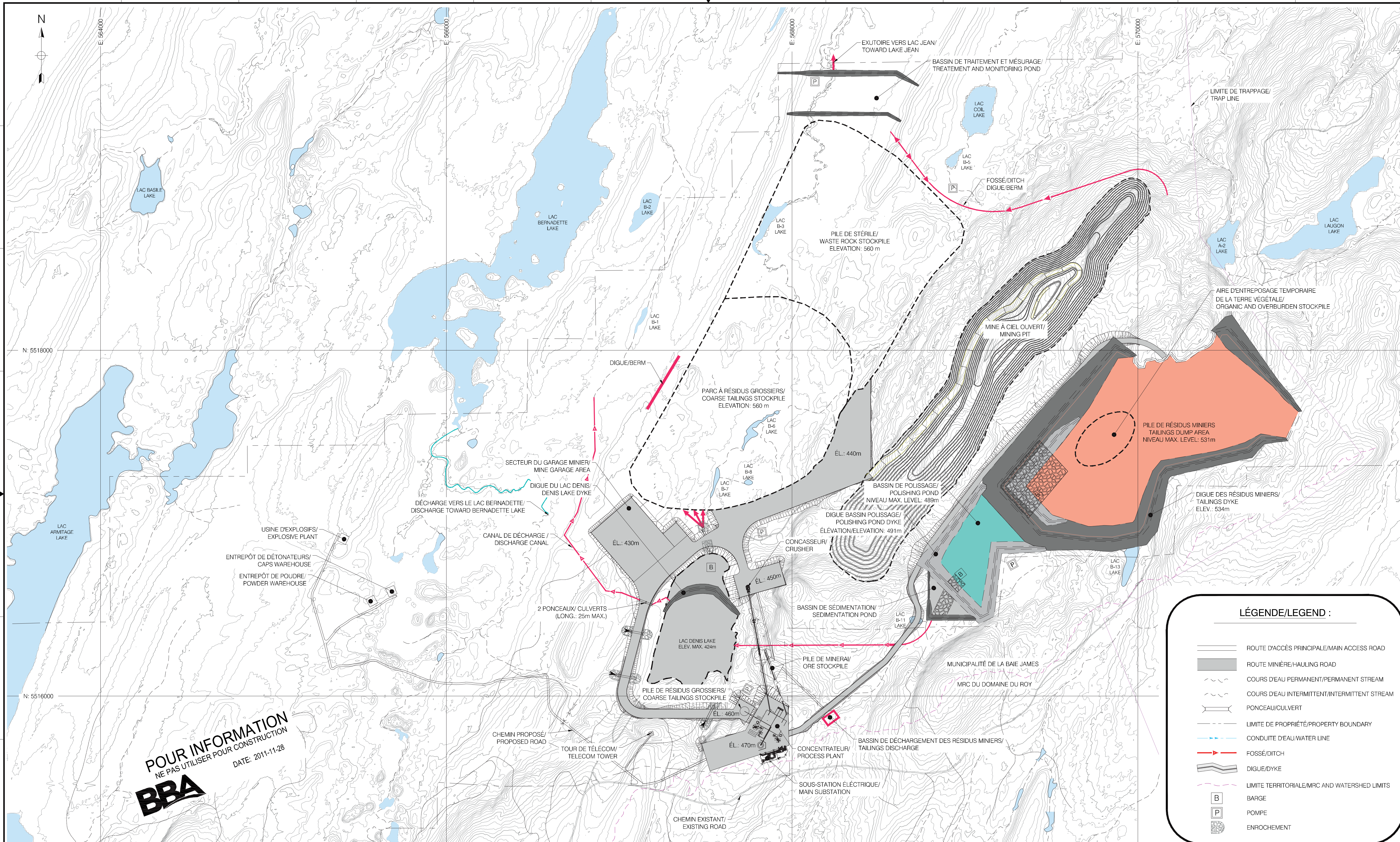
The rail transfer point is also in the James Bay watershed, in the Municipality of James Bay. It is adjacent to the CN rail line and covers an area of approximately 1 km^2.

Table 4.1 Footprint of the Mine Facilities

FACILITY	AREA (approximate)	COMMENTS
Pit	112 hectares	Southwest Zone (Phase 1) between Lac Laugon and Lac Denis
Processing Plant	3 hectares	Southwest of Lac Denis, includes the main substation and the concentrator
Crusher	1 hectare	Northeast of Lac Denis
Ore stockpile	1 hectare	Beside the processing plant
Coarse tailings pile at the processing plant	1 hectare	Temporary storage before transfer to the coarse tailings pile
Conveyors	5.6 hectares	Between the crusher, the concentrator and the concentrate stockpile
Garage	10 hectares	Northwest of Lac Denis
Fine tailings pond and polishing pond	175.8 hectares	Southeast side of the pit
Waste rock pile	109.7 hectares	Northwest side of the pit
Coarse tailings pile	109.1 hectares	South of Lac Jean
Organic and overburden stockpile	27 hectares[1]	In the northern part of the fine tailings pond
Explosives magazine	1 plant and 2 magazines = 5 hectares	At the southwest edge of the installations; Lac Bernadette catchment
Haulage roads	3,000 m long x 30 m wide = 9.0 hectares	Road connecting the pit to the facilities (crusher, stockpiles, garage)
Rail transfer point and 1.5-km section of the Lac Audet road	100 hectares	Area partially developed and used
Telecommunications tower	0.06 hectare	Concentrator area to the east of the polishing pond
Workers' camp	7.5 hectares	Intersection road 210 - Lac France road
Access road (Lac France road)	3.5 hectares	To be built between road 210 and Lac Yvette
TOTAL	653.26 hectares	

The mine site roads used to haul the ore from the pit to the processing plant and for transport to the waste rock piles are 30 m wide and approximately 3 km long in total. The road into the pit is not included as it is part of the open pit area (112 ha).

[1] This area is within the fine tailings pond area.



NOTE :

LES NOMS DES LACS PROVIENNENT DU RAPPORT D'ENTRACO, AVRIL 2011/ SMALLER LAKE IDENTIFICATIONS WITHIN THE CLAIMS LIMITS REFERS TO ENTRACO'S REPORT, APRIL 2011

REV	DESCRIPTION	VERIFIED BY	APPROVED BY	DATE
AH	POUR INFORMATION/FOR INFORMATION	L. CHARRON, eng. OIQ No. 103088	A. ALLAIRE, eng. OIQ No. 38480	2011-11-28
AG	POUR INFORMATION/FOR INFORMATION	L. CHARRON, eng. OIQ No. 103088	A. ALLAIRE, eng. OIQ No. 38480	2011-11-09
AF	POUR COMMENTAIRES/FOR COMMENTS	L. CHARRON, ing. OIQ No. 103088	A. ALLAIRE, ing. OIQ No 38480	2011-09-29
AE	POUR COMMENTAIRES/FOR COMMENTS	L. CHARRON, ing. OIQ No. 103088	A. ALLAIRE, ing. OIQ No 38480	2011-09-22
AD	FOR INFORMATION	L. CHARRON, eng. OIQ No. 103088	A. ALLAIRE, eng. OIQ No 38480	2011-08-04
AC	FOR INFORMATION	L. CHARRON, eng. OIQ No. 103088	A. ALLAIRE, eng. OIQ No 38480	2011-06-13
AB	FOR INFORMATION	L. CHARRON, eng. OIQ No. 103088	A. ALLAIRE, eng. OIQ No 38480	2011-05-18
AA	FOR INFORMATION	L. CHARRON, eng. OIQ No. 103088	A. ALLAIRE, eng. OIQ No 38480	2011-05-06

REVISIONS

DRAWING No.	DESCRIPTION

REFERENCE DRAWINGS

SEAL:

BBA

CLIENT: MÉTAUX BLACKROCK / BLACKROCK METALS

PROJECT: BLACKROCK

TITLE: INFRASTRUCTURES SITE PREPARATION ENVIRONMENTAL SITE PLAN PLAN VIEW

DESIGNED BY: L. CHARRON, eng. OIQ No 103088
DRAFTED BY: R. PANAZAN
VERIFIED BY: L. CHARRON, eng. OIQ No 103088
APPROVED BY: A. ALLAIRE, eng. OIQ No 38480
SCALE: 1:10000
DATE: 2011-05-06
DRAWING No.: 3017003-001000-41-D09-0001
SHEET:
SIZE: A1
REV.: AH

BY: PANAZAN, RENÉ PRINTED: 2011-11-28 14:29:31

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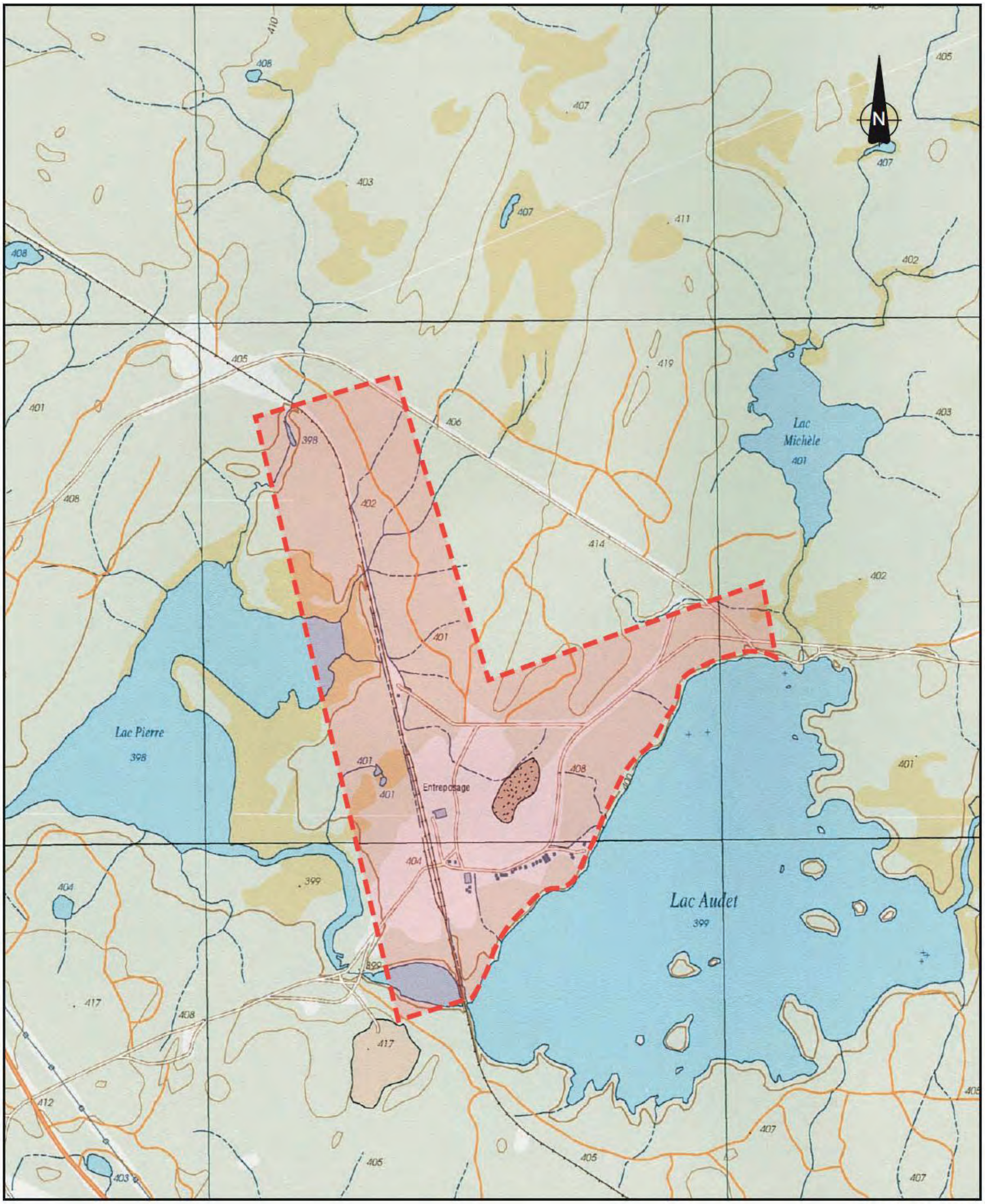
Figure 4.2 Rail Transfer Point



Échelle: 1: 20 000

Limite approximative de la propriété à l'étude

Source : Ressources naturelles et Faune, Québec
Carte topographique 32G09-200-0201,
Lac Chevrier, 2003.

The mine site layout proposed by BlackRock Inc. aims to minimize the project footprint, greenhouse gas emissions and costs associated with ore transport. In addition, the separate access and haulage road routes and the layout of the buildings and tailings management facilities improve the safety of personnel working at the various mining activities.

From a geochemical perspective, it should be noted that the vanadium is closely related to the structure of the magnetite. Titanium is in turn mainly associated with the ilmenite. Because ilmenite is only very slightly magnetic, a significant portion of the titanium is not recovered. BlackRock Inc. is currently doing tests on isolating the ilmenite in the tailings and extracting the titanium. This is, however, a long-term project whose economic feasibility will not be known for several years yet. It is therefore important to be able to reclaim the coarse tailings in the event that the technical and economic studies are positive.

The Southwest Zone deposit contains proven reserves estimated at 152.2 million tonnes of ore grading an average of 29.1% iron. BlackRock plans to produce 2.5 Mt of concentrate per year with an iron content of 62-65%. At this rate, 30,441 tonnes of ore would be processed daily to produce 7,610 tonnes of concentrate. The concentrator is expected to run 24 hours a day, 365 days per year with a 90% availability. Average production would therefore be 6,849 tonnes per day of concentrate from 27,397 tonnes of ore.

The estimated proven reserves would yield 38.4 Mt of concentrate, for a mine life of 15 years. The mining of the 152.2 Mt of ore will also result in the production of 271.6 Mt of waste and overburden and 113.8 Mt of tailings.

4.2 MINING AND PROCESSING

Mining takes place in an open pit and includes drilling, blasting, loading and transport to a primary crusher and then to a concentrator for processing into iron ore concentrate.

4.2.1 Pit

Pit optimization and design was performed using *MineSight* mining software. This software takes into account economic, geotechnical and operational factors (bench and ramp width, height and angles, safety constraints, etc.). These factors are processed using algorithms in order to optimize operating costs and revenues from previously-defined mining blocks within the pit. Plan and 3-D views of the final pit design are shown in Figures 4.3 and 4.4.

It was also established that the haulage roads inside the pit should be 34 metres wide to allow the 220-tonne haulage trucks to pass each other safely. The haulage roads have a maximum gradient of 10%. Trucks will exit the pit via the southwest to facilitate access to the processing facilities and the coarse tailings and waste rock piles.

Table 4.2 below shows the forecast mining schedule for the entire project life. These forecasts take into account an initial six to nine months of overburden stripping, followed by 15 years of mining.

Overall, 152,165 Kt of ore will be mined from the pit to produce 38,335 Kt of concentrate. During the same period, 264,219 Kt of tailings will be generated and 7,249 Kt of overburden will be stockpiled. In total, 423,633 Kt of material will be excavated from the pit site.

Table 4.2 Annual Mining Forecasts

Period	Ore mined	Ore processed	Waste material			Total mine (Kt)	Stripping ratio	% recovery	Total concentrate
			Rock	Over-burden	Total				
PP	1,089	-	5,078	1,597	6,675	7,764	6.13	20.24	-
Year 1	10,089	10,098	8,037	1,307	9,344	19,442	0.93	24.76	2,500
Year 2	9,906	9,906	14,258	569	14,827	24,733	1.50	25.24	2,500
Year 3	10,139	10,139	18,664	1,521	20,165	30,304	1.99	24.66	2,500
Year 4	9,985	9,985	22,206	481	22,686	32,672	2.27	25.04	2,500
Year 5	10,327	10,327	24,690	286	24,977	35,304	2.42	24.21	2,500
Year 6	10,172	10,172	24,693	559	25,252	35,424	2.48	24.58	2,500
Year 7	10,413	10,413	24,059	76	24,134	34,548	2.32	24.01	2,500
Year 8	10,147	10,147	23,084	570	23,654	33,801	2.33	24.64	2,500
Year 9	9,639	9,639	21,618	283	21,901	31,540	2.27	25.94	2,500
Year 10	9,812	9,812	20,087	-	20,087	29,899	2.05	25.48	2,500
Year 11	9,347	9,347	17,070	-	17,070	26,417	1.83	26.75	2,500
Year 12	9,977	9,977	16,367	-	16,367	26,344	1.64	25.06	2,500
Year 13	9,315	9,315	13,711	-	13,711	23,026	1.47	26.84	2,500
Year 14	9,729	9,729	7,904	-	7,904	17,633	0.81	25.70	2,500
Year 15	9,759	9,759	2,507	-	2,507	12,266	0.26	25.62	2,500
Year 16	2,310	3,399	206	-	206	2,516	0.09	24.56	835
Total	**152,165**	**152,165**	**264,219**	**7,249**	**271,467**	**423,632**	**1.78**	**25.19**	**38,335**

(Source BBA, Feasibility study report, Volume 1: Report, August 5, 2011)

Figure 4.3 Final Southwest Pit Design

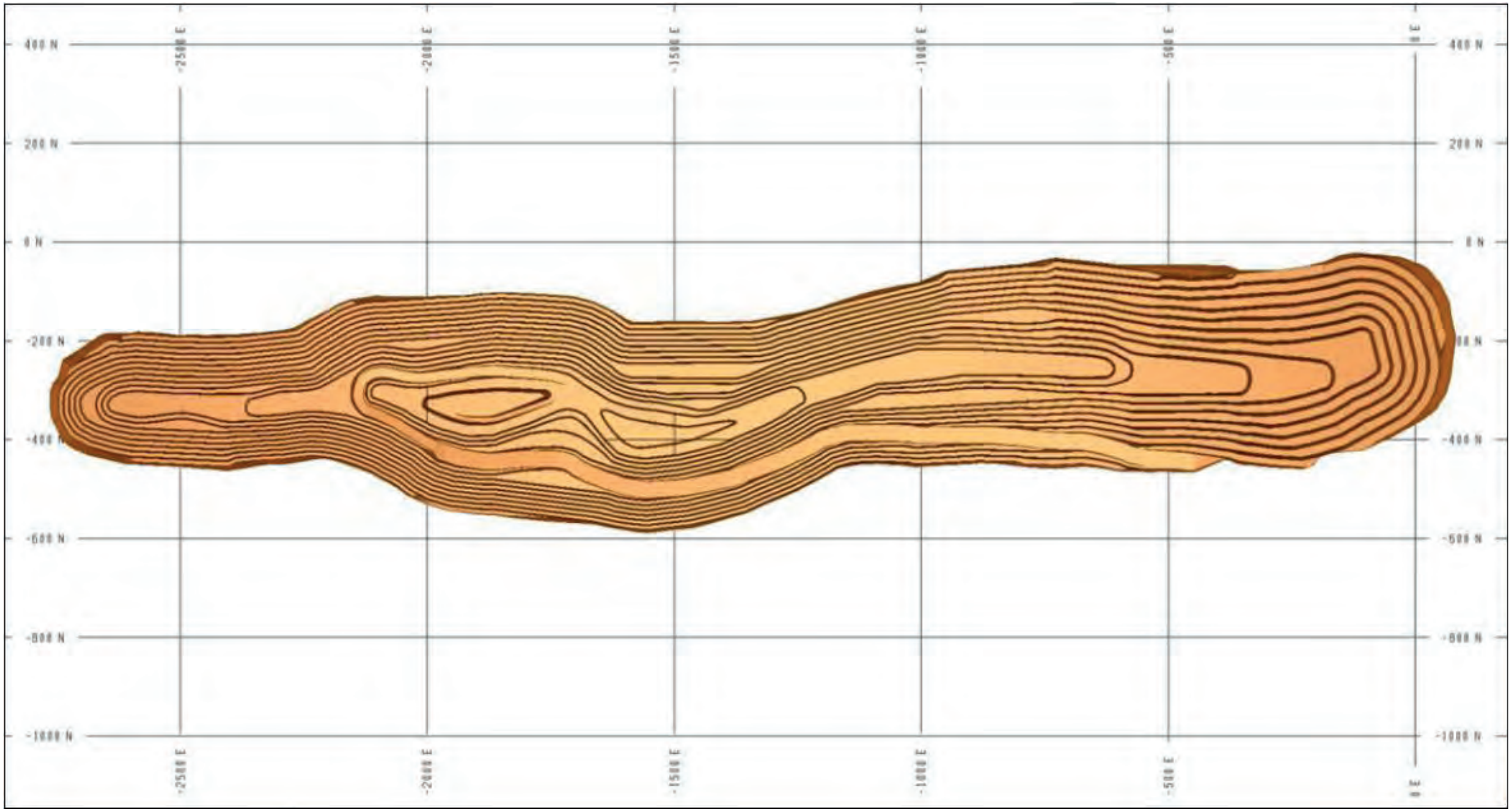


Figure 4.4 Final 3D Southwest Pit Design

4.2.2 Drilling and Blasting

Drilling will be done by *Atlas-Copco PV 351*-type electric drills. Holes drilled in the mineralized zones will be 311 mm in diameter, 11.5 metres deep and 8 metres apart.

Holes drilled in the waste zones will have the same diameter and the same depth, but will be spaced at 7.5 metres. The two drilling patterns produce better fragmentation of the ore and facilitate visual selection of the two rock types.

From the second year until the end of operations, two drills will be permanently assigned to blast preparation. The drill crews will relieve each other every twelve hours.

Blasting will be done by BlackRock or a subcontractor. Emulsion-type explosives with an average density of 1.20 g/cm^3 will be used. Based on the above-mentioned drilling patterns, 0.28 kg and 0.32 kg of explosives will be used per tonne of ore and waste, respectively. The holes are loaded with emulsion over a length of 7.0 metres, meaning that 638 kg of emulsion will be required per hole. Explosives are mixed on site, and the raw materials are stored in specially-designed buildings located at the southwest end of the mining area.

Emulsion explosives have an advantage over the typical dry mixtures of ammonium nitrate and slurry. Emulsions have very good water resistance and produce 2% less residual ammonia than ANFO (ammonium nitrate / fuel oil). Emulsions also have a detonation velocity that rises rapidly from a critical diameter to the thermohydrodynamic value; this is because the mixture is higher quality. This type of explosive not only performs better, it is also easier and safer to handle than other explosives.

The emulsion selected is Dyno Nobel"s *TITAN XL 1000*, which is designed specifically for quarries and open pit mining. *TITAN XL 1000* is delivered in the form of a blasting agent and is formulated to be sensitized during the hole loading process. The process used to make *TITAN XL 1000* enhances water resistance and detonation performance, while improving loading characteristics. This feature thus results in less waste. In addition, its use produces some 2% less residual ammonia. NONEL or electronic high-precision detonators or electronic type will be used to optimize rock fragmentation.

4.2.3 Loading and Hauling of Ore, Waste and Overburden

The ore and waste are loaded by two 25-m^3 hydraulic crawler excavators (*KOMATSU PC-5500*-type) and a 24-m^3 hydraulic wheel loader (*Letourneau L-1850*-type). Ten 220-tonne trucks (*KOMASTU 830E-1AC*-type) will haul the overburden, ore and waste rock out of the pit. As a guideline, 5-6 bucketfulls are needed to load the overburden into the trucks, 3-4 for the ore and 4-5 for the waste rock. In each case, the loading operation takes approximately 3 minutes. The ore haulage cycle time (pit-concentrator-pit) ranges from 10 to 25 minutes, depending on the depth of the pit. The same return-trip cycle time ranges from 16 to 23 minutes for the waste rock and 22 to 36 minutes for the overburden.

4.2.4 Mineral Processing

Mineral processing is almost exclusively physical with the exception of the flotation stage, which uses organic chemicals. In chronological order, the steps are: primary crushing, grinding, screening, magnetic separation, flotation and concentrate dewatering. Figures 4.5 and 4.6 show the process flow diagrams. The various steps are described below.

4.2.4.1 Primary Crushing

The 220-tonne haulage trucks feed a gyratory crusher with a rated capacity of 4,000 t/hour. The ore is dumped into the hopper adjacent to the crusher, and is processed as and when the trucks arrive. The 0-20 cm crushed ore is fed onto a variable speed conveyor that feeds the concentrator at a steady rate. The first conveyor is approximate 240 metres long. The conveyor unloads the ore at a transfer tower, where it is cleared of any scrap metal. A second variable speed conveyor about 450 metres long then carries the ore to the ore stockpile. This dome-covered stockpile has a storage capacity equivalent to 12 hours of concentrator production. A third, same-type conveyor approximately 300 metres long reclaims the ore from the stockpile to feed the semi-autogenous grinding (SAG) mill in the concentrator. Grinding is carried out in aqueous media.

4.2.4.2 Grinding

The SAG ball mill is the first processing equipment in the plant. It substantially reduces the size of the ore, which decreases from a size range of 0-20 cm to ±1,000 μm. The ore that does not reach the desired size (±1,000 μm) is returned to the SAG mill by a belt conveyor system. The SAG mill is 36 feet in diameter (10.9 m) and 20 feet (6 m) long. The ore pulvarized to 1,000 μm is fed to a magnetic separator. The SAG mill has a power rating of 15,000 kW.

4.2.4.3 Magnetic Separation

Magnetic separation takes place in an aqueous medium at a density of 40% (solids/water). The slurry containing the ground ore feeds a primary stage of magnetic separation (cobbing). This magnetic concentrate (±1,000 μm) is pumped to a set of cyclones and a ball mill to undergo a second stage of attrition (±75 μm). The fines are fed directly to a second magnetic separation stage. The magnetic particles that have not reached the desired particle size (±75 μm) are returned to the ball mill. In the second magnetic separation stage, the magnetic separators do cleaning and re-cleaning. The D_{80} 1,065 μm non-magnetic tailings are dewatered (density 80% solids) and trucked to the coarse tailings pile, and the ±75 μm non-magnetic tailings are pumped to the fine tailings pond. The concentrate is sent to a subsequent flotation stage that reduces its sulpher content.

4.2.4.4 Flotation

The concentrate from the second magnetic separator (±75 μm) has a sulpher content of up to 0.2%. It is fed into a flotation circuit consisting of cells connected in parallel to reduce the sulpher concentration to under 0.05%.

Two organic products are used for this purpose. The first is a collector with an affinity for pyrrhotite. The second is a frother whose function is to capture the collector and pyrrhotite in the bubbles rising to surface. The collector is supplied in powder form. It is mixed in a screw feeder with clean water to achieve a 15% concentration, and is then added to the flotation cells. The frother is delivered by truck in liquid form and added to the flotation columns; no additional handling is required. The magnetite is separated from the pyrrhotite during this process, and the latter is then sent to the fine tailings pond. The magnetite is dewatered and sent to the final stage of processing. The characteristics of the aforementioned chemicals are described in detail in Chapter 11.

4.2.4.5 Concentrate Dewatering and Heating

The magnetite concentrate slurry (65.75% by weight) is pumped to filters that reduce the water content to 8% by weight. The concentrate cake is steamed to bring its moisture from 5.5 to 6.9% and raise its temperature to ±70ºC. Finally, the concentrate is transported by conveyor belts to the concentrate stockpile before being trucked to the rail transfer point.

Figure 4.5 Process Flow Diagram - Crushing (BBA, August 5, 2011)

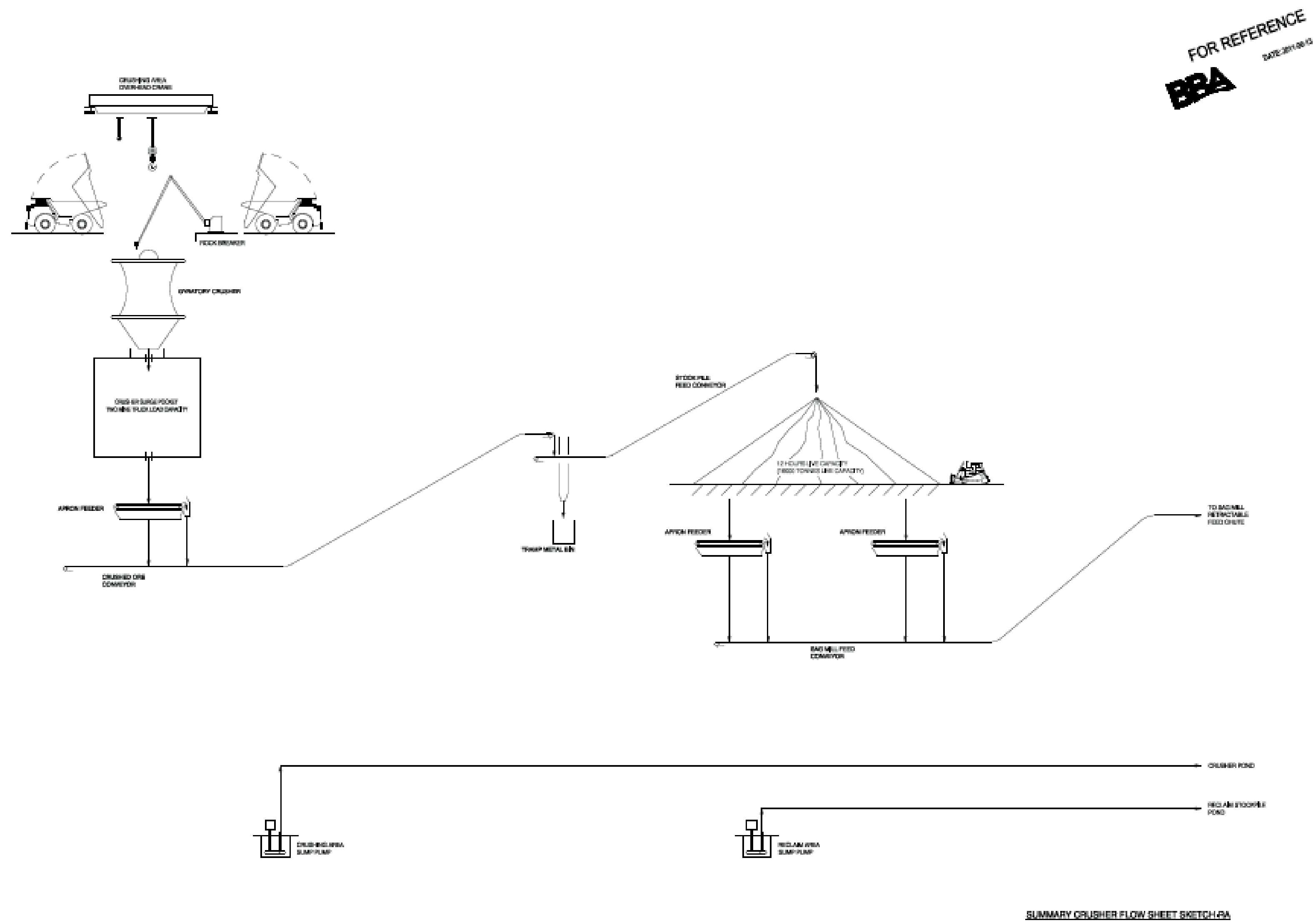
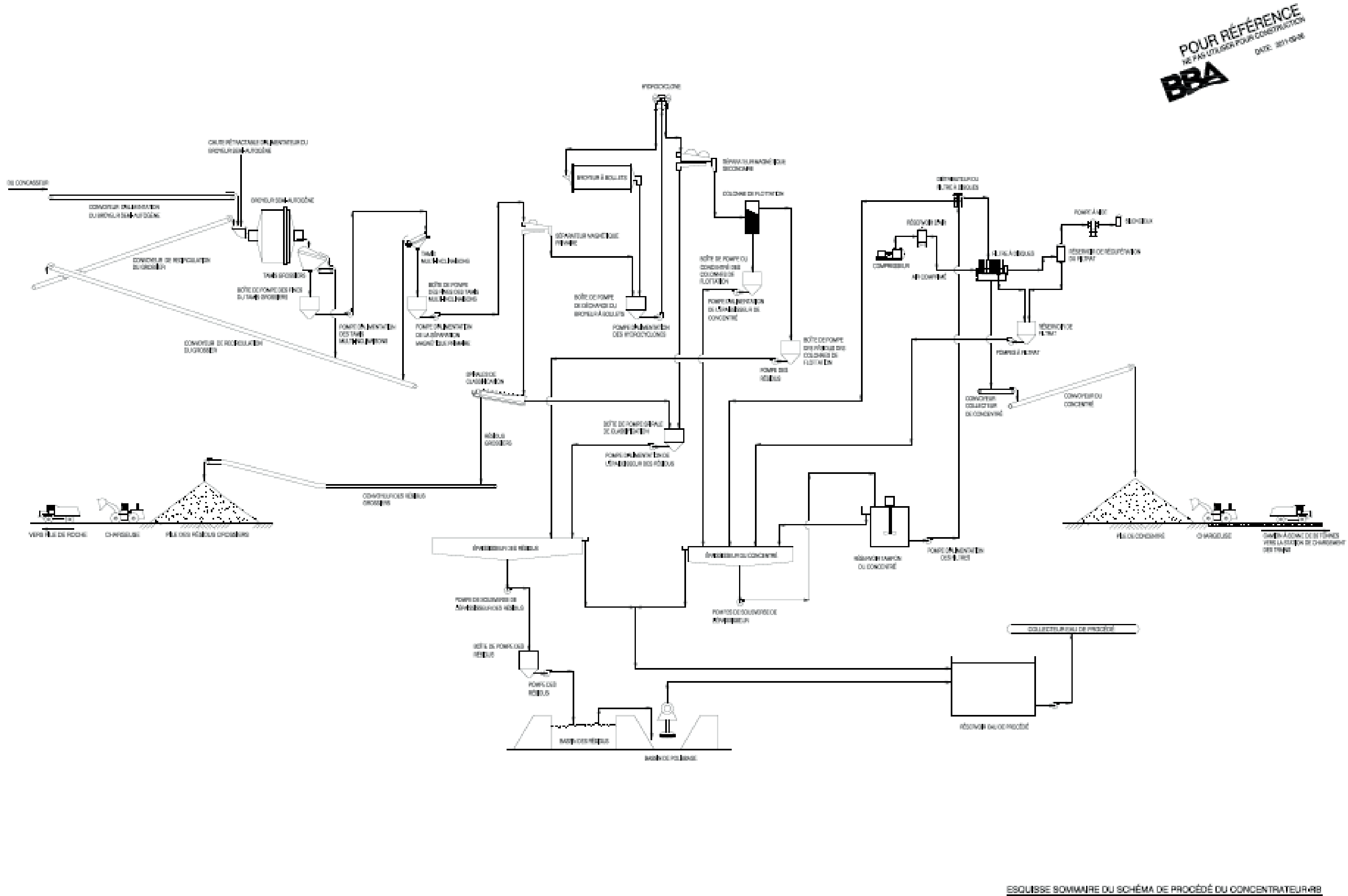


Figure 4.6 Process Flow Diagram – Mineral Processing (BBA, August 5, 2011)



4.3 CONCENTRATE TRANSPORT TO THE RAIL TRANSFER POINT

The ready-to-ship concentrate is stockpiled just southwest of the concentrator. This stockpile is protected by a building for environmental reasons and to keep temperature and humidity at acceptable levels. Wheel loaders load the semi-trailers on an ongoing basis as the concentrate exits the concentrator.

The trip to the rail transfer point takes about 30 minutes on a 27.2-km road. Upon arrival at the railway, the material is stockpiled in one of the two heated domes. In cold weather, propane gas will be used to keep temperatures between 12 and 15ºC. A locomotive brings the cars into the domes for loading. Each 38x100-metre dome can hold 50 cars. Once loaded, the cars are pushed into a 12-metre wide by 540-metre long extension to the dome, where they are kept warm until the train is fully loaded. The thermal inertia of the mass (±100 tonnes/car) will prevent the ore from freezing during transport to the port. At its widest point, the dome is 16 metres high. Its top is fitted with ventilation hatches on which a CO_2 detector is installed. When the CO_2 level reaches a given threshold, the hatches opened to keep air quality within the acceptable limits. Each car can carry a maximum load of 102 tonnes. Seventy-two cars are required to transport the 7,200 tonnes of concentrate per day. Once all the cars are loaded and covered, the train is assembled for the daily trip to the Saguenay or Quebec City port.

4.4 TAILINGS MANAGEMENT

Magnetic separation, which is at the heart of the hydrometallurgical process, involves the rejection of all non-magnetic material, and later of the pyrrhotite, which has a magnetic susceptibility close to that of magnetite. Initially, non-magnetic tailings from the first stage of magnetic separation are split using a spiral classifier and the water is removed. The coarse tailings produced (80% solids) are between 150 and 1,500 µm, with 80% larger than or equal to 1,065 µm. These coarse tailings are picked up by a conveyor belt and sent to the temporary coarse tailings stockpile near the concentrator. This stockpile has a storage capacity equivalent to twelve hours of production. Wheel loaders fill 60 to 220-t haulage trucks (size TBD), which carry the tailings to the coarse tailings pile.

The fine tailings (<150 µm) from primary magnetic separation, previously isolated by the spiral classifier, join the tailings (±75 µm) from the second stage of magnetic separation. These two fine fractions are sent to a thickener and pumped to the fine tailings pond. When they enter the pond, the fine tailings have a density of 45% (solids). Once the fine particles settle in the pond, the water is pumped to the polishing pond. Retention time of the water in the polishing pond is 30 days. This allows for the settling of finer particles, including the silicates present as chlorites. On leaving the polishing pond, water is transferred to a final settling tank or may eventually be treated to meet the discharge criteria for suspended solids. From that point on, the water is recirculated to the concentrator and excess water is transferred to Lac Denis.

Coarse Tailings

Coarse tailing production amounts to 14,115 tonnes of solids per day. At final deposition, the moisture content is 20%. The coarse tailings have a D_{80} of 1,065 µm. Pilot test results indicate that the coarse tailings have the following chemical composition, in percentages:

Fe_T	SiO_2	Al_2O_3	Fe_2O_3*	MgO	CaO	Na_2O	K_2O	TiO_2
17.7	34.5	16.20	25.3	4.65	8.68	1.68	0.24	6.0
MnO	**P_2O_5**	**Cr_2O_3**	**V_2O_5**	**ZrO_2**	**ZnO**	**CO_2**	**S**	**LOI**
0.26	0.02	0.02	0.16	0.02	0.03	0.99	0.240	3.27

Fine Tailings

The fine tailings contain about 45% solids when they are discharged into the pond. The flow is 6,856 tonnes per day. The fine tailings have a D_{80} of 75 µm. The results of pilot tests indicate that fine tailings have the following chemical composition:

Fe_T	SiO_2	Al_2O_3	Fe_2O_3*	MgO	CaO	Na_2O	K_2O	TiO_2
21.1	29.2	14.9	30.2	4.85	6.96	1.19	0.19	9.8
MnO	**P_2O_5**	**Cr_2O_3**	**V_2O_5**	**ZrO_2**	**ZnO**	**CO_2**	**S**	**LOI**
0.32	0.02	0.04	0.20	0.02	0.04	0.78	0.21	2.98

The various mining wastes are stored in specially-designed areas in accordance with their granulometric and geochemical properties. Three separate waste disposal sites are therefore planned.

4.4.1 Waste Rock Pile

The deposit host rock excavated is sent to the waste rock pile, which is located northwest of the pit, in an area where the surficial materials consist of moraine. The pile covers an area of 109.7 hectares. The design criteria for the waste rock pile are:

- bench height: 10 metres;
- bench slope angle: 34º;
- inter-ramp angle: 22º;
- maximum pile height: 150 metres;
- compaction factor: 30%;
- angle of the haulage ramp between the benches: 10%;
- width of the ramp between the benches: 34 metres.

These are typical parameters for this type of waste rock. Historically, multiple design criteria have been used for bench slope angles, which are often steeper than planned here. The stability parameters of the waste rock pile are therefore conservative.

The waste rock is trucked to the waste rock pile as it is excavated from the Southwest pit. Once the material has been dumped, track bulldozers will arrange the material to meet the design criteria. A total of 264.3 Mt of waste rock are expected to be dumped at the waste rock pile over the life of the mine, excluding mineral and organic soils, which will be stored separately.

Some of the inert, competent waste rock (6.3 Mm^3) will be used for the construction of infrastructure, including dams, roads and work platforms.

4.4.2 Coarse Tailings Pile

This pile receives the coarse, non-magnetic tailings (150-1,500 µm). It lies southwest of the pit adjacent to the waste rock pile, and covers an area of 109.1 hectares. In order to minimize its footprint, this pile is in contact with the waste rock pile. Their adjoining faces gradually merge to form a single pile by the end of the mining operation. This approach will, however, be reconsidered if technical and economic studies confirm that the titanium in the coarse tailings can be recovered. The coarse tailings pile sits on the same moraine deposit as the waste rock pile.

The design criteria for the coarse tailings pile were as follows:

- bench height: 10 metres;
- bench slope angle: 30º;
- inter-ramp angle: 25º;
- maximum pile height: 120 metres;
- compaction factor: 30%.

These concentrator tailings are trucked to the pile. Track bulldozers arrange the material to meet the above-mentioned design criteria. A total of 42 Mm^3 of coarse tailings will be dumped at the site over the life of the project.

4.4.3 Fine Tailings and Polishing Ponds

All the tailings from the magnetic separation smaller than 150 µm are collected in the fine tailings pond, along with precipitation and mine site runoff and water from the open pit. The pond covers an area of about 149 hectares and is designed to hold 27 Mm^3 of Southwest pit tailings. The total volume of tailings and locked-in water in the pond is expected to total about 23.3 Mm^3 after 15 years of operation. The fine tailings pond dams will be built sequentially as tailings production progresses. Water storage space is limited, and water will therefore be transferred to the polishing pond on a regular basis.

The main function of the polishing pond, which has a volume of 2.3 Mm^3 and an area of 27 hectares, is to clarify the water from the fine tailings pond before it is released into the environment. The residence time of the water is 30 days. The pond is also used to store water to be recycled to the concentrator. In a full cycle, from the use of water at the concentrator until its return, 10% of the volume is lost to evaporation and as moisture in the coarse tailings, fine tailings and concentrate. Any excess water from the polishing pond is transferred to Lac Denis by gravity. Construction of the polishing pond must be completed approximately 18 months before the start of operations to store enough water for the initial months of operation.

4.4.4 Organic and Overburden Stockpiles

The mineral and organic soil at the pit is usually very thin and in some spots nonexistent. A significant portion of the pit is on a rocky ridge. The mineral and organic soil is mainly from the hollows between the peaks of the ridge. The amount of overburden to be stripped from the surface of the pit is estimated at 7.3 Mt. The two types of soil are separated and stockpiled to the east of the pit, in the upstream part of the fine tailings site, which will only be used in the latter years of mine operation. This approach minimizes the project footprint while facilitating ongoing stockpile maintenance. The criteria for the mineral soil stockpile are as follows:

- bench height: 10 metres;
- bench slope angle: 20º;
- inter-ramp angle: 15º;
- maximum stockpile height: 30 metres;
- compaction factor: 20%.

4.5 WATER MANAGEMENT AND RECYCLING

The overall water balance for the project is based on that of the the mining process as well as precipitation data and data for the subsystems in which the mining facilities are located. The following sites and mining infrastructure were included in the water balance and water recycling strategy:

- waste rock pile;
- coarse tailings pile;
- fine tailings pond;
- polishing pond;
- Lac Denis;
- pit.

All these sites and infrastructure contribute to the collection, storage and recirculation of water in a closed loop at the mine site.

4.5.1 Process Water Balance

Process water requirements are 4,115 m^3/hr. However, with the added moisture content of the concentrate (54 m^3/hr), water for reagent preparation (4 m^3/hr) and water required for boilers (8 m^3/hr) and hydraulic seals (123 m^3/hr), total consumption for the process and ancillary functions is 4,304 m^3/hr.

Process water is fed into the plant at a number of stages in the process, starting with the semi-autogenous grinding (SAG) mill. The water is subsequently used to adjust the slurry density at various stages of the hydrometallurgical process and at the flotation stage. At the end, process water is used as wash water for the screens and flotation columns and to recover the concentrate cake on the magnetic drums. The amount of water required at each stage of processing in the concentrator is shown in Table 4.3, and the water balance is shown in Figure 4.7.

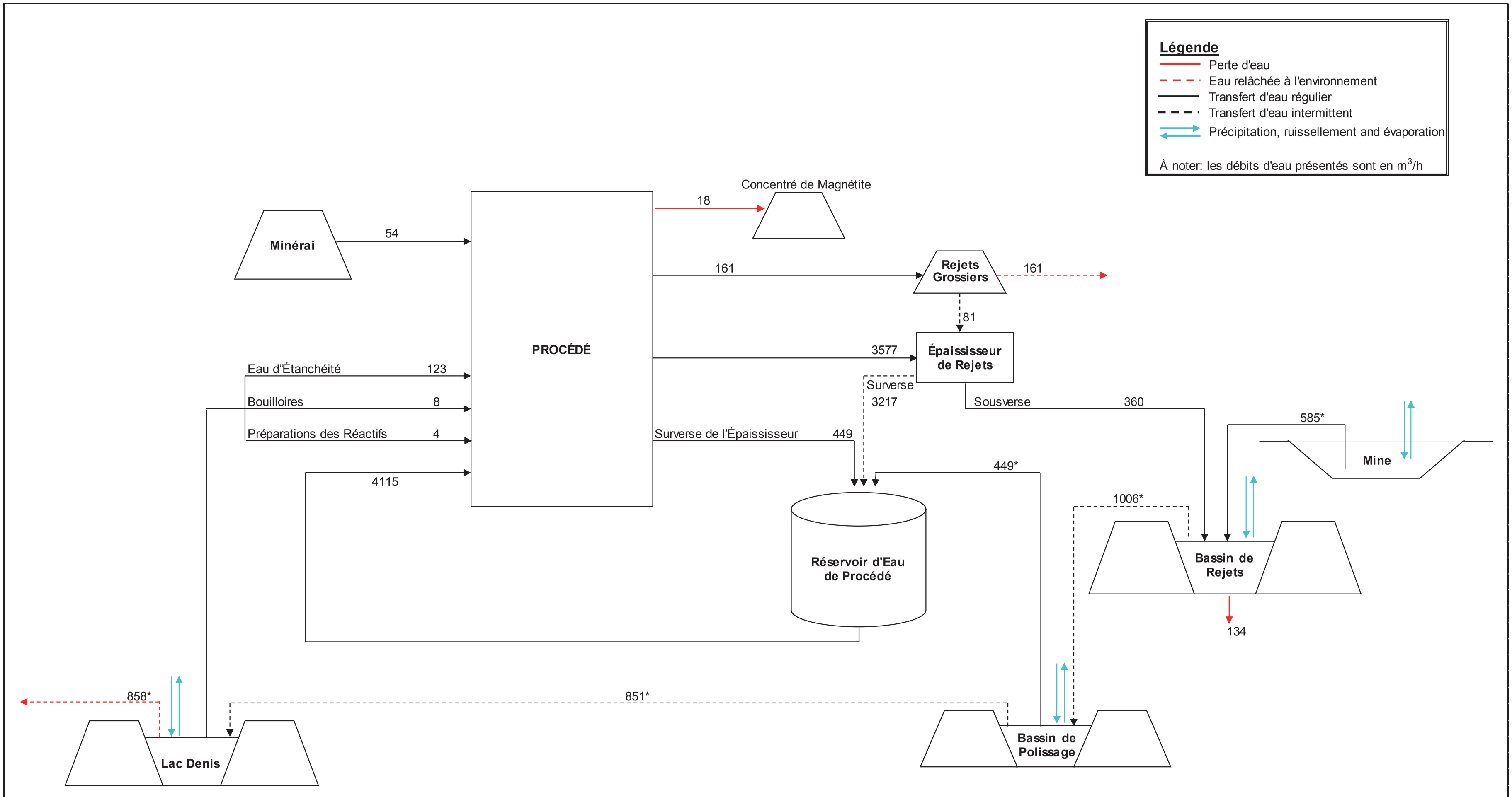
Table 4.3 Water Required at Each Stage of Processing

Concentrator	Flow (m^3/h)	Annual consumption (m^3)
SAG mill	555	4,375,620
Scalping screen	50	394,200
Multi-slope screens	500	3,942,000
Process water at discharge end of the multi-slope screens	759	5,983,956
Ball mill discharge pump box	1,000	7,884,000
Cyclone overflow	12	94,608
Washing at the primary magnetic separation stage	14	110,376
Repulping at the second magnetic separation stage	716	5,644,944
Washing at the second magnetic separation stage	14	110,376
Dilution water at the flotation cells	290	2,286,360
Washing water in the flotation column troughs	50	394,200
Reagent dilution	6	47,304
Dilution of tailings pumped to the tailings pond	149	1,174,716
Total	**4,115**	**32,442,660**

The fresh water that enters the process comes primarily from the moisture content of the ore, which is 4% by weight. This corresponds to an intake of 54 m^3/hr. The other sources of fresh water for the concentrator are Lac Denis (135 m^3/hr), the polishing pond (449 m^3/hr), and tailings and concentrate thickening and dewatering (3,217 m^3/hr and 449 m^3/hr). Any excess water is released into the receiving environment via Lac Denis, at which point the water meets the standards for release into the aquatic environment. The release of excess water from Lac Denis is also controlled.

The production facilities and tailings sites are grouped in a single drainnage subsystem, the Lac Jean subsystem. Within this subsystem, three storage ponds help manage the water balance: Lac Denis, the fine tailings pond and the polishing pond. The characteristics of these three ponds are shown in Table 4.4, and a diagram of the water balance is shown in Figure 4.7.

Figure 4.7 Water Balance



* Les valeurs présentées sont des maximums de débit d'eau transferée (m^3/h) et incluent les contributions de précipitation et du ruissellement. Les débits actuels son intermittents ou varient sur une base mensuelle.

4.5.2 Ponds Used for Water Recycling

4.5.2.1 Fine Tailings Pond

By the end of mine operations, the fine tailings pond will have a maximum capacity of 27.0 Mm^3. However, it should be noted that the impoundment dams are built sequentially to meet annual tailings deposition requirements

The pond stores water pumped from the mine (390 m^3/hr), the water accompanying the fine tailings (360 m^3/hr) and any precipitation that falls directly on the impoundment area. A significant proportion of the water locked into the fine tailings (pore water) cannot be reclaimed. This quantity of water is estimated at 134 m^3/hr. The amount of water transferred to the polishing pond will vary depending on the season. A maximum of 1,005 m^3/hr of water can be pumped to the polishing pond.

4.5.2.2 Polishing Pond

The polishing pond has a capacity of 2.3 Mm^3. It receives water from the fine tailings pond (an intermittent flow of up to 1,005 m^3/hr), as well as any precipitation that falls directly on its surface.

From the polishing pond, 449 m^3/hr of water is recycled in the processing circuit. Depending on the season, varying amounts of water treated to meet discharge standards are transferred to Lac Denis, up to a maximum of 851 m^3/hr.

Table 4.4 Characteristics of the Water Storage Ponds

Pond	Maximum capacity Mm^3	Catchment (ha)	Supply	Usage
Lac Denis	1.3	198	• Precipitation and runoff • Excess water from the polishing pond	• Fresh water supply (pump gland seal, reagent preparation, boilers) • Released into the environment
Fine tailings pond	27.0	291	• Precipitation and runoff • Water reclaimed from the open pit mine • Tailings thickener underflow	• Reclaimed water sent to the polishing pond
Polishing pond	2.3	107	• Precipitation and runoff • Fine tailings pond reclaim water	• Process water tank supply

4.5.2.3 Lac Denis

With a maximum capacity of about 1.3 Mm^3, Lac Denis serves two purposes in the BlackRock project water balance. The first use is to provide fresh water for the mill. This water is used for the preparation of reagents, for the boilers and as seal water for production equipment, for a total of 135 m^3/hr. The second use is to act as a transfer point for excess water released into the environment. Sources of water fed to Lac Denis include precipitation and runoff over an area of about 2.7 Mm^2 of its catchment, and excess water from the polishing pond (intermittent flow of up to 851 m^3/hr). The Lac Denis dam must be functional 18 months before the start of operations to allow enough water to accumulate for the initial months of operation.

Once the entire water management system is in equilibrium in the second year of production, water will occasionally be released into the environment. This will mainly take place between May and November. The peak of 858 m^3/hr is scheduled for September. The quality of the water released into the environment is controlled by regulating equipment to prevent any imbalances in the receiving environment. At the outlet of Lac Denis (elevation 424), the flow will be channeled under the mining road, and fed into lake B-1.

The canal will empty into a stilling pool (elevation ±414). This rip-rap basin, whose dimensions are still to be determined, has a sill on its downstream side. At the sill discharge, the water rejoins the tributary of lake B-1. Additional sills in the lake B-1 tributary are also planned to ensure better water distribution over time.

The design criteria for the sills and drainage canal are based on peak flow and low flow. The sills will help slow flow velocity and increase oxygenation. The ponds immediately downstream from the sills are made of riprap to prevent erosion. The entire network will be optimized based on hydrological, hydraulic and biological criteria.

Lac Jean catchment runoff will flow to the treatment and monitoring pond at the north end of the waste rock pile. A waste rock platform will be built to facilitate the flow of water under the waste rock and coarse tailings piles.

4.5.2.4 Process Water Tank

The process water tank is not a storage facility with significant buffering capacity. It is located at the concentrator, and serves to collect water for recycling. This water comes from tailings and concentrate dewatering (3,217 and 449 m^3/hr, respectivly) and water reclaimed through percolation at the coarse tailings pile (81 m^3/hr, six months per year). The polishing pond water is also sent to the tank at a fairly steady rate of up to 449 m^3/hr.

The water from various sources is treated to meet the industrial needs, and then recirculated through the concentrator circuit.

4.6 INDUSTRIAL WATER TREATMENT

Industrial water treatment depends on the mineralogical and geochemical properties of the tailings and the nature of the metallurgical process.

At the Southwest deposit, the waste rock and concentrator tailings contain significant amounts of silicates, including chlorites, which are particularly difficult to dissolve. The hydrometallurgical process is also almost exclusively based on physical separation of minerals. The process itself is not very aggressive, and does not affect the stability of the mineralogical structures of the concentrate and tailings, which obviously facilitates regulatory compliance. In this respect, the *Directive sur les industries minières (Directive 019)* specifies the physicochemical and toxicological properties that the mine effluent must meet at its final point of discharge.

Analyses of these parameters were performed on the effluent from pilot testing of BlackRock"s hydrometallurgical process. The pilot tests were conducted by COREM, and the analyses were performed independently by COREM and Entraco. The results obtained by the two groups show that the effluent meets all the *Directive 019* discharge criteria. The tests conducted on waste rock and tailings from the same pilot plant show that they contain less than 0.3% sulphur and are not acid-generating. These aspects are discussed in Chapter 9.

Aside from the fact that all the parameters analyzed meet the *Directive 019* discharge criteria, the abundance of chlorite in the process water merits special attention. The lamellar structure of chlorites, their surface charges and their abundance as fine particles encourage their continued suspension.

In the laboratory, the concentration of suspended solids in the final effluent was 17 mg/l after 13 days of settling. In an operating context, the impact of wind on the water column and the transition of the water from the tailings pond to the polishing and settling ponds make for a much more dynamic setting. Consequently, the finest chlorites could remain in suspension longer. The polishing pond is therefore designed so that water resides there for 30 days. If this proves insufficient, the precipitation of chlorite will be achieved through the addition of a flocculant prior to release into the receiving environment. The precipitated chlorites will be returned to the fine tailings pond.

4.6.1 Treatment Sites

Given the context described above, a suspended solids treatment station is planned at the outlet of the sedimentation pond. This pond receives water from the polishing pond. Its location is shown on the plan view of the mine production facilities (see Figure 4.1). Should suspended solids exceed acceptable limits early in the mining operation, flocculants will be injected directly at the level of the equipment that transfers the water from the polishing pond to the sedimentation pond. This procedure will continue until an automated treatment station is installed.

The water is then sent to the concentrator and any excess water is released into the environment at Lac Denis.

It is also possible that fine chlorite particles will be sent to the waste rock and coarse tailings piles. The level of fine particles at the waste rock pile should be low, as this pile consists of large-sized shot rock from the pit. The coarse tailings pile, however, could receive such fines if the spiral classifier malfunctions. The spiral classifier separates the non-magnetic tailings into a coarse fraction with a D_{80} of 1,000 µm and a fine fraction with a D_{80} of 75 µm. This operation allows the different-sized tailings to be sent to specially-designed sites.

To the east, the coarse tailings and waste rock piles are confined below the rocky ridge of the deposit. On the south and southwest sides, the access platform used for the pit, the crusher and the garage directs the runoff to the lowest edge of the piles. The ground naturally slopes gently in a southwest-northwest direction to the final treatment and monitoring pond.

On the north side of the tailings, there is a ditch to intercept runoff from the pit and the coarse tailings and waste rock piles. This ditch begins at the north end of the pit, at an elevation of about 500 metres, and runs westward (elevation 409 metres) to the aforementioned treatment and monitoring pond. This ditch is about 2.4 km long. Runoff from the entire mine site is therefore intercepted and directed into the treatment and monitoring pond.

An automated suspended solids treatment station is planned at the entrance to the treatment and monitoring pond. The treatment station starts up whenever standards are exceeded. The precipitated fines are returned to the fine tailings pond.

The lower floors of all the mining facilities are equipped with tanks for collecting waste water. This is the case for the crusher, the ore transfer tower, the processing plant, the main substation and the garage. These tanks allow the suspended solids to settle. They are connected to hydrocarbon collection traps. The hydrocarbon-free water collected is sent to the treatment and monitoring pond as described above.

4.6.2 Water Volumes at the Final Effluents of Lac Jean and Lac Denis

The final effluent of Lac Jean includes precipitation that falls on the coarse tailings and waste rock piles and surface work areas, as well as water from the mine infrastructure (garage, processing plant).

The overflow from Lac Denis is channeled to lake B-1. This other final effluent will also be subject to controls under *Directive 019* and the *Règlement sur les effluents des mines de métaux* (REMM). Table 4.5 shows the annual volumes of water released into the environment from the treatment and monitoring pond and from Lac Denis to lake B-1.

Table 4.5 Water Released Through the Treatment and Monitoring Pond

Annual Final Effluent Treatment								
Year	2012	2013	2014	2015	2015	2016	2017	2018
Final effluent Lac Jean (Mm^3)	-	1,260	1,260	1,260	1,260	1,260	1,260	1,260
Overflow from Lac Denis to lake B-1 (Mm^3)	0	0	0	0	0	1,225	1,485	1,226

Annual Final Effluent Treatment									
Year	2019	2020	2021	2022	2023	2024	2025	2026	2027
Final effluent Lac Jean (Mm^3)	1,260	1,260	1,260	1,260	1,260	1,260	1,260	1,260	1,260
Overflow from Lac Denis to lake B-1 (Mm^3)	1,183	1,183	1,183	1,138	1,130	1,130	1,130	1,130	1,130

The final effluent volume is calculated based on the following assumptions:

- runoff coefficients range from 0.3 to 0.95 depending on the type of terrain; these coefficients are the same as those used to calculate catchment runoff for the design of the tailings and polishing ponds;
- the volume of water from the Lac Denis overflow is taken from the water balance;
- all the snow that accumulates during the winter months melts in May and June;
- water that falls on the piles flows along the slope of the ground under the piles; the shape of the piles was not taken into consideration.

The sources of water flow into the final treatment and monitoring pond are shown below.

<u>Final Treatment and Monitoring Centre (FTMC):</u>

- precipitation that falls on the coarse tailings and waste rock piles flows to the FTMC;
- groundwater discharge flows to the FTMC;
- all the Lac Denis overflow flows to lake B-1;
- groundwater discharge from the coarse tailings and waste rock piles flows to the FTMC;
- the treatment and monitoring pond is used for settling, control and water treatment.

At the point of release into the environment, water is poured onto riprap to obtain maximum oxygenation. From that point onward, the water is no longer controlled. Annual effluent flows shown in the above table indicate that a steady state is reached in the second year of operation.

4.7 ANCILLARY INFRASTRUCTURE

4.7.1 Support Infrastructure and Facilities

In addition to the production facilities described in Section 4.2.4, the processing plant has the following support facilities:

- electrical control room;
- compressor room;
- boiler room;
- grinding mill engine room;
- heating and ventilation room;
- washrooms.
- metallurgical laboratory;
- administrative office;
- canteen;
- equipment and locker room

The garage is the largest support building, with a maximum height of almost 17 metres so that it can accommodate the largest mining equipment. The warehouse and mine management office are also located just outside the garage.

4.7.2 Transmission Line, Substation and Power Grid

The power requirements for the mining project are 45 mW. Power will be supplied by the construction of a 161-kV power line some 22 km long. This new line is connected to the Hydro-Quebec grid at line #1627 (Obalski/Obatogamau). The #1627 line runs along Route 167 to serve the town of Chibougamau.

Under the agreement between Hydro-Quebec and BlackRock Inc., Hydro-Quebec is entirely responsible for power line studies, engineering and construction. The location of the substation (161-34.5-4.16kV) beside the concentrator is dictated by the large power requirements of the SAG mill and ball mill. As an indication, the installed capacity is 20,000 HP for the SAG mill (two 10,000-HP motors) and 13,000 HP for the ball mill (two 6,500-HP motors). Both mills are fed directly from the substation at a voltage of 34.5 kV. There is a SF_6 gas-insulated 161-kV circuit breaker where the 161 kV line connects to the substation.

In addition to the above-mentioned motors, a number of induction motors are also powered by the substation. These engines have a capacity of between 300 and 2,500 HP. Such motors require a 4.16 kV power supply. A 4.16-kV line feeds the facilities located outside the processing plant, including the 1,000-HP gyratory crusher. The production equipment in the pit, like the track shovel and the pumps, are powered by flexible 7.2-kV cables.

A 34.5-kV power grid feeds a substation (34.5-7.2 kV, 7.5 MVA) that lowers the voltage for the electric mining equipment. This substation is located near the pit to reduce the length of the 7.2-kV power grid and ensure its integrity during blasting. Power distribution to various other facilities is provided by a 25-kV power grid that feeds the following facilities and equipment:

- garage;
- hydraulic shovel and drills;
- fine tailings pond and water control equipment;

- polishing pond;
- telecommunications tower;
- explosives magazine;
- waste water (mining and domestic) and drinking water treatment equipment.

Given the different distribution voltages, eight transformers are needed to produce the appropriate voltage:

- two 34.5 kV/4.16 kV, 15/20 MVA dry-type cast coil transformers;
- three 34.5 kV/34.5kV, 45/60/75 MVA dry-type cast coil transformers;
- one 161 kV/34.5 kV, 45/60/75 MVA oil transformer;
- one 34.5 kV/7.2 kV, 7.5 MVA oil transformer;
- one 25 kV/600 V, 2.5/3.3 MVA oil transformer.

A set of four emergency generators will feed the following installations:

- concentrator (1,200 kW and 800 kW);
- primary crusher (800 kW);
- mine garage (1,200 kW).

4.7.3 Drinking Water and Domestic Wastewater: Mining Operations and Rail Transfer Point

The mine site drinking water is supplied by an artesian well. There are two separate treatment systems for the mine site drinking water, the first for the concentrator and the second for the garage. The treatment process comprises filtration, chlorination and UV sterilization. Average daily and peak consumption for the mine site are 125 m^3 and 200 m^3, respectively.

There are two wastewater treatment units for the concentrator and the garage. A combination process, a membrane bioreactor, was selected. A bioreactor is associated with physical separation using porous membranes. The final effluent is sent to a discharge point downstream from Lac Denis through heated pipes. The rail transfer point is also supplied by an artesian well, fitted with the same type of treatment equipment for drinking water and wastewater. The final effluent is sent to the ditch that runs along the tracks. The septic sludge is collected regularly by a licensed contractor.

4.7.4 Communication System

The radio communication system will be set up during the exploration phase. This network covers the mine site, access road, rail transfer site and BlackRock‟s Chibougamau office. The telecom tower sits on a rise to the east of the polishing pond. The telecommunications system is used to manage the following equipment:

- 200 telephone sets;
- surveillance cameras for the concentrator circuit and site security;
- site access control (gates and main doors);
- mobile radio network;
- Internet access;

- fire detection system.

4.7.5 Fire Protection

The fire protection systems at the mine and transfer sites are fed by artesian wells and are supplied by a dedicated 1,000-m^3 tank. Hydrants are strategically located around the perimeter of the main buildings. The network that feeds the hydrants is a closed loop that provides a constant bidirectional feed should a break occur in a section of the network.

4.7.6 Hydrocarbon Supply and Storage

Fuel oil No. 2 oil is the main fuel used on site. Along with gasoline, it is brought to the mine site and transfer point by tanker trucks. The fuel depot at the mine site has a storage capacity of 400,000 liters, with five 80,000-liter tanks grouped at the site next to the mine garage. Diesel rolling stock is supplied by three aboveground double wall 50,000-liter tanks, one located at the garage, the second at the concentrator and the third at the rail transfer point. There is also a double wall 20,000-liter gas tank at the garage to fuel light vehicles. These four tanks are Gasboy-type units, and have all the measurement and protection systems required for vehicle refueling.

The fuel tanks meet the following standards:

Diesel	CAN-ULC-S601 double wall tank, 50,000 L maximum volume, mechanical and electrical over-fill protection, concrete barrier collision protection
Gasoline	CAN-ULC-S601 double wall tank, 20,000 L maximum volume, mechanical and electrical over-fill protection, concrete barrier collision protection
Propane	Complies with applicable standards, installed by a licenced contractor

The fuel depot is contained, protected and managed in accordance with the applicable regulations, including the "*Storage Tank Systems for Petroleum Products and Allied Petroleum Products Regulations" "SOR/2008-197*". In this regard, Article 2.5.2 of MDDEP *Directive 019* (April 2005) states that storage areas for new and used petroleum products shall be equipped with a containment area with sufficient capacity to contain leaks and accidental spills.

4.7.7 Construction Camp

The construction camp can accommodate a maximum of some 500 workers, well above the lodging capacity of Chibougamau, which is the nearest town. The town of Chapais is 80 kilometres from the mine site. The camp is located at the junction of logging road 210 and the new mine site access road, 7.5 kilometres from the mine.

The camp will be built in two separate stages. The first stage involves leveling and installation of dormitories and services to meet the needs of up to 21 people. At this initial stage, the camp will be used for exploration (see Figure 4.8) on the BlackRock property as a whole. The second stage corresponds to the housing needs for mine construction, and will begin as soon as the certificate of authorization is issued for the project.

The camp includes a kitchen that can accommodate 250 workers and serve 500 meals in one hour, an administrative office, a medical clinic, a recreation hall and a laundry room. The construction camp (see Figure 4.9) is designed to accommodate 500 people in 11 housing units. The camp is equipped with a closed-loop fire protection system. It is heated by a propane gas system, and electricity is supplied by an 800-kW generator. Average hourly consumption over a 24-hour period is 250 kWh.

There is already a well in place for drinking water supply. The artesian well can supply 45 m^3/hr, more than enough to meet average and peak daily consumption of 125 and 200 m^3/hr, respectively. Drinking water is stored in a tank and distributed to all housing and service units for sanitary purposes. The drinking water and wastewater treatment system and final waste disposal is similar to those at the mine site.

The camp will not be used once the mine is in operation. Because the number of workers is smaller at this stage, they will be transported to the mine site on a daily basis from the main communities in the area. Tables 4.6 and 4.7 provide an overview of the waste produced at the BlackRock site during construction and operation.

Table 4.6 Waste Type and Volume – Construction Phase

	Volume for the project	Peak quantity per period	Collection schedule
Construction Phase			
Construction waste	7,500 m^3/year		Chibougamau municipal norms
Domestic waste	310,500 kg/year	1,035 kg/day	Chibougamau municipal norms
Recycling	99,000 kg/year	330 kg/day	Chibougamau municipal norms
Sewage treatment system solids	410 m^3/year	1.36 m^3/day	According to treatment system specifications

(Source BBA, Feasibility Study Report, Volume 1: Report, August 5, 2011)

Table 4.7 Waste Type and Volume – Operation Phase

	Volume for the project	Peak quantity per period	Collection schedule
Operation Phase			
Production waste	4,000 m^3/year		Chibougamau municipal norms
Domestic waste	73,000 kg/year	200 kg/day	Chibougamau municipal norms
Recycling	22,000 kg/year	60 kg/day	Chibougamau municipal norms
Sewage treatment system solids	100 m^3/year	0.27 m^3/day	According to treatment system specifications

(Source BBA, Feasibility Study Report, Volume 1: Report, August 5, 2011)

Figure 4.8 Exploration Camp

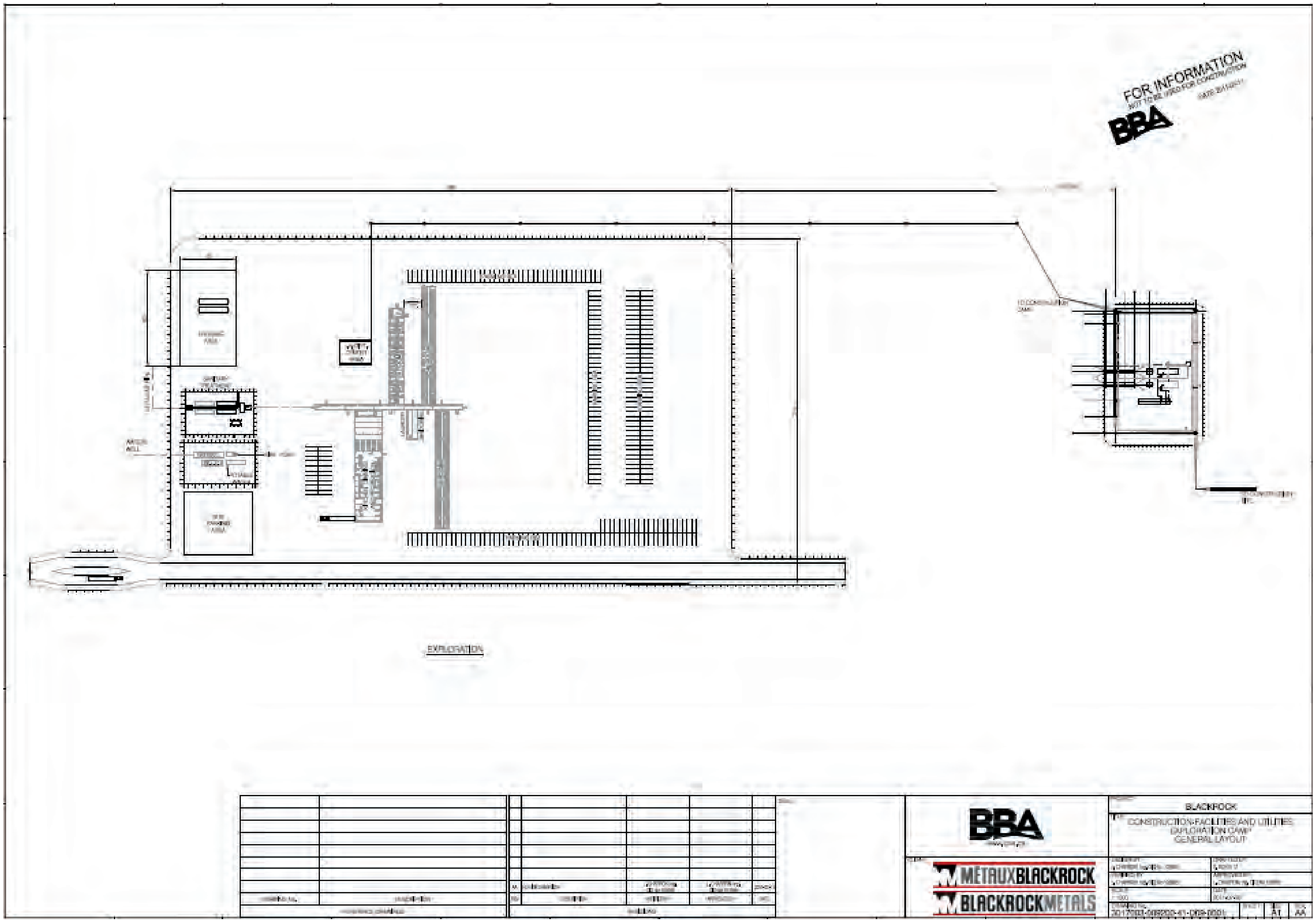
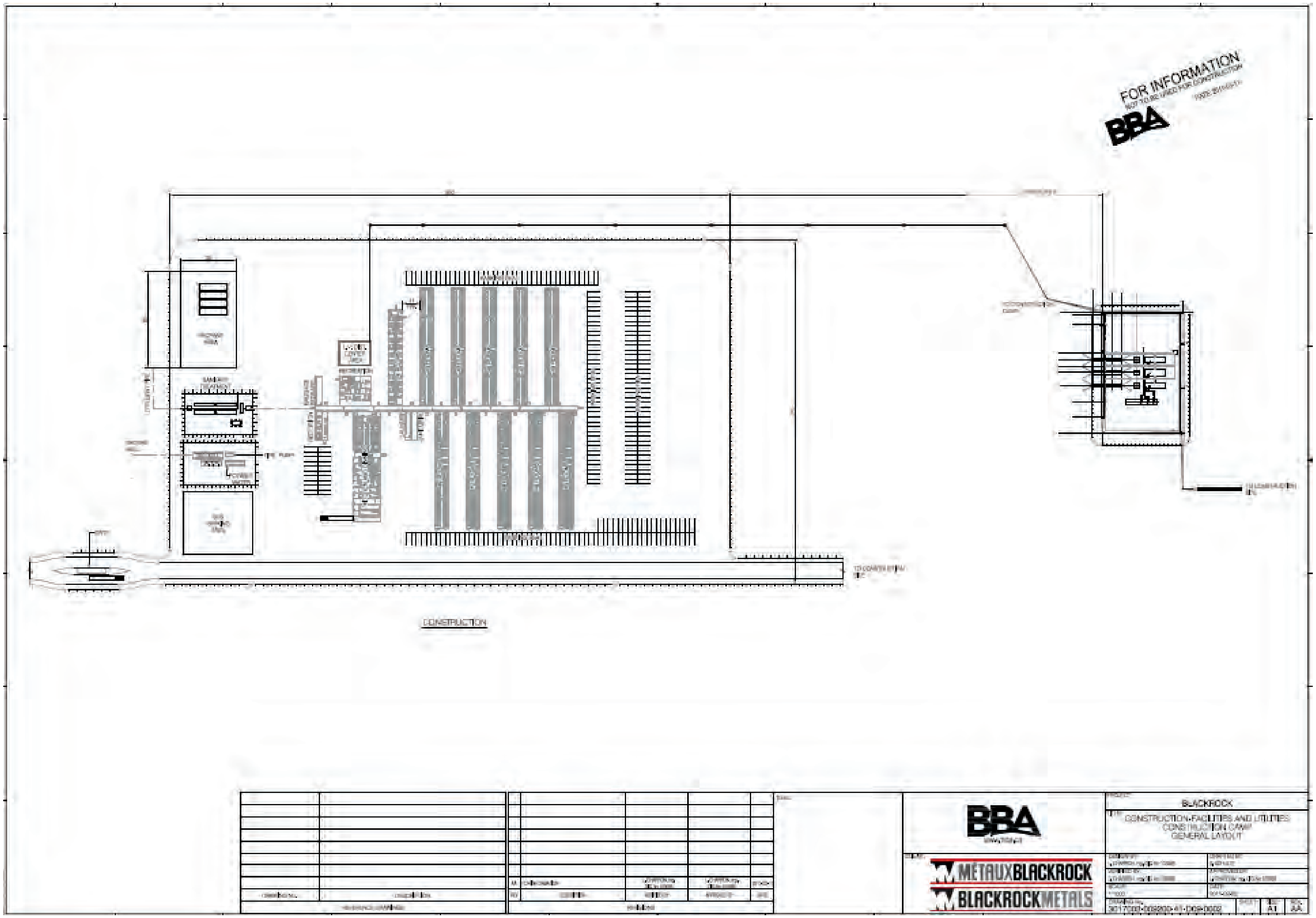


Figure 4.9 Construction Camp



4.7.8 Domestic Waste and Recyclables

Domestic waste generated at the mine facilities, rail transfer point and construction camp are placed in closed containers and collected on a weekly basis by a contractor licenced by the town of Chibougamau (mine site and camp) and the Municipality of James Bay (rail transfer point). Domestic recyclables are handled the same way. Recyclable and non-recyclable construction waste is placed in separate roll-on/roll-off type containers and handled by the same contractors. Standard non-recyclable construction materials are sent to a dry materials landfill site. All waste is handled at the town of Chibougamau"s facilities.

4.7.9 Storage and Handling of Hazardous Waste

Hazardous waste such as contaminated oil cans, solvents, gaseous products and residual emulsion explosives is stored in a separate building adjacent to the garage. The building is heated to avoid freezing and has a concrete floor with the required chemical resistance for the stored products.

The building has a watertight pit that in the event of spills can hold 25% of the total storage capacity. All hazardous waste will be stored in containers compatible with their chemical characteristics. Chemically-incompatible hazardous waste materials are stored in separate areas and in different-coloured containers. The storage building is located near a fire hydrant and can be directly accessed by emergency response teams.

The petroleum products supplier is responsible for handling contaminated hydrocarbons and their containers. Handling procedures still need to be negotiated with the supplier. The materials will either be picked up directly at the mine site or transported by BlackRock to a drop-off point designated by the supplier. All hazardous waste is removed from the mine site regularly by a licensed carrier.

4.7.10 Riprap, Crushed Rock and Granular Material

The total surficial material requirements for the project are estimated at 7.7 Mm^3, including 6.4 Mm^3 from quarries and 1.3 Mm^3 from borrow pits.

The riprap and crushed rock will be sourced from two sites, the first being the site of the concentrator, crusher and project work areas. A little more than 79,000 m^3 of shot rock from the mountainside (Southwest quarry) will be used to build foundations for the following installations:

- crusher;
- conveyors;
- processing plant;
- main substation;
- tailings pile and concentrate stockpile pads;
- telecommunications site.

Some of this rock is also crushed to make concrete for the construction of the same installations.

Secondly, 6.3 Mm^3 of waste rock from the pit will be used to complete the construction of the aforementioned mining installations, as well as the following infrastructure:

- garage;
- haulage roads;
- access roads;
- dams.

The large rock is used in heavy equipment traffic areas, for production infrastructure and on the downstream sides of dams. Different sizes of crushed rock are mainly used for the roadways, mine site access road repair and the finishing of the upstream site of the dams. All the rock is from the area being mined. This approach avoids the creation of any additional footprint in the host environment. Borrow pits are used to supply the other granular materials needed for the project (±1.3 Mm^3).

The sand needed to make concrete comes from existing borrow pits listed in the GESTIM directory (MRNF). The two borrow pits are numbered GESTIM 32-G09-01 and G09-32-17 and are located near Route 167. These two pits have a volume of about 1.2 Mm^3 and are used by the Quebec Ministry of Transport. They are clearly sufficient to meet the project‟s concrete sand needs (±14,700 m^3) and to provide the filter sand (139,800 m^3) for the tailings dams.

The impervious cores of the project‟s dams are made of compacted glacial till. Total requirements for this type of waterproof material are estimated at 574,720 m^3 for the impoundment structures. Some 15,000 and 20,000 m^3 of glacial till are required at the construction camp and garage, respectively. Overall requirements amount to 609,720 m^3.

The glacial till must be sourced from borrow pits identified by photo-interpretation and located close to the mineral deposit. These are borrow pits listed in GESTIM, which by definition have therefore already been operated. These borrow pits are numbered 32G16-09, 32G16-46 and 32G16-44. Their potential minable volumes are 625,000, 1,250,000 and 1,250,000 m^3, respectively. Although their total volume (3,125,000 m^3) is much higher than the project glacial till requirements (609,720 m^3), the quality of the material and its impermeability in particular is yet to be determined. Some of these borrow pits may be unusable or only partially usable. However, there is an extensive drumlin (borrow pit No. 13) some three kilometres long, not listed in GESTIM, running parallel to Lac Bernadette on the east side. Glacial till is also available below the drumlin. The quantity and quality of this material must nevertheless also be determined.

Use of the glacial till below borrow pit No. 13 is the preferred alternative in the interest of minimizing the project footprint. This area is adjacent to the waste rock and coarse tailings piles. In addition, this area is only visually accessible from the mining project. However, the operation of borrow pit No. 13 and the adjacent glacial till is still subject to confirmation of the quality of the granular material found there.

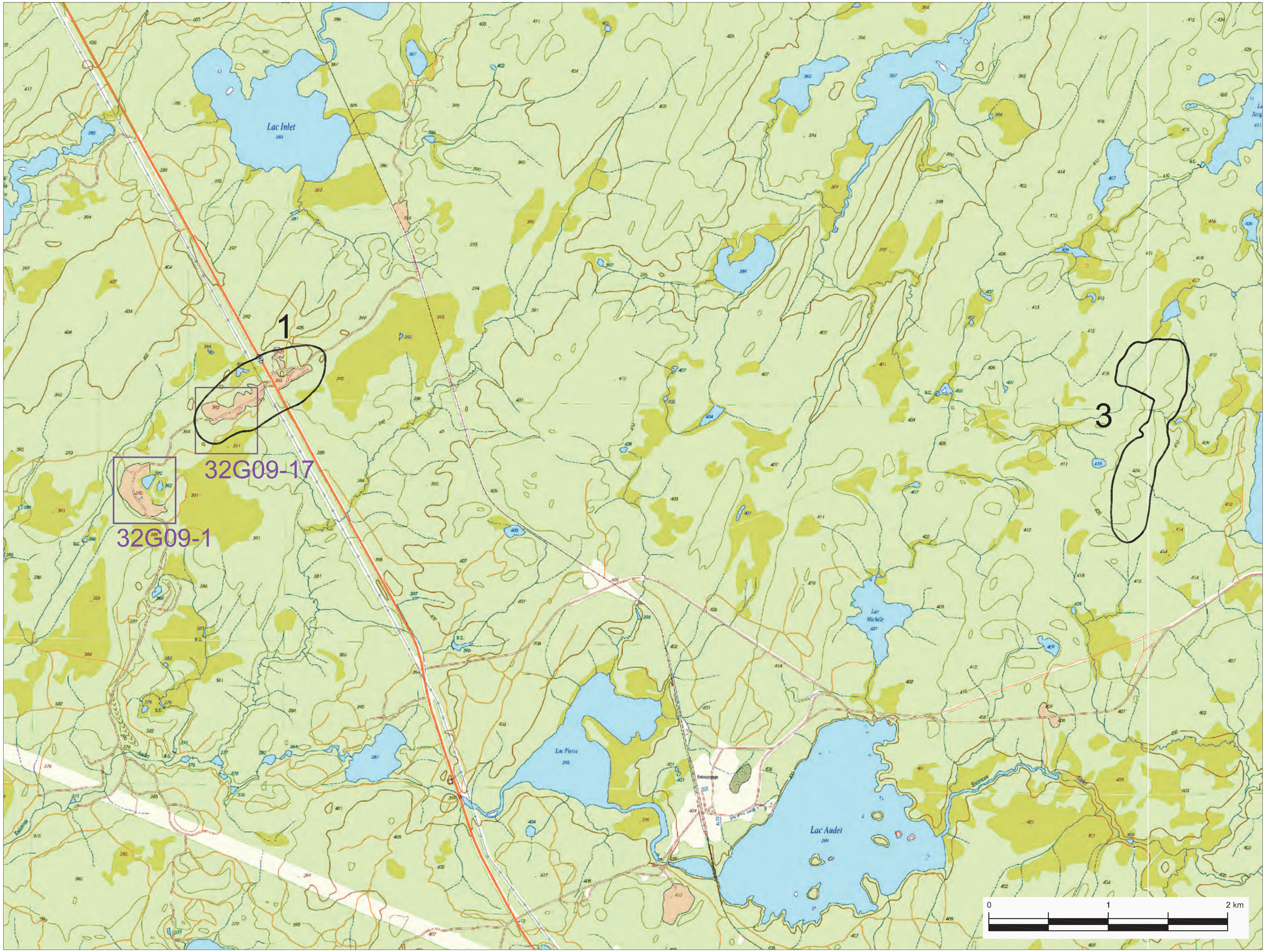
Other impermeable granular materials will have to come from drumlins. Drumlins are composed of coarse, loose glacial material (boulders, gravel, sand and a small proportion of fine particles). They can be used as-is in certain applications, such as large fills. The boulders that they contain can also be crushed to make the particle size of the entire system more uniform. The material can then be divided into size ranges (e.g., 0-300, 0-150, 150-300). This sorted material can thus meet all other project requirements of the project, estimated at a total of 609,720 m^3.

Material from the drumlins will be used at the garage site, at the rail transfer point, on the access roads and as a transition material in the dams. Borrow pit No. 13 consists of a series of small hills aligned northeast-southwest. This series of drumlins lies between Lac Bernadette and the waste rock and coarse tailings piles. The total length of these drumlins is nearly three kilometres. They vary in width from 100 to 200 metres and are 10 metres high on average. The theoretically usable volume is 7.5 Mm^3. Given the advantageous location of borrow pit No. 13 and the fact that it is not visually accessible to outside observers, its operation is preferred to that of other drumlins.

The two other borrow pits with similar characteristics are numbered GESTIM 32-G09-18 and 8. The first has been operated before and is identified as such in the GESTIM directory. The second was identified by photo-interpretation and has never been mined. These two borrow pits contain estimated quantities of 60,000 and 200,000 m^3, respectively. The borrow pits are shown in Figures 4.10 to 4.13. Table 4.8 shows the granular material requirements (rock and borrow) for the entire project.

Table 4.8 Granular Material Requirements (Source: BBA, August 5, 2011)

ACTIVITIES	SITE	SOUTHWEST QUARRY (m^3)	PIT (m^3)	GRANULAR (borrow) (m^3)	CONCRETE SAND (borrow) (m^3)
PREPARATORY ACTIVITIES					
	Garage		298,000	26,000	
MINE SITE (WORK AREA CONSTRUCTION)	Crusher, conveyors, concentrator, stockpile sites, main substation	62,565	1,167,815		
RAIL TRANSFER POINT (WORK AREA CONSTRUCTION)	Platforms and siding (1 km)			295,000	
	Transfer point access (approx. 2 km)			9,000	
MINE SITE ACCESS ROAD (CONSTRUCTION AND REPAIR)	Km 0 – Km 29.4		162,520	68,700	
MINE SITE ROADS (CONSTRUCTION)	Mine site		3,438,022		
DAMS			1,269,985	714,520	
CONCRETE	Mine site	16,316			14,706
TOTAL		**79,021**	**6,336,567**	**1,232,900**	**14,706**



MÉTAUXBLACKROCK
BLACKROCKMETALS

Emplacement approximatif des bancs d'emprunt GESTIM

Emplacement approximatif des bancs d'emprunt ENTRACO

SOURCE (fond de plan) :
Cartes 1:20 000 du MRNF

Rév.	Description	Par/By	Date
-	-	-	-
-	-	-	-

ENTRACO
Conseillers en environnement

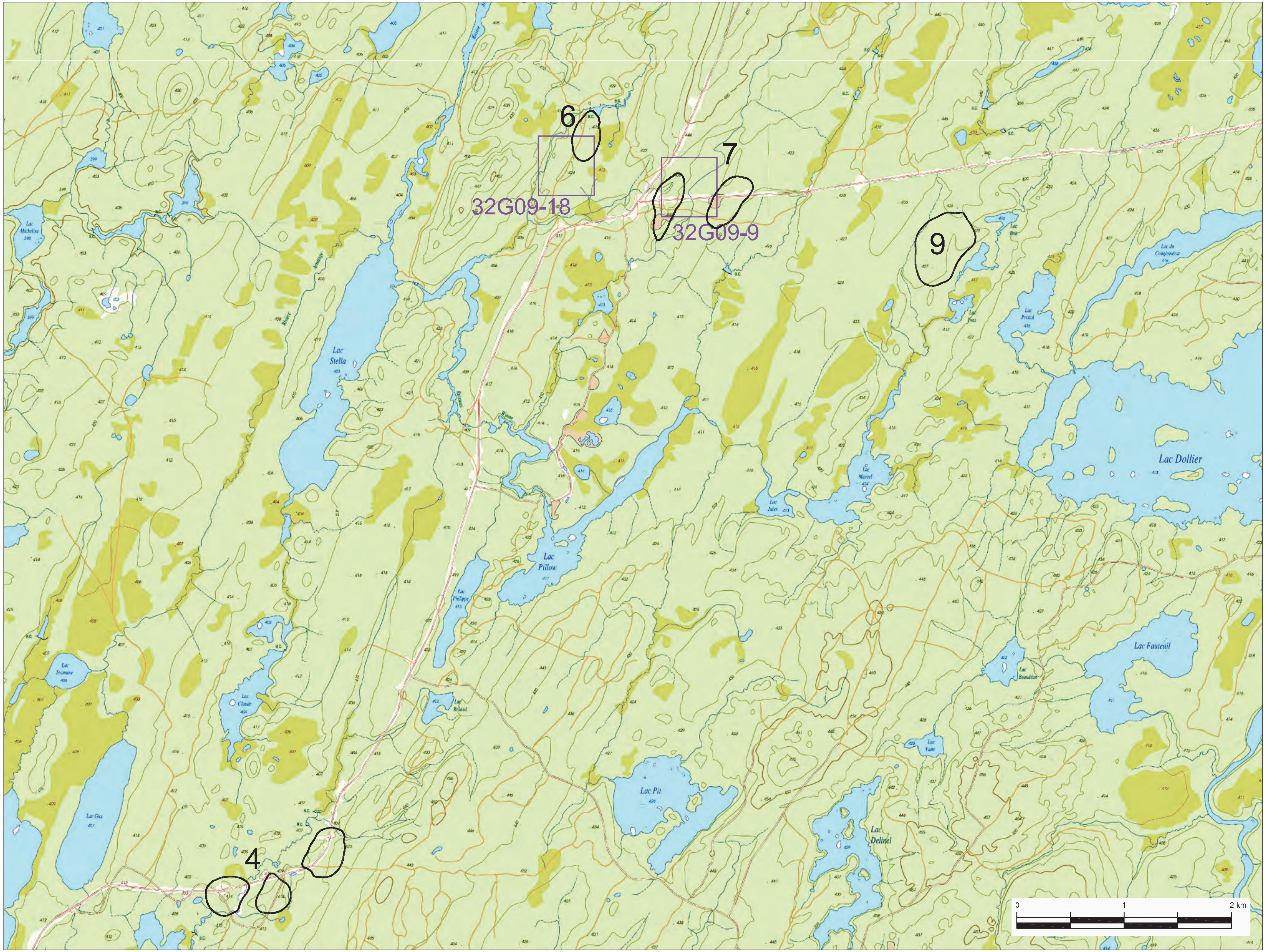
Dossier / File:

Projet minier BlackRock
Phase Exploration

Dessin / Drawing:

FIGURE 4.10
Localisation des bancs d'emprunt

Conçu par / Designed by: N.L.	Date 2011-10-05
Dessiné par / Drawn by: L.T./N.L.	Date 2011-10-07
Vérifié par / Verified by: N.L.	Date 2011-10-07
Approuvé par / Approved by: L.A.	Date 2011-10-11
No. dossier / File no.: P0919	Échelle / Scale: Graphique
No. dessin / Drawing no.:	Feuille / Sheet:



MÉTAUX BLACKROCK
BLACKROCK METALS

Emplacement approximatif des bancs d'emprunt GESTIM

Emplacement approximatif des bancs d'emprunt ENTRACO

SOURCE (fond de plan) :
Cartes 1:20 000 du MRNF

Rév.	Description	Par/By	Date
–	–	–	–
–	–	–	–

ENTRACO
Conseillers en environnement

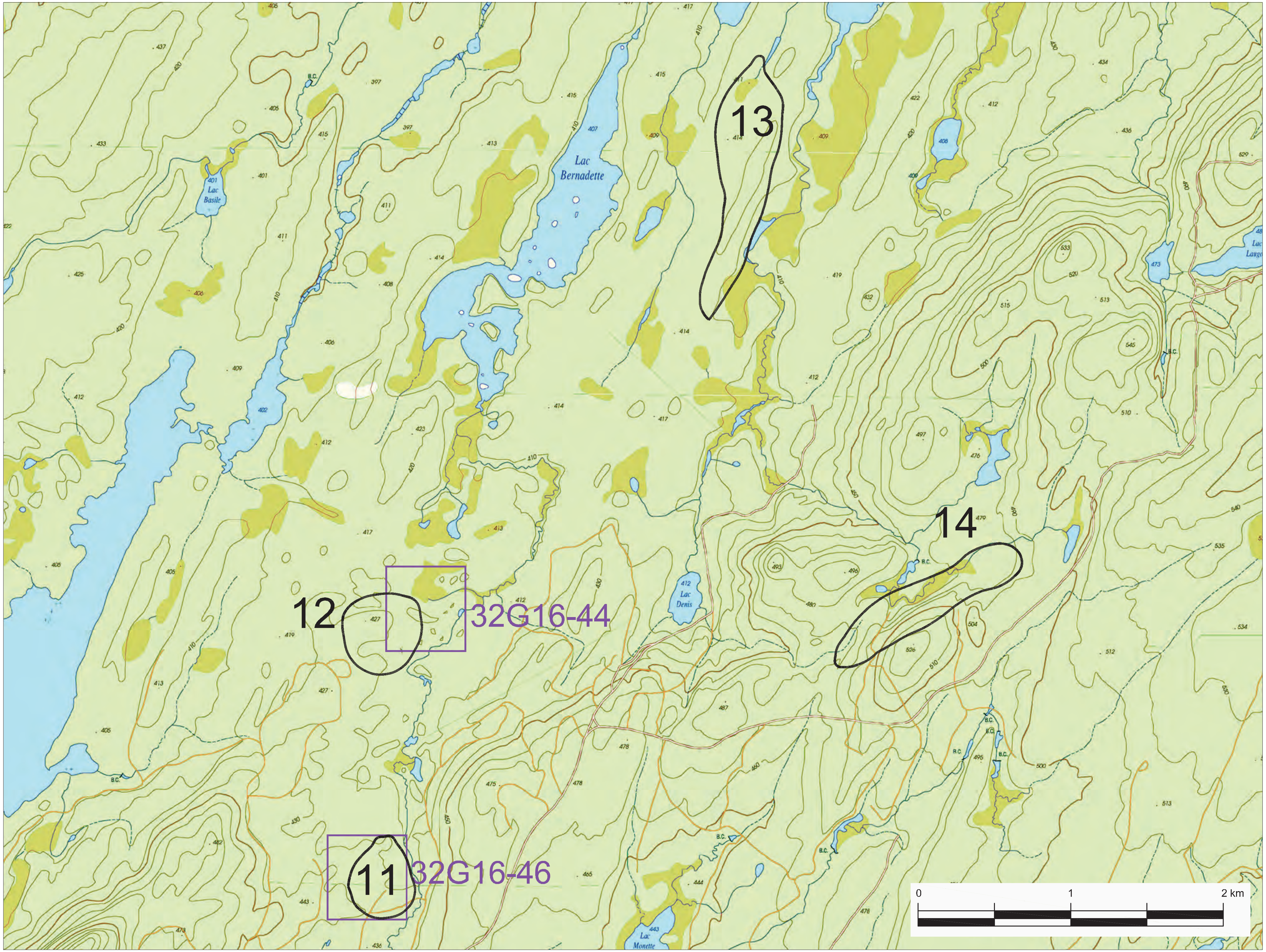
Dossier / File:

Projet minier BlackRock
Phase Exploration

Dessin / Drawing:

FIGURE 4.11
Localisation des bancs d'emprunt

Conçu par / Designed by: N.L.	*Date* 2011-10-05
Dessiné par / Drawn by: L.T./N.L.	*Date* 2011-10-07
Vérifié par / Verified by: N.L.	*Date* 2011-10-07
Approuvé par / Approved by: L.A.	*Date* 2011-10-11
No. dossier / File no.: P0919	*Échelle / Scale:* Graphique
No. dessin / Drawing no.:	*Feuille / Sheet:*



MÉTAUXBLACKROCK
BLACKROCKMETALS

Emplacement approximatif des bancs d'emprunt GESTIM

Emplacement approximatif des bancs d'emprunt ENTRACO

SOURCE (fond de plan) :
Cartes 1:20 000 du MRNF

Rév.	Description	Par/By	Date
-	-	-	-
-	-	-	-

ENTRACO
Conseillers en environnement

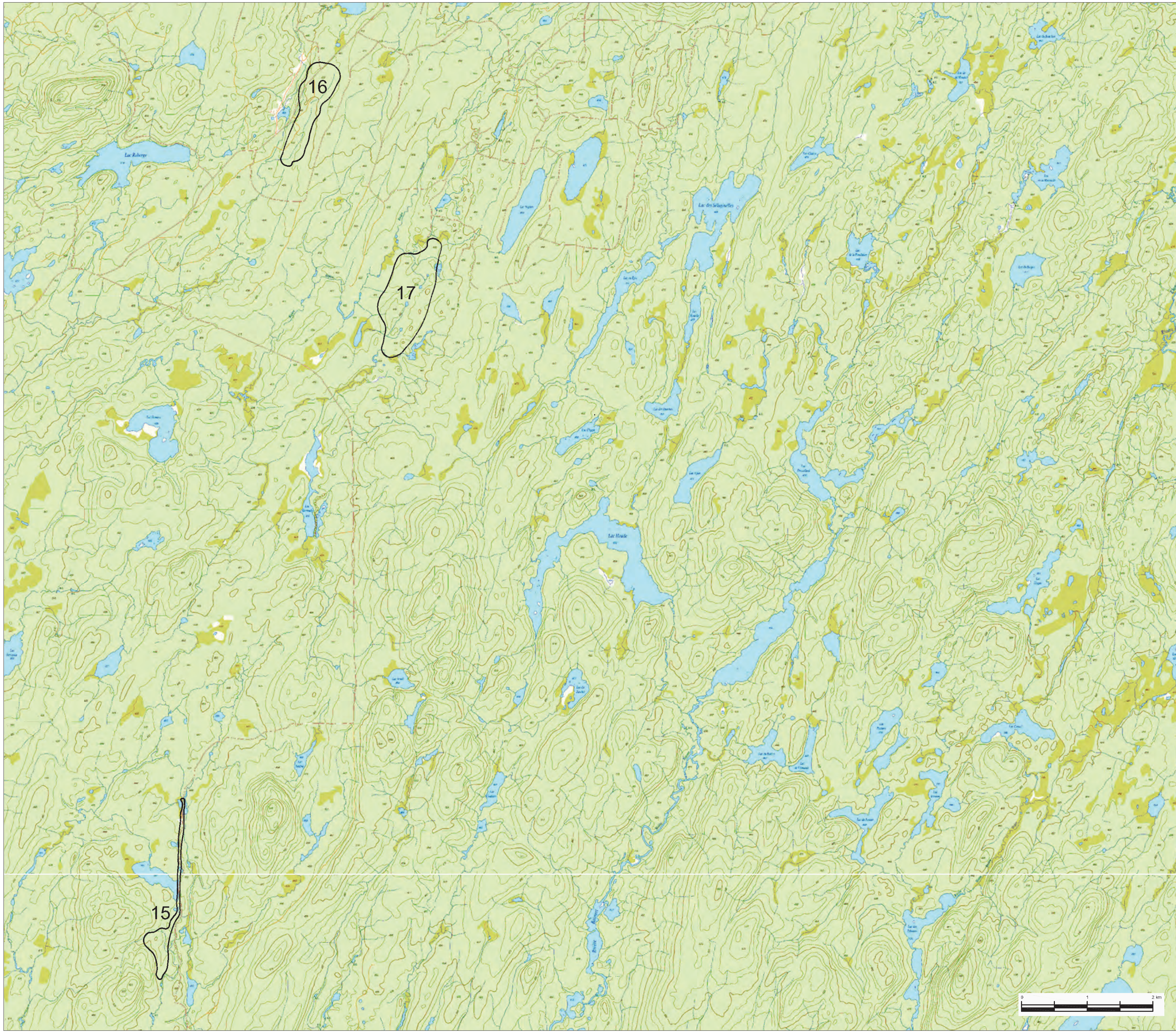
Dossier / File:

Projet minier BlackRock
Phase Exploration

Dessin / Drawing:

FIGURE 4.12
Localisation des bancs d'emprunt

Conçu par / Designed by: N.L.	Date 2011-10-05
Dessiné par / Drawn by: L.T./N.L.	Date 2011-10-07
Vérifié par / Verified by: N.L.	Date 2011-10-07
Approuvé par / Approved by: L.A.	Date 2011-10-11
No. dossier / File no.: P0919	Échelle / Scale: Graphique
No. dessin / Drawing no.:	Feuille / Sheet:



MÉTAUXBLACKROCK
BLACKROCKMETALS

Emplacement approximatif des bancs d'emprunt GESTIM

Emplacement approximatif des bancs d'emprunt ENTRACO

SOURCE (fond de plan) :
Cartes 1:20 000 du MRNF

Rév.	Description	Par/By	Date
–	–	–	–
–	–	–	–

ENTRACO
Conseillers en environnement

Dossier / File:

Projet minier BlackRock
Phase Exploration

Dessin / Drawing:

FIGURE 4.13
Localisation des bancs d'emprunt

Conçu par / Designed by: N.L.	Date 2011-10-05
Dessiné par / Drawn by: L.T./N.L.	Date 2011-10-07
Vérifié par / Verified by: N.L.	Date 2011-10-07
Approuvé par / Approved by: L.A.	Date 2011-10-11
No. dossier / File no.: P0919	Échelle / Scale: Graphique
No. dessin / Drawing no.:	Feuille / Sheet:

4.8 STRUCTURE DESIGN AND STABILITY

4.8.1 Containment Dam Design Criteria

Tailings dams are made of granular material and are built on top of a starter dam that serves as a base for sequential additions to tailings dam height and length as the volume of tailings increases. The Lac Denis dam is an exception to this sequential approach to construction; it is built in its entirety right at the beginning of the construction phase.

The dams have an impervious core in order to contain the fine tailings and water. All the dams have emergency spillways located three metres below the theoretical wave and ice level.

Granular materials used in dam design are:

- Coarse shot rock: > 600 mm
- Screened shot rock: 300-600 mm
- Fine crushed rock: 0-300 mm

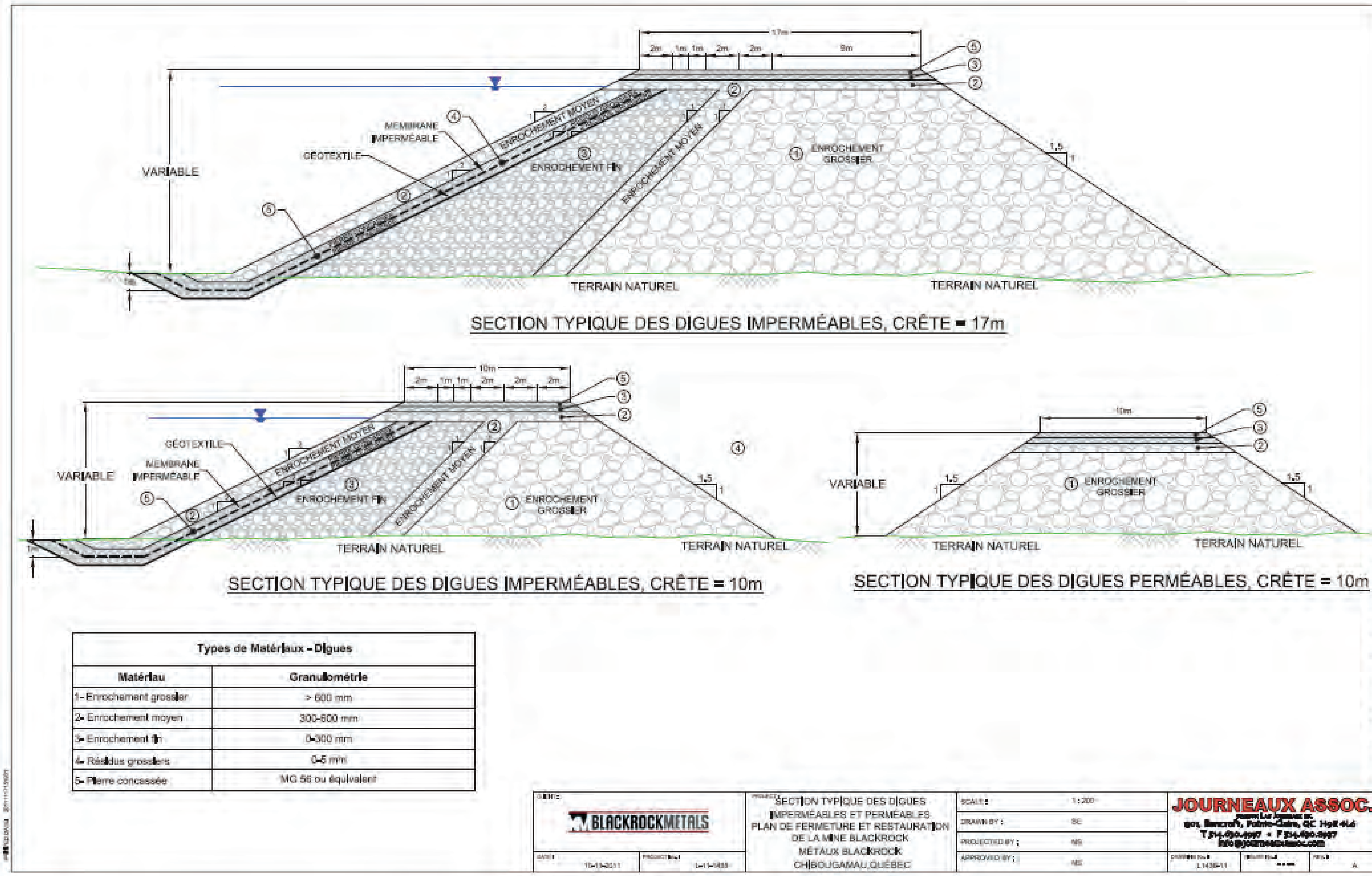
The dams can each contain a 1,000-year flood event. This design criterion is based on a fine tailings and polishing pond volume equivalent to the volume of process water required for one month of production. A tailings dam cross-section is shown in Figure 4.14. From downstream to upstream, dams are made of a coarse rock cladding for stability and wave resistance. This cladding is followed by sand or filter sand within a geotextile membrane that prevents the filter material from migrating downstream. Next comes the core made of impermeable glacial till. A zone of silty filter sand is followed by a layer of sand. A geotextile is placed between the filter bed and the random fill material that makes up the bulk of the dam.

4.8.2 Dam and Stockpile Stability Analysis

Stability analyses for the dams were performed by *Journeaux et associés* in July 2011 based to final dam height. This work was carried out using Geo-Slope‟s *SLOPE/W* software. The geotechnical data used was from the site geotechnical investigation, the literature and experience gained in the soils of the region. The peak ground acceleration (PGA) for the region is 0.036 g according to the 2010 *National Building Code*, or Zone 1 (A=0.05) according to CAN/CSA-S6-06.

The MRNF requires a minimum safety factor of 1.3 under static loading and 1.1 under dynamic loading. The stability analysis results are gven in Table 4.9.

Figure 4.14 Cross-Section of Tailings Dams



Types de Matériaux - Digues	
Matériau	**Granulométrie**
1- Enrochement grossier	> 600 mm
2- Enrochement moyen	300-600 mm
3- Enrochement fin	0-300 mm
4- Résidus grossiers	0-5 mm
5- Pierre concassée	MG 56 ou équivalent

Table 4.9 Safety Factors Obtained for Dam Stability

Dam	Static Stability	Seismic Stability
Fine tailings pond	1.66	1.59
Polishing pond	1.49	1.43
MRNF requirements	1.3	1.1

The stability analysis takes into account information on soils and bedrock, as identified by LVM in the summer of 2011 (holes BBAJ-BH-4001 to 4006 and exploration trenches BBAJ-TP-3001 to 3014). The analysis also takes into account typical properties of compacted soils according to the NAVFACDM7 1982 manual. The glacial till under the dams ranges from 1.2 to 2.6 metres thick. A thickness of 2.0 metres was used for the stability analysis.

Half the seismic acceleration value of 0.036 g was used for the stability analysis for the containment dams and waste rock piles. Modelling for the tailings pond, the polishing pond and Lac Denis was done at maximum storage capacity.

Stability testing of the waste rock and coarse tailings piles is also based on the properties of the in situ soil from holes drilled by LVM (BBAF-TP-2047 to 2051). The in situ material is from 2.2 to over six metres thick (BBAF-TP-2044 to 2046). The simulations were done based on conditions at the start of construction and when the piles have reached their maximum height. Safety factors are equal to or greater than 1.5 under static conditions and 1.3 under dynamic conditions.

The potential for water loss in the impermeable core of the impoundment structures was also analyzed. The glacial till in the construction area has a very low permeability. It contains 26.5 to 48.7% fine particles. Once this material is compacted, its permeability is from $k=10^{-6}$ to 10^{-7} cm/sec. This till is therefore quite adequate for the construction of foundations and can be used for the impervious core of the dams. The permeability results for the in situ soil are similar to the results for glacial till deposits found elsewhere on the BlackRock property.

Rock permeability sampling data (LVM BBAJ, BH-4001 to 4006) indicates moderate to excellent quality (RQD of 60 to 100%) and low permeability of from 10^{-4} to 10^{-6} in the first ten metres.

4.9 PROJECT COSTS

The results of the BBA feasibility study dated August 5, 2011, show that is both technically and economically possible to produce 2.5 Mt/year of magnetite concentrate from the Southwest deposit, for a mine life of 15 years.

It must also be noted that the vanadium in the concentrate represents potential additional revenue. The presence of vanadium in the concentrate gives BlackRock an edge over conventional iron ore producers, making it much less sensitive to a global decline in demand. Vanadium can be extracted from the magnetite and transformed into vanadium pentoxide (V_2O_5). Vanadium in the form of V_2O_5 is in demand for the manufacturing of high-strength steel, particularly for aerospace applications and tool-making. BlackRock‟s situation is unique among

Quebec iron producers. Furthermore, the coarse tailings contain titanium that might also eventually be recoverable. These tailings will be disposed of in such a way that they can be easily reclaimed.

The BlackRock mining project cost estimate meets the requirements for a Class 2 estimate, meaning that it provides sufficient detail for cost monitoring and control during construction and operation. This type of estimate has many detailed budget items. Accuracy ranges from 15% on the high side of actual to 10% on the low side.

4.9.1 Operating Costs

Operating costs cover mining and processing activities, general and administrative expenses, and the costs of handling and transport to port. Table 4.10 provides a summary of operating costs.

Table 4.10 Summary of Operating Costs

Budget Item	$M/year	$/t of concentrate
Mining	55.9	22.36
Processing	45.4	18.17
Rail transfer point	2.97	1.19
Transport: mine to transfer point	8.75	3.50
Transport: transfer point to port	40.0	16.0
Port	15.0	6.00
General and administrative expenses	8.7	3.48
Other	1.25	0.50
Rolling stock lease (years 1 to 10)	3.27	1.31
Mining equipment lease (years 1 to 7)	10.3	4.12
Total, years 1 to 7	**188.9**	**75.5**
Total, years 8 to 10	**191.8**	**76.7**
Total, years 11 and later	**174.1**	**69.63**

Source: BlackRock Metals, Feasibility Study Report, BBA, August 5, 2011
Costs are based on annual production of 2.5 Mt of concentrate per year.

4.9.2 Capital Costs

Capital costs include mining, processing and ore transport facilities and associated infrastructure.

Table 4.11 summarizes the direct and indirect capital costs.

Table 4.11 Summary of Direct and Indirect Capital Costs

Budget Item	Initial ($M)	Ongoing ($M)
Direct costs		
Mine electrical and infrastructure	14.5	
Off-site electrical and infrastructure	53.9	
Crushing and stockpiling	67.0	
Processing plant	228.2	
Tailings and water management	36.8	
Mining equipment		55.8
Subtotal (direct costs)	400.4	
Indirect costs		
Owner"s cost	6.2	
Engineering, procurement and construction management (EPCM)	40.3	
Construction and commissioning	63.1	
Contingency	43.5	
Soubtotal (indirect costs)	153.1	
TOTAL	**553.5**	**55.8**

Source: BlackRock Metals, Feasibility Study Report, BBA, August 5, 2011

4.9.3 Manpower Requirements

A direct cost of some 1,290,000 hours is estimates for project construction. Table 4.12 shows these hours by discipline. Work will be performed by skilled contractors who will be asked to bid on various workpackages.

Table 4.12 Work Hours by Discipline - Construction

Discipline	Number of Hours	Main Jobs
Architecture	124,600	Specialists in exterior finishing, roofers, interior finishing carpenters, plumbers
Concrete	282,819	Carpenters, labourers, metal workers, cement workers
Civil	311,890	Labourers, heavy equipment operators and truck operators
Structural steel	83,162	Steel erectors
Mechanical	197,731	Industrial mechanics, boilermakers
Piping	172,926	Pipefitters
Electricity	87,492	Electricians
Instrumentation	25,684	Instrumentation technicians, electricians
Telecommunications	3,586	Telecommunications specialists

During the operation phase, annual operating and maintenance manpower requirements will range from 80 to 160 people. Preconstruction activities require the smallest number of people, 80, while some 160 workers are needed from the sixth to the tenth year of operation. The mine will operate with 12-hour work shifts and four crews rotating on day and night shift.

The highest demand is for heavy-equipment operators (40 to 72 jobs per year) and mechanics (14 to 28 jobs per year). Table 4.13 shows the annual manpower requirements for each type of job.

Staff will be hired at an annual salary, and will number 60 to 68 per year during the life of the project. Table 4.14 shows the types of jobs to be filled for management, operations, maintenance, engineering and geology.

Table 4.13 Annual Manpower Requirements by Job Type *(see separate document with translation)*

EMPLOIS	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
	Avt. Projet	Ann.1	Ann.2	Ann.3	Ann.4	Ann5.	Ann.6	Ann.7	Ann.8	Ann.9	Ann10	Ann.11	Ann.12	Ann.13	Ann.14	Ann.15	Ann.16
Opération de la mine																	
Opérateur de pelle et chargeur	4	4	4	6	6	6	8	8	6	6	6	6	6	4	4	2	2
Opérateur de camion de roulage	12	14	18	22	24	28	32	36	34	34	34	26	26	24	20	16	12
Opérateur de foreuse	2	4	4	6	6	8	8	8	8	6	6	6	4	4	4	4	2
Opérateur de bouteur sur roues	4	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
Opérateur de bouteur sur chenilles (580 HP)	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
Opérateur de bouteur sur chenilles (410 HP)	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Opérateur de niveleuse	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
Opérateur de camion à eau/chasse neige	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Autres équipements auxiliaires	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
Manœuvres	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
Concierges	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Sous-total	**57**	**65**	**69**	**77**	**79**	**83**	**91**	**95**	**89**	**89**	**89**	**81**	**79**	**75**	**71**	**65**	**57**
Entretien																	
Mécanicien de chantier	4	4	4	8	8	8	8	8	8	8	8	8	8	4	4	4	4
Soudeur de chantier	2	2	2	4	4	4	4	4	4	4	4	4	4	2	2	2	2
Électricien de chantier	2	2	2	4	4	4	4	4	4	4	4	4	4	2	2	2	2
Mécanicien d'excavation	4	4	4	8	8	8	8	8	8	8	8	8	8	4	4	4	4
Électricien d'atelier	2	4	4	4	6	6	6	6	6	6	6	6	6	6	4	4	4
Mécanicien d'atelier	6	8	8	10	10	10	12	12	12	12	12	12	12	12	10	8	8
Aide mécanicien	2	2	2	4	4	4	4	4	4	4	4	4	4	4	4	2	2
Soudeur/machiniste	2	2	2	4	4	4	4	4	4	4	4	4	4	4	4	2	2
Conducteur camion service	1	2	2	2	2	4	4	4	4	4	4	4	4	2	2	2	2
Technicien en électronique	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Concierge	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Préposé aux outils et pièces	2	2	2	2	2	2	4	4	4	4	4	4	4	2	2	2	2
Sous-total	**29**	**35**	**35**	**53**	**55**	**57**	**61**	**61**	**61**	**61**	**61**	**61**	**61**	**45**	**41**	**35**	**35**
TOTAL	**86**	**100**	**104**	**130**	**134**	**140**	**152**	**156**	**150**	**150**	**150**	**142**	**140**	**120**	**112**	**100**	**92**

Table 4.14 Annual Management and Technical Personnel Requirements by Job Type

Job	Preproduction	(Years 1 to 3)	(Years 4 to 16)
Mine superintendent	1	1	1
Mine general foreman	2	2	2
Shift foreman	8	8	8
Drilling and blasting foreman	4	4	4
Blaster	1	2	2
Dispatcher	4	4	4
Training foreman	1	1	1
Mine production clerk	1	1	1
Secretary	1	1	1
Subtotal, operating staff	**24**	**24**	**24**
Maintenance superintendent	1	1	1
Maintenance general foreman	1	1	1
Maintenance planner	2	2	2
Project engineer	1	1	1
Maintenance foreman	4	4	4
Matinenance trainer	1	1	1
Maintenance clerk	1	1	1
Subtotal, maintenance staff	**11**	**11**	**11**
Chief engineer	1	1	1
Senior planning engineer	1	1	1
Pit engineer	1	1	1
Geotechnical engineer	1	1	1
Blasting engineer	1	1	1
Mine engineering technician	2	2	2
Mine surveyor	2	2	2
Assistant surveyor	2	2	2
Subtotal, engineering staff	**11**	**11**	**11**
Chief geologist	1	1	1
Geologist	1	1	1
Grade control geologist	2	2	2
Geological technician	2	2	2
Sampler	4	8	8
IBA agreement manager	2	4	0
IBA agreement technical assistant	2	4	0
Subtotal, geology staff	**14**	**22**	**14**
Total	**60**	**68**	**60**

4.9.4 Rolling Stock

The rolling stock required for mine operation, by activity, is as follows:

Drilling and Blasting

- 2 *ATLAS-Copco PV 235*-type drills

Loading and Haulage

- 2 25 m^3 track hydraulic shovels: *KOMATSU PC-5500*-type
- 1 24 m^3 wheel hydraulic loader: *LÉTOURNEAU L-1850*-type
- 10 220-tonne haulage trucks: *KOMATSU 830E-1AC*-type

In addition to the equipment used for ore loading and haulage, the following heavy equipment will also be required, mainly for overburden stripping and tailings site and road management:

- 1 wheel bulldozer (627 HP);
- 2 track bulldozers (580 HP);
- 2 16-ft graders;
- 1 30,000-gallon water truck (dust control).

The following ancillary equipment is also required during operation. This equipment is used much less than the equipment listed above:

- 1 hydraulic crane;
- 1 *Air Track*-type drill;
- 1 wheel loader;
- 1 articulated dump truck;
- 1 mechanical shovel;
- 2 service trucks (fuel and lubricants);
- 1 flatbed truck;
- 1 mechanical service truck;
- 1 tire service truck
- 1 tire-changing truck;
- 3 minibuses;
- 6 4x4 pick-ups (Crew-cab type)
- 6 4x4 pick-ups (single cab type);
- 6 site lighting units;
- 2 250-HP electric pumps (pit dewatering);
- 4 mobile diesel pumps (125 HP).

4.10 PROJECT SCHEDULE

Preliminary exploration-phase work is planned prior to issuance of the MDDEP certificate of authorization. This work mainly involves the exploration camp and the installation of equipment for drinking water supply and drinking water and wastewater treatment.

The project schedule is based on an accelerated supply and construction manpower recruiting scenario. The construction period starts as soon as government approvals are received. The construction camp will therefore be set up quickly starting in March 2012.

Dam construction for the fine tailings pond and Lac Denis is also critical to the start of operations. The water required for processing must be recycled in a closed loop. To achieve this, construction of the Lac Denis dam must start in May 2012 and be finished by November. This will allow 3 Mm^3 of water to collect so that mineral processing can begin at the end of 2013.

For the same reasons, the fine tailings and polishing pond dams must be built between May and October 2013.

Work on major equipment engineering and detailed engineering started in June 2011 and will be completed by September 2012.

The certificate of authorization for the project is expected to be issued in March 2012, at which time the exploration camp will be expanded so that large-scale construction work and pre-production development can begin. The required authorizations from the federal government are expected in early June 2012, at which point the dams will be closed across the rivers and lakes in question.

The 161-kV line should be operational by March 2013 and the project power grid by April 2013. Construction should be completed by December 2013. The project master schedule is shown in Figure 4.15.

The various contracts to be awarded are described in Figure 4.16, Contracts Schedule. Construction contracts begin as of March 2012 and end in September 2013.

Figure 4.15 Project MasterSchedule

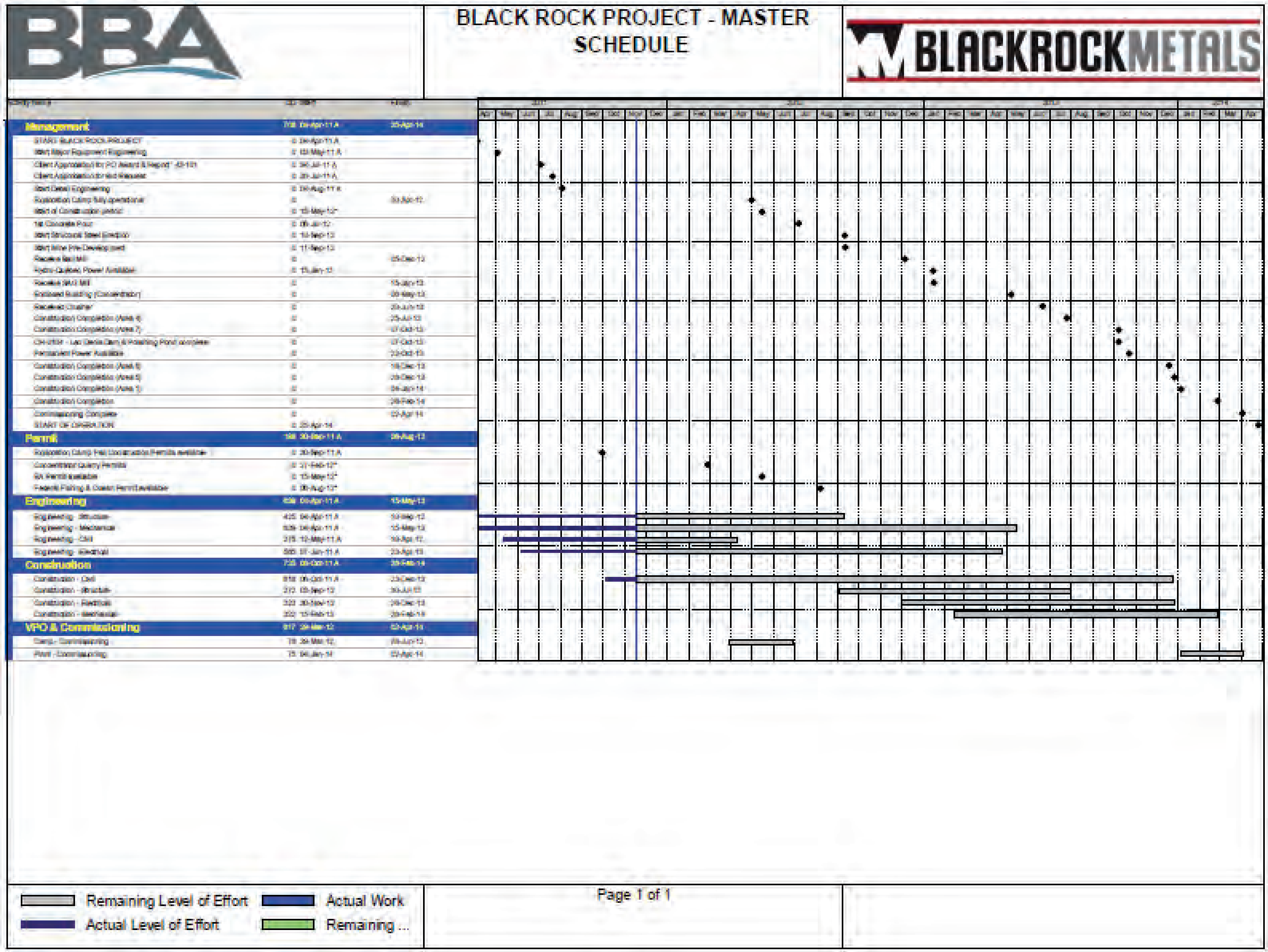
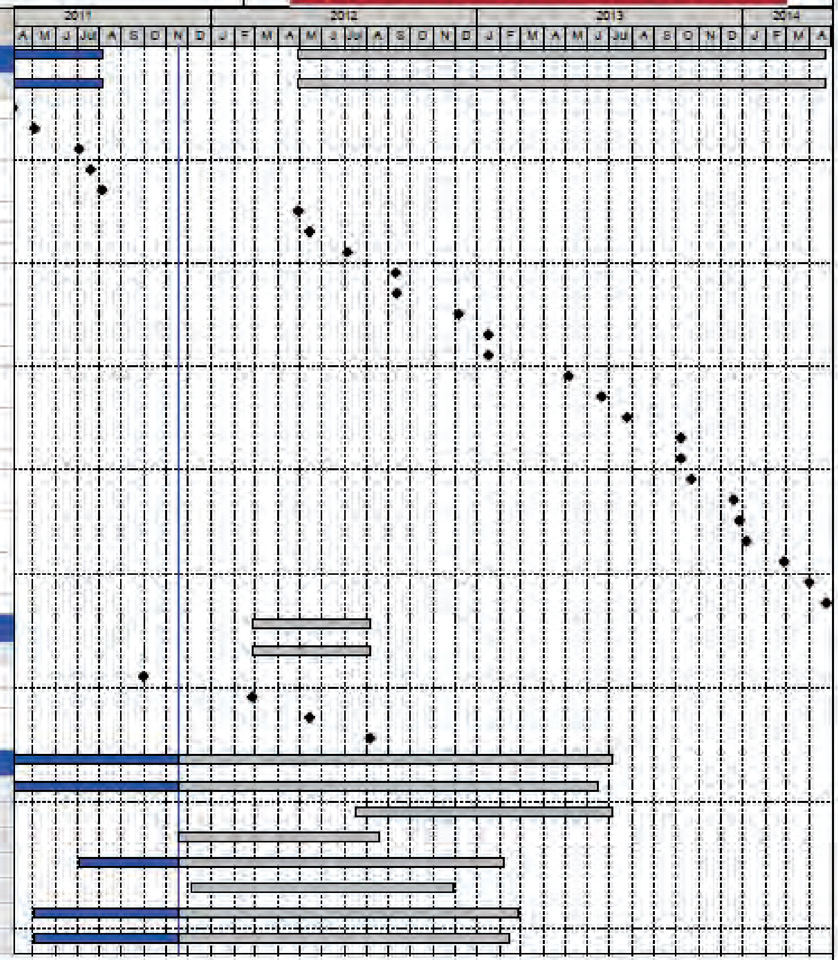


Figure 4.16 Contracts Schedule

BBA — BLACKROCK PROJET - LEVEL 2 Schedule — BLACKROCK METALS

WBS / Activity Name	OD	Start	Finish
Management	706	04-Apr-11 A	25-Apr-14
Project	706	04-Apr-11 A	25-Apr-14
3017004-2011/11/18 START BLACK ROCK PROJECT	0	04-Apr-11 A	
3017004-2011/11/18 Start Major Equipment Engineering	0	03-May-11 A	
3017004-2011/11/18 Client Approbation for PO Award & Report: 43-101	0	04-Jul-11 A	
3017004-2011/11/18 Client Approbation for Bid Request	0	20-Jul-11 A	
3017004-2011/11/18 Start Detail Engineering	0	04-Aug-11 A	
3017004-2011/11/18 Exploration Camp fully operational	0		30-Apr-12
3017004-2011/11/18 Start of Construction period	0	15-May-12*	
3017004-2011/11/18 1st Concrete Pour	0	06-Jul-12	
3017004-2011/11/18 Start Structural Steel Erection	0	10-Sep-12	
3017004-2011/11/18 Start Mine Pre-Development	0	11-Sep-12	
3017004-2011/11/18 Receive Ball Mill	0		05-Dec-12
3017004-2011/11/18 Hydro-Québec Power Available	0	15-Jan-13	
3017004-2011/11/18 Receive SAG Mill	0		15-Jan-13
3017004-2011/11/18 Enclosed Building (Concentrator)	0		06-May-13
3017004-2011/11/18 Received Crusher	0		20-Jun-13
3017004-2011/11/18 Construction Completion (Area 4)	0		24-Jul-13
3017004-2011/11/18 Construction Completion (Area 7)	0		07-Oct-13
3017004-2011/11/18 CH-0104 - Lac Denis Dam & Polishing Pond complete	0		07-Oct-13
3017004-2011/11/18 Permanent Power Available	0		22-Oct-13
3017004-2011/11/18 Construction Completion (Area 6)	0		18-Dec-13
3017004-2011/11/18 Construction Completion (Area 5)	0		26-Dec-13
3017004-2011/11/18 Construction Completion (Area 1)	0		04-Jan-14
3017004-2011/11/18 Construction Completion	0		26-Feb-14
3017004-2011/11/18 Commissioning Complete	0		02-Apr-14
3017004-2011/11/18 START OF OPERATION	0	25-Apr-14	
Permit	198	30-Sep-11 A	06-Aug-12
Project	198	30-Sep-11 A	06-Aug-12
3017004-2011/11/18 Exploration Camp Pad Construction Permits available	0	30-Sep-11 A	
3017004-2011/11/18 Concentrator Quarry Permits	0	27-Feb-12*	
3017004-2011/11/18 EA Permit available	0	15-May-12*	
3017004-2011/11/18 Federal Fishing & Ocean Permit available	0	06-Aug-12*	
Engineering	524	04-Apr-11 A	04-Jul-13
Temporary installations	512	04-Apr-11 A	14-Jun-13
Off Site (Train Loading station and Road 210)	223	18-Jul-12	04-Jul-13
Infrastructures (Acces road & Water Collection)	173	18-Nov-11	17-Aug-12
Services (Mainsub, Telecom and Gate)	370	04-Jul-11 A	05-Feb-13
Mine (Substation & Garage)	229	06-Dec-11	27-Nov-12
Crusher	422	03-May-11 A	26-Feb-13
Stockpile and Conveying	416	03-May-11 A	15-Feb-13



Remaining Level of Effort — Actual Work — ◆ Milestone
Actual Level of Effort — Remaining Work

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TASK filters: (Untitled Filter), Not Level of Effort.

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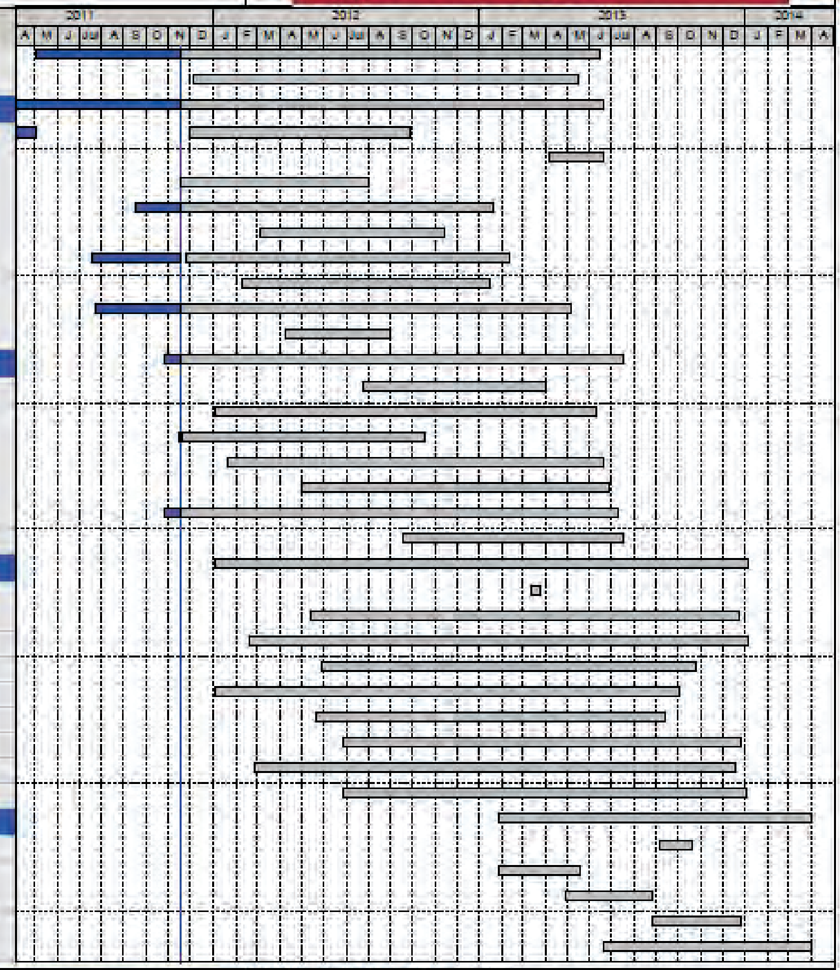
Figure 4.16 Contracts Schedule (cont'd)

BLACKROCK PROJET - LEVEL 2 Schedule

WBS / Activity Name	OD	Start	Finish
Concentrator	493	03-May-11 A	14-Jun-13
Tailings & Water Management	333	05-Dec-11	15-May-13
Procurement	514	04-Apr-11 A	19-Jun-13
Temporary installations	348	04-Apr-11 A	27-Sep-12
Off Site (Train Loading station and Road 210)	48	08-Apr-13	13-Jun-13
Infrastructures (Acces road & Water Collection)	183	18-Nov-11	02-Aug-12
Services (Mainsub, Telecom and Gate)	310	16-Sep-11 A	21-Jan-13
Mine (Substation & Garage)	164	05-Mar-12	13-Nov-12
Crusher	362	20-Jul-11 A	11-Feb-13
Stockpile and Conveying	215	10-Feb-12	15-Jan-13
Concentrator	416	22-Jul-11 A	08-May-13
Tailings & Water Management	95	09-Apr-12	31-Aug-12
Fab & Delivery	398	27-Oct-11 A	17-Jul-13
Infrastructures (Acces road & Water Collection)	156	25-Jul-12	01-Apr-13
Services (Mainsub, Telecom and Gate)	371	03-Jan-12	10-Jun-13
Mine (Substation & Garage)	243	14-Nov-11 A	19-Oct-12
Crusher	330	20-Jan-12	20-Jun-13
Stockpile and Conveying	269	30-Apr-12	27-Jun-13
Concentrator	383	27-Oct-11 A	09-Jul-13
Tailings & Water Management	190	18-Sep-12	17-Jul-13
Construction	461	02-Jan-12	04-Jan-14
Temporary installations	12	12-Mar-13	26-Mar-13
Off Site (Train Loading station and Road 210)	491	15-May-12	23-Dec-13
Infrastructures (Acces road & Water Collection)	575	20-Feb-12	04-Jan-14
Services (Mainsub, Telecom and Gate)	428	29-May-12	24-Oct-13
Mine (Substation & Garage)	537	02-Jan-12	03-Oct-13
Crusher	305	22-May-12	14-Sep-13
Stockpile and Conveying	458	26-Jun-12	26-Dec-13
Concentrator	422	27-Feb-12	18-Dec-13
Tailings & Water Management	463	26-Jun-12	01-Jan-14
VPO & Commissioning	269	26-Jan-13	02-Apr-14
Services (Mainsub, Telecom and Gate)	40	03-Sep-13	19-Oct-13
Mine (Substation & Garage)	96	26-Jan-13	18-May-13
Crusher	76	30-Apr-13	26-Aug-13
Stockpile and Conveying	77	26-Aug-13	26-Dec-13
Concentrator	176	20-Jun-13	02-Apr-14



Remaining Level of Effort — Actual Work — ◆ Milestone
Actual Level of Effort — Remaining Work

Page 2 of 3

TASK filters: (Untitled Filter), Not Level of Effort.

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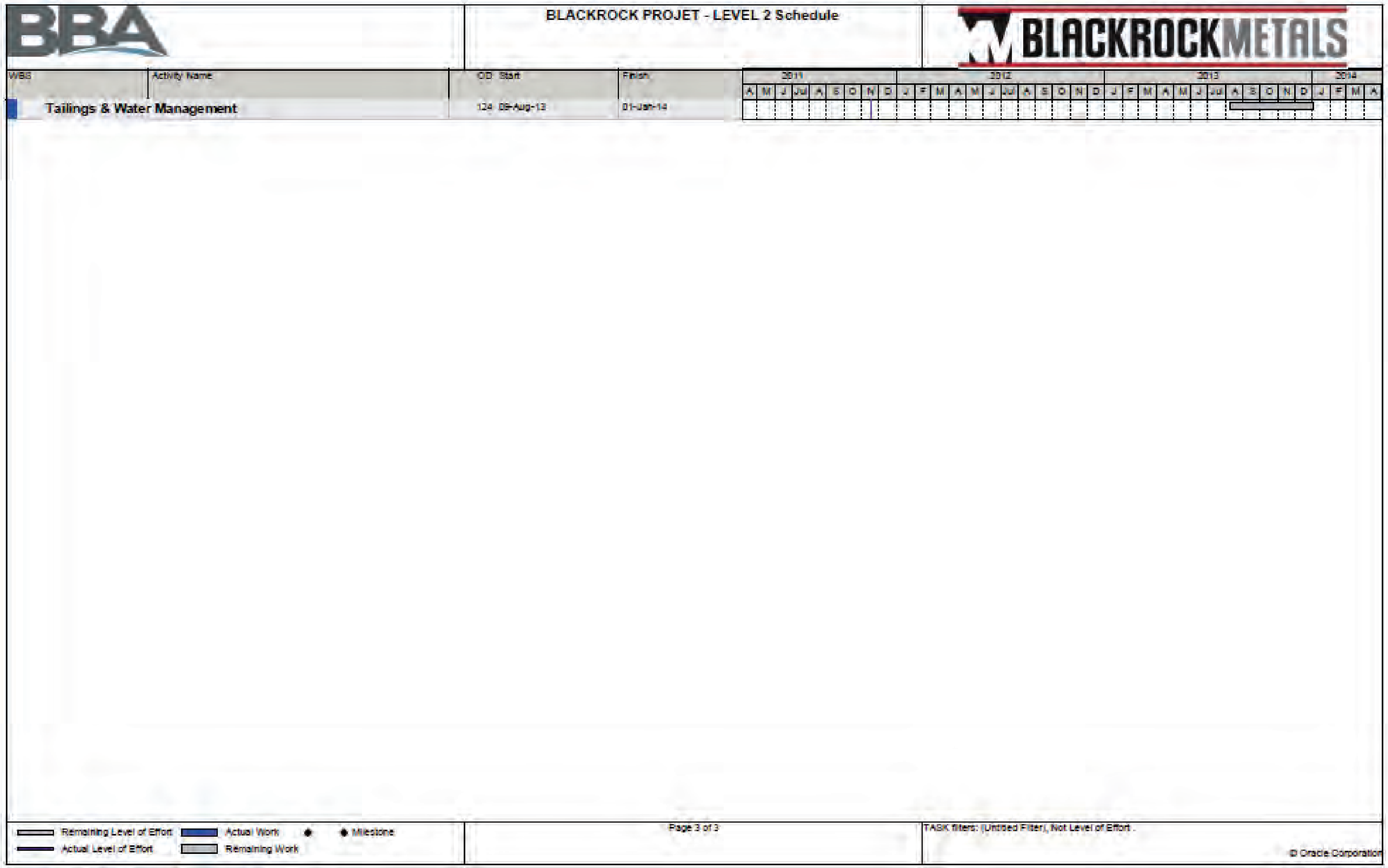
Figure 4.16 Contracts Schedule (cont'd)



REFERENCES

Breton, Banville & Associées (BBA), August 2011. *BlackRock Project, Feasibility Study Report (Volumes 1 and 2).*

Breton, Banville & Associées (BBA), August 2011. Métaux BlackRock Inc. Chibougamau - Réponses de BBA à Entraco pour la rédaction de l‟étude d‟impact environnemental.

Ministère du Développement Durable, de l‟Environnement et des Parcs, Direction des politiques de l‟eau, Service des eaux industrielles ENV/2005/0120. avril 2005. *Directive 019* sur l‟industrie minière.

5. ATMOSPHERIC DISPERSION OF CONTAMINANTS

5.1 BACKGROUND

This chapter looks at atmospheric dispersion modelling and concentration calculations for contaminants emitted by various activities planned for the mining project. The effects on the area‟s air quality are evaluated, and maximum concentrations obtained are checked against applicable Quebec standards for both project construction (Phase 1) and operation (Phase 2). For the purposes of the study, two modelling scenarios were considered for Phase 2 (Scenario 1: mine start-up year 2014, and Scenario 2: operating year 2020).

The final product from iron ore mining is a magnetite concentrate containing titanium (Ti) and vanadium (V). Since titanium and vanadium do not require any special processing, the future on-site concentrator has been designed to process magnetite iron ore. The forecast life of the zone to be mined is 15 years. Iron ore from the Southwest zone (drilling, blasting and haulage within the pit) will be trucked to the primary crusher located several hundred metres south of the mine. Conveyors will transfer the crushed ore to a dome-sheltered ore stockpile to feed the concentrator. The building that houses the concentration process is 95.65 m long x 64 m wide x 33 m high. The final product from the concentrator will be hauled by truck along a 25-km long upgraded logging road connecting the mine site to the rail transfer point.

The second section of this chapter pertains to modelling methodology, particularly the atmospheric dispersion model used to determine future maximum concentrations of contaminants emitted as gas or particulate matter into the ambient air. The third section characterizes the principal sources of the selected contaminants, and the method used to calculate their respective emission rates. The fourth section gives initial concentrations and the criteria selected for each contaminant modelled. The fifth section presents simulation results for the various modeling scenarios considered in this study.

The main conclusions of this study, including measures to mitigate the effects on air quality, are presented in Section 5.6. Appendix 5 (5.1) gives a detailed account of the many calculations used to determine contaminant emission factors for all sources considered. Appendix 5.2 provides a sample data output file from the AERMOD model used in the simulations.

Modelling work was done in accordance with the MDDEP‟s air dispersion modelling guide (MDDEP, 2005). The modelling specification (*devis de modélisation*) submitted to the MDDEP allowed the validation of certain data required for air dispersion simulations associated with the project.

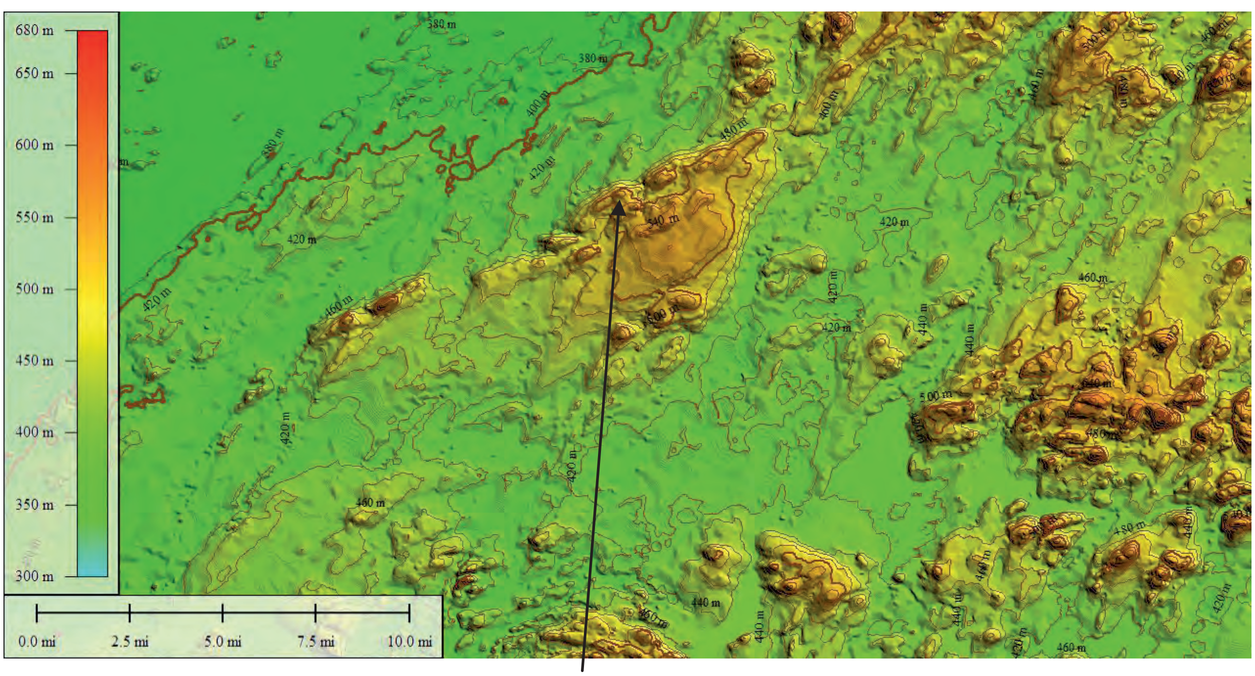
Photo 5.1 shows a regional panoramic view from the western shore of Lac Chibougamau and points to the mine site location on the lake‟s eastern shore. The mine site is located in a forested environment with a relatively complex topography and numerous lakes (Lac Chibougamau, Lac Bernadette, etc.).

Figure 5.1 shows the existing topography in the area of the mine site, which ranges in elevation from 400 m (Lac Bernadette sector) to 533 m (deposit hill).

Photo 5.3: Panoramic view from the *Centre d'intérêt minier* lookout, looking towards the future mine site.

Photo Entraco 2011

Figure 5.1 Topography of the Study Area (the arrow points to the deposit)



5.2 MODELLING METHODOLOGY

5.2.1 *AERMOD* Atmospheric Dispersion Modelling System

AERMOD is the atmospheric dispersion modelling system recommended by the MDDEP (2005) to study and calculate concentrations of contaminants emitted by future mining activities. It is a steady-state dispersion model for determining short-range (50 km maximum) contaminant concentrations.

The AERMOD model is equipped with an AERMET pre-processor that processes the meteorological data and surface parameters required for the simulations (surface roughness, albedo and Bowen ratio). AERMOD is also equipped with an AERMAP pre-processor that processes and analyses topography data for the modelling domain.

AERMOD comes with a module called BPIP_PRIME that can process and determine the effects of downwash from buildings near emission sources on atmospheric dispersion of contaminants.

According to the air modelling guide recommended by the MDDEP, the AERMOD model is a level 2 model that is required for atmospheric dispersion studies in most of the following cases:

- when the sum of simulated and ambient emissions represents 80% or more of applicable Quebec standards or criteria;
- when the study area and contaminant emission sources are located in an area of complex topography (valley, edge of a large lake, etc.);
- in industrial parks, namely in urban areas where ambient contaminant levels are relatively high and close to regulatory criteria and standards;
- when oil is used as an alternative fuel in industrial facilities.

The AERMOD model and all its preprocessors are fully integrated in a user-friendly interface called *AERMOD View*, marketed by Lakes Environmental (www.weblake.com). This study was conducted using the latest version of the *AERMOD View* software (version 7.1.0).

5.2.2 Definition of Modelling Scenarios

Simulations are based on a set number of scenarios that relate to the BlackRock project schedule. The project has two major phases:

1. Phase 1 of the project will be carried out from 2012 to 2014 and mainly corresponds to mine facility construction. The only significant emissions are the ones related to the use of fuel oil No. 2 in the five generators to be used during this period. However, during construction, particulate matter may be released from the use of field equipment and from construction of the mine infrastructure, access roads and buildings. No mining activities are planned during the construction phase.
2. Phase 2 is devoted to mining operations, with start-up planned in early 2014. According to information obtained, this phase will last some 15 years, until 2029, when the Southwest pit will have reached its maximum depth of 300 m. For modelling purposes,

there are two scenarios for which maximum concentrations of air contaminants were calculated:

- Scenario 1, with the start-up of operations in 2014 as a reference;
- Scenario 2, with operating year 2020 as a reference.

The two scenarios correspond to two difference depths for the open pit mine, with Scenario 1 corresponding to a 30-m depth and Scenario 2 to a 120-m depth (see Table 5.1).

Table 5.1 Change in the Dimensions of the "Southwest" Open Pit.

Year	"Southwest" Pit Dimensions		
	Depth (m)	Length (m)	Width (m)
2014 (Scenario 1)	30	1500	220
2015	40	1500	360
2016	50	1700	450
2017	60	2200	450
2018	80	220	450
2019	100	2750	450
2020 (Scenario 2)	120	2750	450
2021	140	2750	450
2022	160	2800	450
2023	170	2800	450
2024	180	2800	450
2025	190	2800	450
2026	220	2800	450
2027	240	2800	450
2028	270	2800	450
2029	300	2800	450

5.2.3 Building Dimensions

Table 5.2 gives the dimensions of the main mine-site buildings likely to influence the dispersion of contaminants during mining operations (Phase 2).

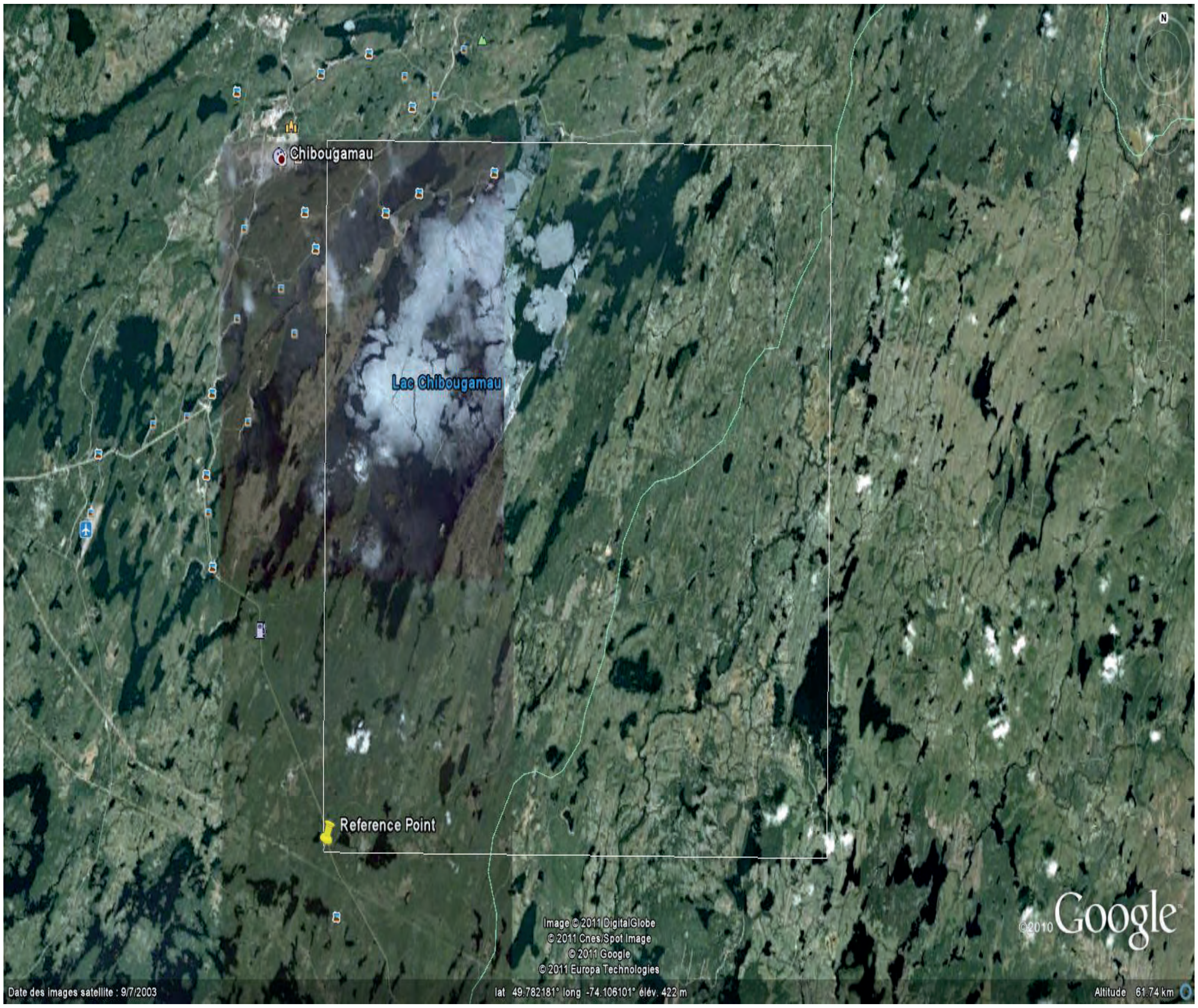
5.2.4 Modelling Domains

The total modelling domain is a 30 km x 30 km area located north of Route 167 and east of Lac Chibougamau (see Figure 5.2). Point receiver grids used to calculate contaminant levels in the ambient air are also comprised in this domain.

Table 5.2 Dimensions of Buildings Expected to be on the Mine Site as of 2014

Building	Length (m)	Width (m)	Height (m)	Southwest Corner Coordinates	
				X-UTM (m)	Y-UTM (m)
Crusher	41.1	14.8	38.8	567736	5516576
Concentrate dome	60	62	25	568065	5515992
Processing plant - concentrator	95.65	64	33	567972	5515855
Main substation	64	15	6	567882	5515910
Conveyors	1,200	3	6	568028	5516068

Figure 5.2 Modelling Domain Used in the Atmospheric Dispersion Study



Given the large size of the study area, three modelling grids were selected to determine contaminant concentrations relating to the mining project:

- **Grid 1, Phase 1**: a 20 km x 20 km domain with a 250-metre mesh size; this grid was used to calculate contaminant concentrations (CO, NO_x, SO_2 and VOCs) produced by point sources, consisting of the two generators located at the construction camp and at the mine site itself during Phase 1 (2012);
- **Grid 2, Phase 2**: a 10 km x 10 km domain with a 250-metre mesh size centred around the BlackRock mine site; this grid was used to calculate concentrations of contaminants related to the operation phase (Scenario 1 - 2014 and Scenario 2 - 2020);
- **Grid 3, Phase 2**: a 5 km x 5 km domain with a 100-metre mesh size, centred around the rail transfer point; this grid was used to calculate maximum concentrations of total particulate matter and of $PM_{2.5}$ produced by truck transport of iron ore on the unpaved logging road (Phase 2, scenarios 1 and 2).

Table 5.3 gives parameters for the three modelling grids.

Table 5.3 Parameters for Modelling Grids used in Phases 1 and 2

	Coordinates of the southwest grid corner (X-UTM ; Y-UTM)	Grid dimensions (km)	Mesh size (m)
Grid 1 - Phase 1	555000.00 mE ; 5505000.00 mN	20 x 20	250
Grid 2 - Phase 2	562500.00 mE ; 5512000.00 mN	10 x 10	250
Grid 3 - Phase 2	548000.00 mE ; 5500000.00 mN	5 x 5	100

5.2.5 Meteorological Data

Basic surface meteorological data (from 2006 to 2010) used in this study comes from the Chibougamau-Chapais airport (YMT) weather observation station, located some 40 km from the mine site. Upper-air weather data is from the Maniwaki radiosonde station (WMW), more than 450 km from the mine site (see Table 5.4).

Table 5.4 Geographic Coordinates for Referenced Weather Stations

Station	Type	TC ID	Latitude (degrees)	Longitude (degrees)	Elevation (m)	Distance* (km)
Chibougamau-Chapais A.	Surface	YMT	49.76 N	74.53 W	387.1	40
Maniwaki	Upper air	WMW	46.38 N	75.97 W	170.0	450

Note: the approximate distance as the crow flies from the BlackRock mine site

Basic meteorological data was processed with the AERMET software to create meteorological data sets for atmospheric dispersion calculations using AERMOD. Surface parameter values used to prepare the two meteorological data sets are shown in Table 5.5. Given Chibougamau‟s local climate, the two-season principle was selected (a winter season with snow and a summer season without snow). Since numerous lakes and bodies of water are in close proximity to the mine site on its western side (Lac Chibougamau, Lac Bernadette, etc.), two main orientation sectors were defined (Sector 1: 0-180º and Sector 2: 180-360º). The mine site‟s forest environment was also taken into account.

Table 5.5 Surface Parameter Values (Roughness, Albedo and Bowen Ratio)

Parameter	Orientation Sector	Bowen Ratio	Albedo	Roughness (m)
Winter season	Sector 1 (0-180°)	0.7	0.7	1.3
	Sector 2 (180-360°)	0.7	0.7	1.0
Summer season	Sector 1 (0-180°)	0.3	0.16	1.3
	Sector 2 (180-360°)	0.3	0.16	1.0

Between 1 January 2006 and 31 December 2010, wind roses at the Chibougamau-Chapais A meteorological station indicated prevailing winds from the northwest, east and south-southwest, with an average speed of about 3.04 m/s. During the same period, a 6.11% frequency was recorded for calm winds. Figures 5.3 and 5.4 below show the distribution of wind speed and direction recorded at the Chibougamau-Chapais A station.

Environment Canada"s climate normals, based on 1971-2000 climate data for Chibougamau, indicate 182.2 days (49.35%) per year of 0.2 mm (trace precipitation) of precipitation or more. This value is used in calculations of particulate emission factors during haulage of the iron ore mined from the open pit.

Figure 5.3 Wind Class Frequency (%) at the Chibougamau-Chapais A Station

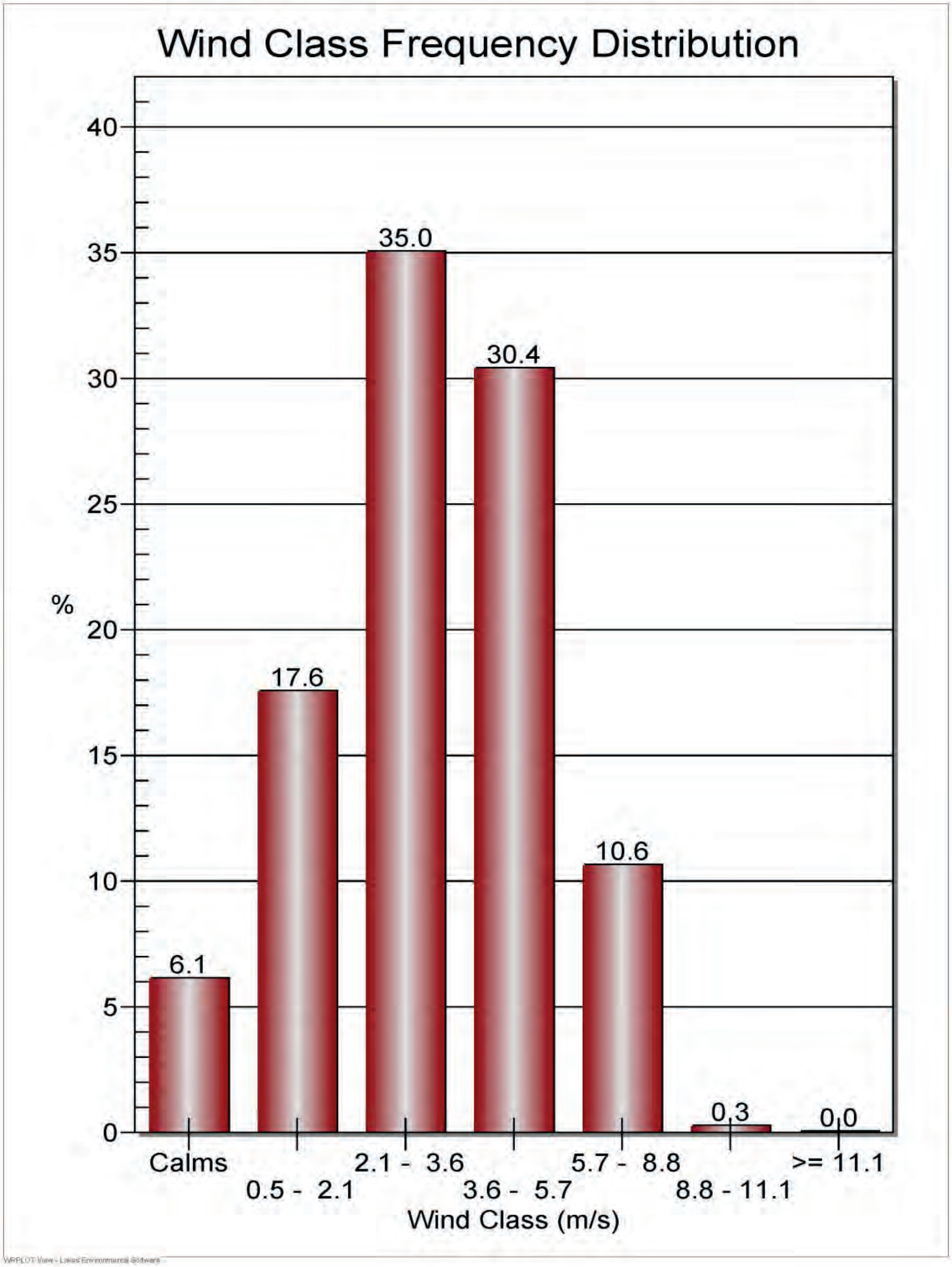
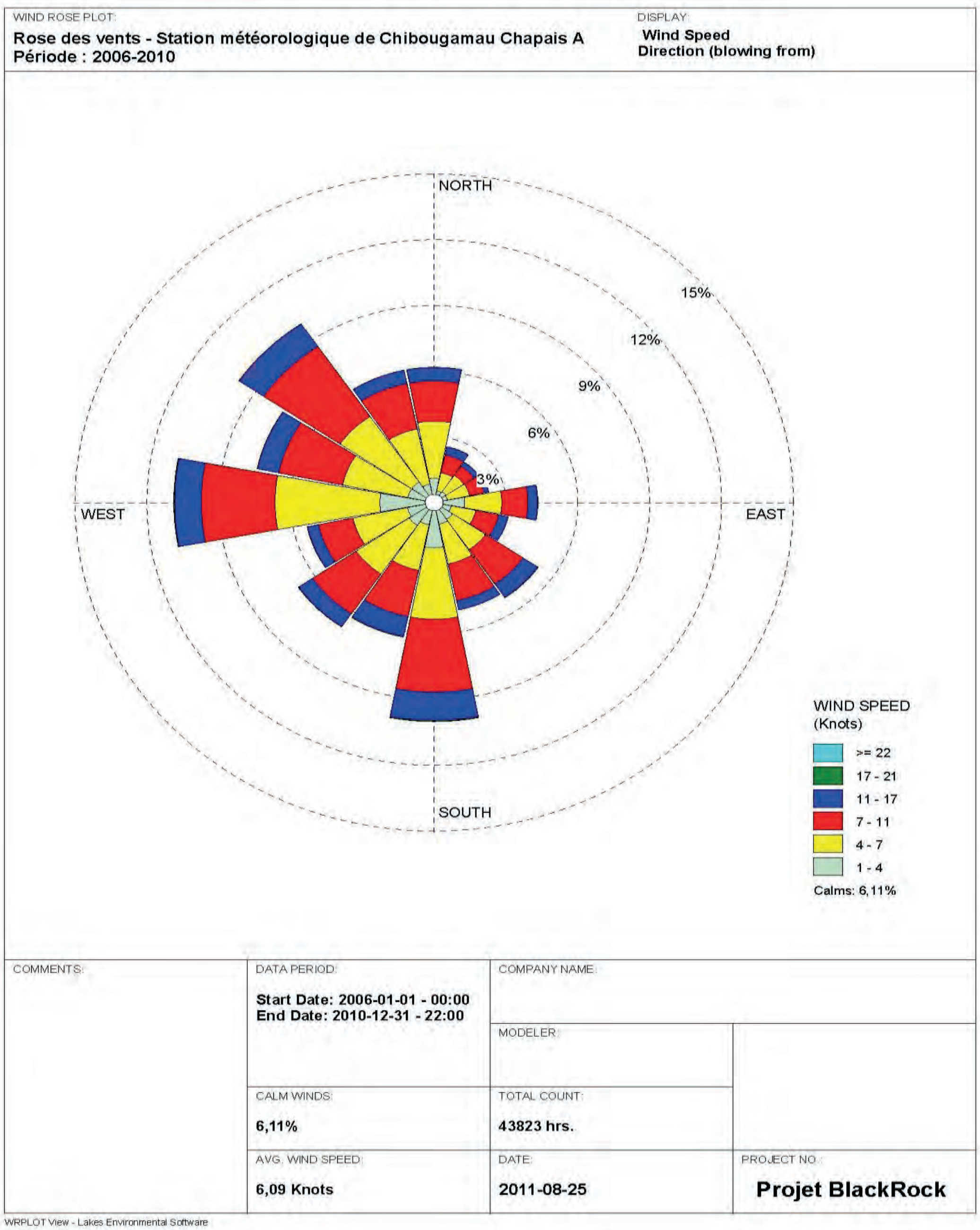


Figure 5.4 Wind Rose Chart for the Chibougamau-Chapais A Station (2006-2010)



5.3 EMISSION SOURCE CHARACTERISTICS

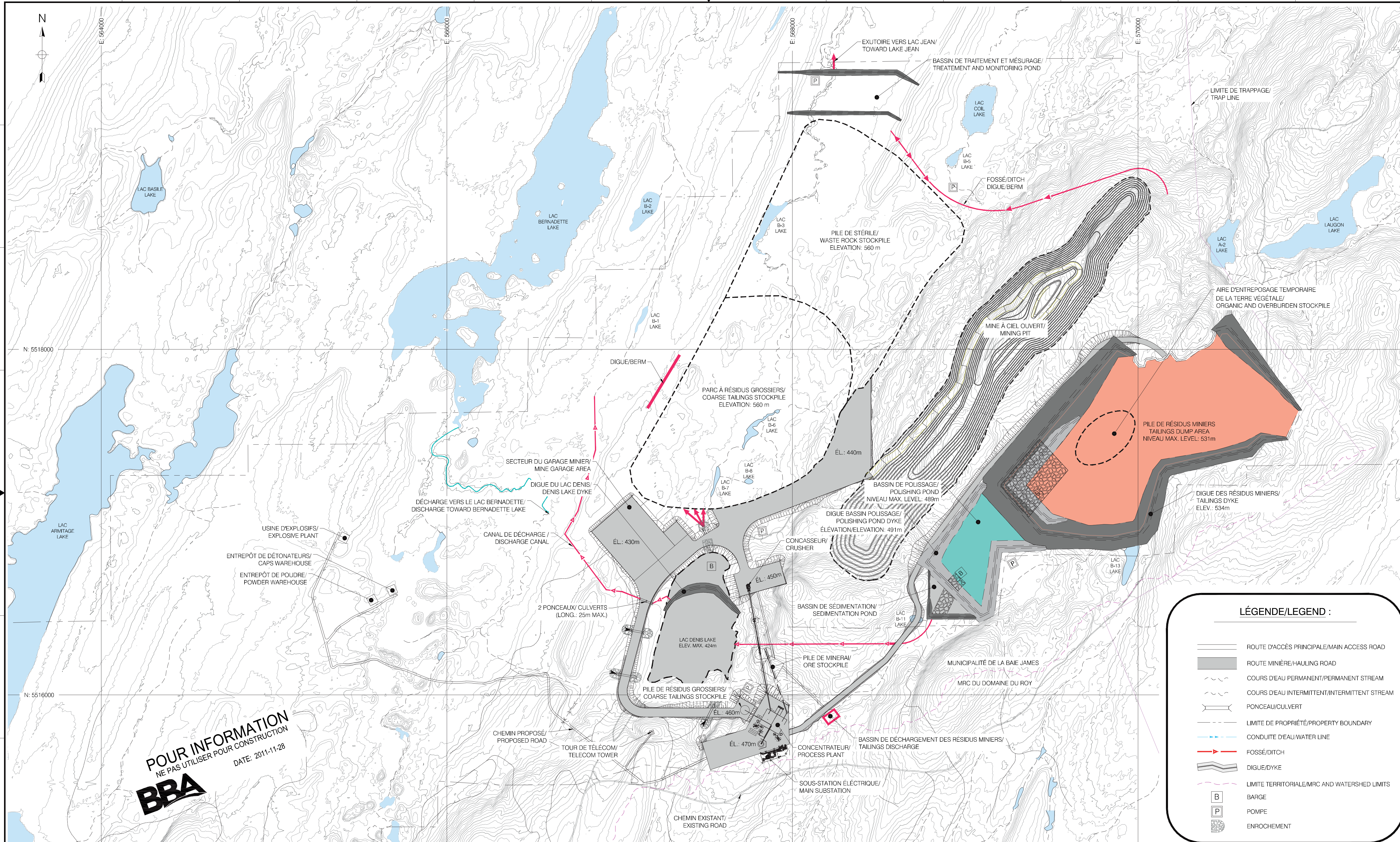
This section briefly describes the methodological approach used to determine emission rates for all contaminants identified in the mining zone. Emission source characteristics are also presented. Figure 5.5 below gives a plan view of the future mining facilities. Figure 5.6 provides an example of AERMOD modelling of all emission sources for Phase 2.

5.3.1 Determination of Phase 1 Emission Rates (2012-2014)

The only emission sources modelled during the construction and preproduction period (Phase 1, 2012) are the installation and commissioning of two electric generators running on fuel oil No.2. Emission rates for these two sources are calculated using the guidance document recommended by the National Pollutant Release Inventory (NPRI) (www.ec.gc.ca/inrp-npri/) entitled "*Emissions Calculator: Airborne Contaminant Emissions from Fuel Oil Combustion*". As mentioned earlier, other sources of particulate matter may also be present in the study area, namely from use of construction equipment and from construction of infrastructure, access roads and buildings.

A few kilometres south of the mine site, two 800-kW generators will meet the construction camp"s power requirements, the second generator serving as backup in case the main one breaks down. Approximately 1,080,000 litres of fuel oil No.2 will be consumed over a 20-month period (maximum duration of Phase 1). This estimate is based on an average hourly consumption rate of 250 kWh over a 24-hour period.

Two 1,200-kW generators will be set up to meet the mine site power requirements. The second generator will act as backup in the event of main generator failure. Fuel oil No. 2 consumption is estimated at 907,200 litres over a 14-month period. This total consumption is based on an average consumption of 300 kWh over a 24-hour period.



NOTE :

LES NOMS DES LACS PROVIENNENT DU RAPPORT D'ENTRACO, AVRIL 2011/
SMALLER LAKE IDENTIFICATIONS WITHIN THE CLAIMS LIMITS REFERS TO ENTRACO'S REPORT, APRIL 2011

DRAWING No.	DESCRIPTION

REFERENCE DRAWINGS

REV	DESCRIPTION	VERIFIED BY	APPROVED BY	DATE
AH	POUR INFORMATION/FOR INFORMATION	L. CHARRON, eng. OIQ No. 103088	A. ALLAIRE, eng. OIQ No. 38480	2011-11-28
AG	POUR INFORMATION/FOR INFORMATION	L. CHARRON, eng. OIQ No. 103088	A. ALLAIRE, eng. OIQ No. 38480	2011-11-09
AF	POUR COMMENTAIRES/FOR COMMENTS	L. CHARRON, ing. OIQ No 103088	A. ALLAIRE, ing. OIQ No 38480	2011-09-29
AE	POUR COMMENTAIRES/FOR COMMENTS	L. CHARRON, ing. OIQ No 103088	A. ALLAIRE, ing. OIQ No 38480	2011-09-22
AD	FOR INFORMATION	L. CHARRON, eng. OIQ No 103088	A. ALLAIRE, eng. OIQ No 38480	2011-08-04
AC	FOR INFORMATION	L. CHARRON, eng. OIQ No 103088	A. ALLAIRE, eng. OIQ No 38480	2011-06-13
AB	FOR INFORMATION	L. CHARRON, eng. OIQ No 103088	A. ALLAIRE, eng. OIQ No 38480	2011-05-18
AA	FOR INFORMATION	L. CHARRON, eng. OIQ No. 103088	A. ALLAIRE, eng. OIQ No. 38480	2011-05-06

REVISIONS

SEAL:

CLIENT: MÉTAUX BLACKROCK / BLACKROCK METALS

PROJECT: BLACKROCK

TITLE: INFRASTRUCTURES
SITE PREPARATION
ENVIRONMENTAL SITE PLAN
PLAN VIEW

DESIGNED BY: L. CHARRON, eng. OIQ No 103088	DRAFTED BY: R. PANAZAN
VERIFIED BY: L. CHARRON, eng. OIQ No 103088	APPROVED BY: A. ALLAIRE, eng. OIQ No 38480
SCALE: 1:10000	DATE: 2011-05-06

DRAWING No.: 3017003-001000-41-D09-0001 | SHEET: | SIZE: A1 | REV.: AH

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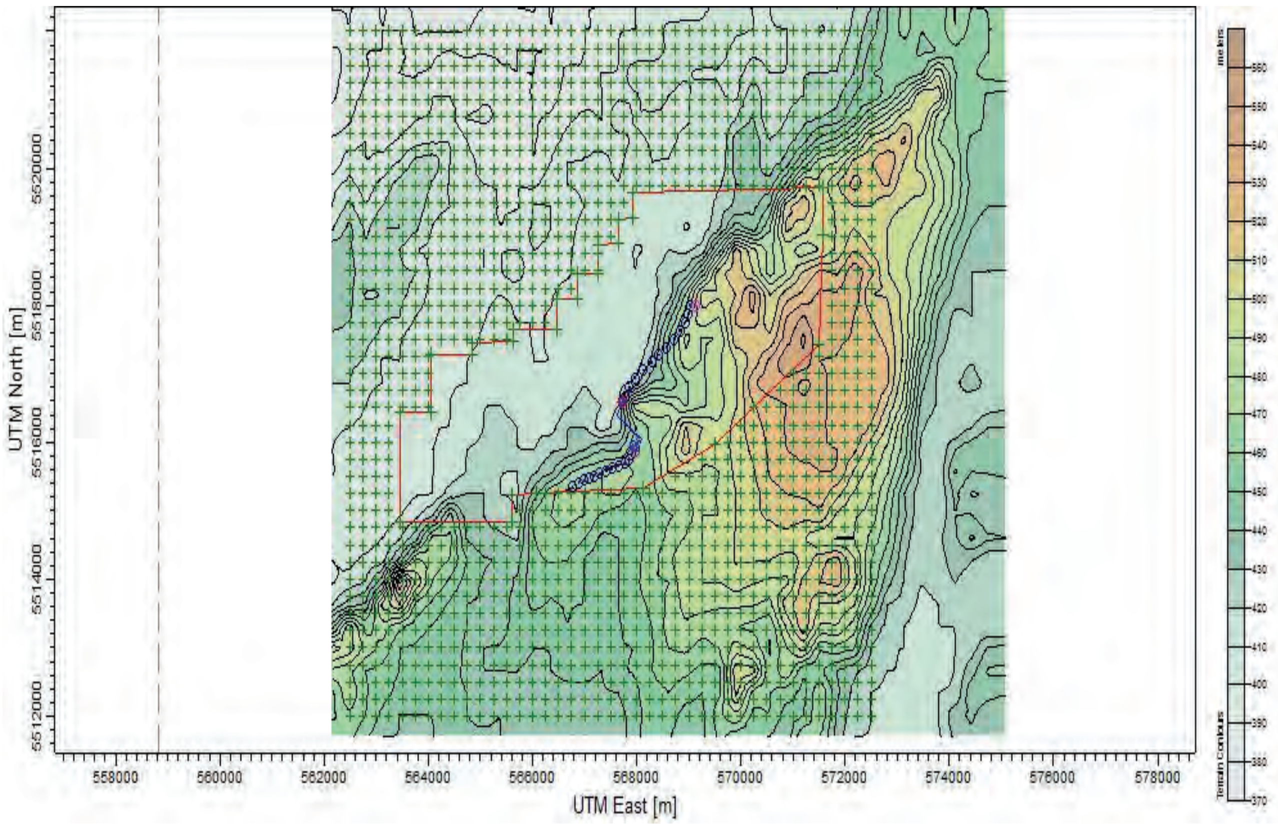
Figure 5.6 Sample Modelling Grid Showing Emission Sources, Buildings and the Mine Site (Property Boundaries)



A 200-kW generator will be set up temporarily for a three-month period to power the telecom tower. It will consume approximately 86,400 litres of fuel oil No. 2 over this three-month period.

Once Hydro-Québec power lines are hooked up and in service, the generators will only be used in case of power failure, and contaminant concentrations from the generators were therefore only calculated for Phase 1 (2012-2014). Table 5.6 describes the main characteristics of the three point sources represented by the three generators.

5.3.2 Determination of Phase 2 Emission Rates (2014-2020)

Emission rates for Phase 2 (2014 and 2020) are given in Tables 5.7 and 5.8. The BlackRock mining operations include several industrial procedures for optimizing the technical, financial and environmental aspects of the project. Mitigation measures are foreseen for particulate matter and gas emissions from drilling, the use of explosives, loading and unloading of ore and waste rock, on-site haulage, concentration and concentrate transport by truck to the rail transfer point.

Table 5.6 Emission Source Characteristics - Construction Phase (Phase 1, 2012-2014)

Source	Type of source	Coordinates (m) X-UTM, Y-UTM	H (m)	T (K)	Contaminant Emission Rate (g/s)					
					CO	NO_x	SO_2	Benzene	TPM	$PM_{2.5}$
Generator 800 kW	Point	563898 mE ; 5510071mN	10	300	2.9172E-01	6.52E-01	5.8343E-02	2.66E-04	2.1278E-02	1.6439E-02
Generator 1.2 MW	Point	567143 mE ; 5516263 mN	10	300	3.5006E-01	7.82E-01	7.0012E-02	3.20E-04	2.5534E-02	1.9727E-02
Generator 200 kW	Point	568880 mE ; 5516097 mN	Emissions are negligible (only used for a three-month period)							

H: source height in m. T: emission temperature in K.

Table 5.7 Emission Rates from All Sources - 2014 (Phase 2, Scenario 1)

Description of Source by Mining Activity		ID	Type	TPM ($g/s.m^2$)	$PM_{2.5}$ ($g/s.m^2$)	CO ($g/s.m^2$)	SO_2 ($g/s.m^2$)	NO_x ($g/s.m^2$)
Extraction of ore and waste rock	Drilling (particulate matter)	S_M_SC1	surface	7.3165E-03	2.9266E-03			
	Blasting (particulate matter and gas)	S_M_SC2	surface	5.5214E-02	1.6564E-03	2.5318E-02	7.4465E-04	5.9572E-03
	Loading/Unloading	S_M_SC3	surface	3.1489E-03	2.2553E-04			
	Haulage inside the pit	S_M_SC4	volume	3.9005E-05	4.4157E-07			
	Haulage outside the pit	Rout1 à 12	volume	1.8574E-05	2.1027E-07			
Primary processing	Crusher - dust collector	TPC_SC10	point	8.00E-03	4.00E-03			
	Conveyor	TPC - SC11	*Under a dome – particulate matter emissions are negligible*					
	Ore stockpile	ASM - SC14	*Under a dome – particulate matter emissions are negligible*					
Plant – concentrator	Concentrator	Usine	*Covered building – particulate matter and gas emissions are negligible*					
	Concentrate stockpile	EM - SC7	surface	1.2684E-10	9.5129E-12			
Concentrate haulage	Truck transport to railway	Rout_C1/12	volume	1.8574E-05	2.1027E-07			
Tailings	Tailing pond - waste rock piles	S_Sterile	*Ongoing rehabilitation of the waste rock pile – negligible emissions*					

Table 5.8 Emission Rates from All Sources - 2020 (Phase 2, Scenario 1)

Description of Source by Mining Activity		ID	Type	TPM ($g/s.m^2$)	$PM_{2.5}$ ($g/s.m^2$)	CO ($g/s.m^2$)	SO_2 ($g/s.m^2$)	NO_x ($g/s.m^2$)
Extraction of ore and waste rock	Drilling (particulate matter)	S_M_SC1	surface	7.3165E-03	2.9266E-03			
	Blasting (particulate matter)	S_M_SC2	surface	5.5214E-02	1.6564E-03	2.9116E-02	6.8508E-03	8.5635E-04
	Loading/Unloading	S_M_SC3	surface	3.1489E-03	2.2553E-04			
	Haulage inside the pit	S_M_SC4	volume	3.9005E-05	4.4157E-07			
	Haulage outside the pit	Rout1 à 12	volume	1.8574E-06	2.103E-08			
Primary processing	Crusher - dust collector	TPC_SC10	point	8.00E-03	4.00E-03			
	Conveyor	TPC - SC11	*Under a dome – particulate matter emissions are negligible*					
	Ore stockpile	ASM - SC14	*Under a dome – particulate matter emissions are negligible*					
Plant – concentrator	Concentrator	Usine	*Covered building – particulate matter emissions are negligible*					
	Concentrate stockpile	EM - SC7	surface	1.2684E-10	9.5129E-12			
Concentrate haulage	Truck transport to railway	Rout_C1/12	volume	1.8574E-05	2.1027E-07			
Tailings	Tailing pond - waste rock piles	S_Sterile	*Ongoing rehabilitation of the waste rock pile – negligible emissions*					

This modelling exercise looked at total particulate matter (TPM) and fine particulate matter with a diameter less than or equal to 2.5 µm ($PM_{2.5}$). Blasting is responsible for releasing gaseous contaminants into the atmosphere. The main potential emission sources of contaminants in Phase 2 are described below.

1. Extraction of ore and waste rock from the open pit (drilling and blasting)

A 42-m^2 drilling area was considered for ore and waste rock extraction from the Southwest mine, with a hole spacing of about 6 metres, a burden of 7 metres and a particulate matter emission height of 1 metre. It is also assumed that mining activities will take place on an ongoing basis, 365 days per year, 24 hours per day. The depth of the pit is estimated at 30 metres for the first year of mining operations (Phase 2, Scenario 1) and at 120 metres for the year 2020 (Phase 2, Scenario 2) (see Table 5.1). Bench blasting of ore and waste rock is planned one day out of three over the entire year.

Emission rate calculations for gaseous contaminants (CO, NO_x and SO_2) from blasting operations assume that 15,000 of explosives will be used in 2014 (Scenario 1), increasing by 15% to 17,250 tonnes in 2020 (Scenario 2).

2. Loading and unloading of ore and waste rock inside the pit

The many loading and unloading operations that follow drilling and blasting of the ore in the pit will also generate particulate matter emissions into the ambient air. Loading and unloading operations will involve a volume of 30,500 tonnes per day, 365 days per year.

3. Ore haulage inside and outside the pit

A haulage distance of about 1.5 km in Scenario 1 and 1.8 km in Scenario 1 was used for the transportation of ore and waste rock within the pit. The average unpaved road width is estimated at about 20 m. Emission factor calculations also allowed for 182 days per year of 0.2 mm or more of precipitation. From the exit of the pit to the crusher, the ore is hauled 1.2 km, with an average road width of 20 m; however, the effective width is considered to be 26 m (20 m of true width plus 6 m of turbulence from truck traffic). Initial vertical and lateral dimensions will be of 3.72 m and 4.65 m, respectively. The MDDEP-recommended methodology to model truck haulage of ore on unpaved roads is described in the document entitled "*Modeling Fugitive Dust Sources with AERMOD*" by A. J. Heinerikson et al. (2007).

4. Ore crusher

Iron ore will be trucked from the open pit mine to the crusher. Under normal circumstances, the trucks will feed the ore directly to the crusher. However, in the event of a power failure or crusher technical issue, the ore will be temporarily stockpiled near the crusher. A dust collector will be installed in the building that houses the crusher. The dust collector is a source of particulate matter emissions. Total particulate matter (TPM) and $PM_{2.5}$ emission rates were determined from the literature.

5. Ore conveyors from the crusher to the concentrator

Conveyors will be used to transport the ore once it is crushed. The primary conveyors will feed an ore stockpile expected to be about 20 m high, located inside a building near the concentrator. The conveyors will be placed at a height of 6 m and will be about 3 m wide. Emissions of particulate matter are considered negligible.

6. Iron ore concentrate storage area

The temporary stockpile for concentrate awaiting transport by truck to the rail transfer point was also considered as a potential source of particulate matter emissions. Particulate matter emissions from wind erosion were calculated for a small, 10-m wide by 11-m high cone-shaped stockpile and maximum daily wind speeds recorded at the Chibougamau-Chapais A. weather station in 2010.

7. Transport of concentrate by truck to the rail transfer point

Volume-type emission source modelling is used for the truck transport of concentrate. The ore will be hauled along a 25-km unpaved logging road. For modelling purposes, only the first kilometre of road along the southeastern property boundary (within the modelling domain) was considered.

Many volume sources at the rail transfer point were considered to determine particulate matter concentrations only (TPM and $PM_{2.5}$) in a 5-km by 5-km modelling grid with a 100-m mesh size. Monthly effluent emission rates show that equilibrium will be reached in 2014.

Emission rates for particulate matter and gaseous contaminants such as carbon monoxide (CO), nitrogen dioxide (NO_2) and sulphur dioxide (SO_2) were estimated using emission factors from the AP-42 guidance published by the U.S. Environmental Protection Agency (EPA) *www.epa.gov/ttn/chief/ap42*. Technical specifications provided by engineers from BBA, which is directly involved in the project, also allowed accurate estimation of input values for emission rate calculations.

5.4 INITIAL VALUES AND AIR QUALITY STANDARDS

Taking the geographic location of the study site into account, the initial concentrations of main contaminants in the ambient air provided by the MDDEP were added to maximum concentration values obtained through *AERMOD* simulations. These initial values are representative of rural and forest environments of the Chibougamau area, far away from industrialized urban areas. Initial concentration values for other contaminants were taken from an official document on air quality criteria for Quebec (*Mise à jour des critères québécois de qualité de l'air*) by the MDDEP"s *Direction du suivi de l'état de l'environnement* (March 2012). Initial values proposed by the MDDEP for calculating maximum concentrations in the ambient air are given in Table 5.

Table 5.9 Values Used in this Study for Initial Concentrations in Ambient Air

Contaminant	Period	Initial Value ($\mu g/m^3$)	AQR Standards ($\mu g/m^3$)
Total Particulate Matter TPM	24 hours	40	120
Fine Particulate Matter $PM_{2.5}$	24 hours	15	30
Carbon Monoxide CO	1 hour	600	34, 000
	8 hours	400	12, 700
Nitrogen Dioxide NO_2(1)	1 hour	20	414
	24 hours	15	207
	1 year	10	103
Sulphur Dioxide SO_2	4 minutes	40	1, 050
	24 hours	10	288
	1 year	1.5	52
Silver - Ag	1 year	0.005	0.23
Arsenic - As	1 year	0.002	0.003
Barium - Ba	1 year	0.025	0.05
Beryllium - Be	1 year	0	0.0004
Cadmium - Cd	1 year	0.003	0.0036
Chromium - Cr	1 year	0.0037	0.004
Copper - Cu	24 hours	0.2	2.5
Nickel - Ni	1 hour	0.25	6
	1 year	0.01	0.012
Lead - Pb	1 year	0.025	0.1
Thallium - Tl	1 year	0.05	0.25
Vanadium - V	1 year	0.01	1

(1) See note below.

Note relating to NO_2 concentration estimates

During initial stages of modelling, the “total conversion” method (considered the simplest method) was used to calculate hourly, daily and annual maximum NO_2 atmospheric concentrations for Phase 1. Results slightly exceeded the standards, and NO_2 criteria were obtained at that time. The “total conversion” method used by AERMOD is the most conservative method, as it assumes that all NO released is converted to NO_2.

When the total conversion method yields maximum NO_2 concentrations that exceed the citeria, MDDEP guidelines (*Guide d’estimation de la concentration de NO_2 dans l’air ambiant lors de l’application des modèles de dispersion atmosphérique*, Couture, 2008) suggest using the Ozone Limiting Method (OLM). Ambient ozone (O_3) concentrations representative of the Chibougamau area must then be taken into account to determine new NO_2 concentrations. Concentrations were provided by the MDDEP‟s *Service des avis et des expertises - Milieu atmosphérique de la Direction du suivi de l’état de l’environnement*. They are based on O_3 concentrations measured at the Air Quality Monitoring Program stations (see below):

Time period	Ozone (O_3) concentration (ppb)	Ambient NO_2 concentration (µg/m^3)
1 hour	80	20
24 hours	60	15
1 year	25	10

5.5 ANALYSIS AND PRESENTATION OF RESULTS

Results from all simulations done with the AERMOD atmospheric dispersion model are presented by contaminant and by time period in Tables 5.12 to 5.17 at the end of this section. For each contaminant, the maximum concentration obtained with AERMOD was added to the initial ambient air concentration provided by the MDDEP. The resulting total maximum concentration was then compared to applicable Quebec criteria.

5.5.1 Maximum Concentrations Calculated with AERMOD

5.5.1.1 Total airborne particulate matter (TPM)

For the mine construction phase (Phase 1, 2012-2014), maximum TPM concentrations calculated for a 24-hour period were 41.51 µg/m^3. However, during mine operation (Phase 2, 2014 and 2020), maximum TPM concentrations for a 24-hour period slightly exceeded the regulatory criteria of 120 µg/m^3. These calculations did not take into account practical measures to mitigate particulate matter emissions at the mine site. Differences observed between scenarios 1 and 2 of Phase 2 are largely attributed to the increase in pit depth from 30 m in 2014 to 120 m in 2020.

5.5.1.2 Fine particulate matter ($PM_{2.5}$)

During the construction phase, maximum $PM_{2.5}$ concentrations are 16.16 µg/m^3, below the criterion of 30 µg/m^3 (ranging from 50 to 60% of the criterion). In the operation phase, maximum $PM_{2.5}$ concentrations for a 24-hour period are in the order of 18 µg/m^3 for both the 2014 and the 2020 scenarios.

5.5.1.3 Carbon monoxide (CO)

Maximum CO concentrations were between 192 and 197 µg/m^3 for the operation phase (Phase 2). The variation is due in part to a 15% increase in the use of explosives in 2020, although this is substantially offset by the greater pit depth in 2020. All concentrations calculated are below the applicable criteria for 1- and 8-hour periods.

5.5.1.4 Sulphur dioxide (SO_2)

Maximum SO_2 concentrations calculated with AERMOD are below the applicable criteria. Total maximum SO_2 concentrations for a 4-minute period showed a marked decrease, falling from 67.7 µg/m^3 during mine construction (Phase 1) to 10.3 µg/m^3 during the operation phase. The use of fuel oil No. 2 as fuel for the 800-kW and 1,200-kW generators to be installed at the two sites in 2012 accounts for the SO_2 emissions during mine construction.

5.5.1.5 Nitrogen dioxide (NO_2)

Maximum hourly NO_2 concentrations for the mine construction phase (2012-2014) are below the criteria. These concentrations were calculated using the MDDEP-recommended OLM method and an annual fuel oil consumption forecast of 1,425,600 litres (648,000 litres for the 800 kW generator and 777,600 litres for the 1,200 kW generator). Simulations were carried out assuming a stack height of 3.5 m, yielding a maximum hourly NO_2 concentration of 196.94 µg/m^3. It should be noted that property boundaries around the construction camp were not taken into consideration in any of the AERMOD simulations.

5.5.2 Maximum concentrations for trace heavy metals

Tables 5.10 and 5.11 give heavy metal concentrations in parts per million (ppm) for the ore and waste rock.

Table 5.10 Element Analysed in the Ore Mined from the Pit and the Final Concentrate (ppm)

Element	LOD	ENBR-20 Ore Feed
Arsenic - As	0.2	7.7
Barium - Ba	50	< 50
Beryllium - Be	0.05	< 0.05
Cadmium - Cd	0.02	0.28
Chromium - Cr	0.5	295
Copper - Cu	0.2	82.0
Nickel - Ni	0.2	84.1
Lead - Pb	0.1	14.3
Vanadium - V	0.5	1,800

Table 5.11 Element Analysed in the Waste Rock (ppm)

Element	LOD	ENBR-20 Feed
Arsenic - As	0.2	1.4
Barium - Ba	50	n/a
Beryllium - Be	0.05	n/a
Cadmium - Cd	0.02	0.15
Chromium - Cr	0.5	95.7
Copper - Cu	0.2	82.0
Nickel - Ni	0.2	95.6
Lead - Pb	0.1	4.8
Vanadium - V	0.5	674

Maximum concentrations for trace heavy metals (see Tables 5.16 and 5.17) were calculated using the results of chemical analyses of ore and waste rock samples (see Tables 5.10 and 5.11). If the proportions of heavy metals found in the ore and waste rock (expressed in ppm) are applied to maximum TPM concentrations (24h period and annual) obtained from dispersion modelling, all resulting concentrations are below the regulatory critera, except for chromium.

The highest chromium concentration is the one obtained using the quantity of chromium in ore. However, it should be noted that chromium concentration calculations do not take into account the mitigation measures described in Section 5.5.4. Furthermore, available data indicates that 271.6 million tonnes of waste rock and 150 million tonnes of ore will be generated over the course of the mine life. Concentrations of metals, including chromium, will be lower in waste rock than in ore.

5.5.3 Contour Maps - Contaminant Concentrations

Iso-concentration contour maps were systematically prepared for all contaminants studied, either directly with AERMOD or exported into other formats (JPEG and Google). Figures 5.9 and 5.10 at the end of this section show sample iso-concentration contour maps of TPM concentrations for a 24-hour period against a Google map background. The highest concentrations are shown in yellow and red. The maps show that the maximum TPM concentration for a 24-hour period was recorded in the southern part of the mine site. Figure 5.7 and 5.8 illustrate TPM and $PM_{2.5}$ contour maps exported as JPEGs for the two Phase 2 scenarios.

5.5.4 Emission Mitigation Measures and Environmental Monitoring

There are several options for controlling and significantly reducing particulate matter emissions, including during haulage of the ore and waste rock inside and outside the pit and when transporting the concentrate to the rail transfer point. Ways of reducing emission of particulate matter generated by the haulage of ore and waste rock fall into the following three categories:

1. The first method relates to restrictions and regulations concerning vehicle traffic on the mine site‟s unpaved roads. Particulate matter emission rates from haulage are directly proportionate to the number of trips per hour on unpaved roads. It is therefore important to limit truck traffic on the unpaved mine site roads to the strict minimum required for service.

2. The second method relates to maintenance and upgrading work on the unpaved mine site roads. This type of work is also among the mitigation measures for particulate matter emissions on roads used for ore and waste rock haulage. For example, studies on this sort of problem demonstrate that particulate matter emissions would be reduced by 90% if roads used for ore and waste rock haulage were paved. While this is not a feasible solution for this project, particulate matter emission rates could be lowered by, for instance, covering unpaved roads using materials with a very low silt content.

3. The third method is one of the most popular ways to reduce particulate matter emissions and involves road surface treatment techniques for ore and waste haulage roads. In winter, unpaved roads will be covered in snow for seven to eight months of the year, and

particulate matter emissions will therefore presumably be very low. In summer, emission control techniques consist of periodically and regularly spraying the roads with water all summer long. The effectiveness of this particulate matter emission control method depends on the following factors:

- the amount of water used per application,
- the frequency of spraying during the day,
- time elapsed between two spraying operations,
- vehicle flow on the unpaved mine site roads,
- weather conditions.

Control methods that take all these aspects into account are described and documented in AP-42. If spraying unpaved roads is considered as a means of reducing particulate matter emissions at the mine site, the following formula from the Air Pollution Engineering Manual (Cowherd, 1992) could, for instance, be used:

$$C = 100 - (0.8*P*D*T/I)$$

Where:

C: is the average emission control and monitoring efficiency (%)
P: is the average hourly daytime evaporation rate (mm/hour)
D: is the average hourly traffic rate on the unpaved mine site roads (h^{-1})
T: is the time between applications (hours)
I: is the application intensity (litres/m^2)

<u>Representative example:</u>

Assuming that the average hourly evaporation rate for a typical summer day (May to October) in the Chibougamau area is 0.2 mm/hour, the average traffic rate on unpaved roads is 70 trucks per hour, unpaved roads are sprayed every 4 hours and 3 litres of water per m^2 are sprayed on all unpaved roads on the site: in this case, effectiveness is approximately 85%, and particulate matter emissions from vehicle traffic can be assumed to be reduced by approximately the same amount. Given a total unpaved road area about 150,000 m^2, the volume of water needed to spray all unpaved roads is on the order of 50,000 litres per application.

In addition to implementing the mitigation measures described, it is important to set up an effective environmental program for monitoring maximum concentrations of contaminants in the ambient air over the entire life of the mining operation, in order to have the most representative and accurate mine site data possible. The following two measuring devices are proposed for this purpose, to be installed and commissioned at the start of mine construction:

a) An air quality sampling and measuring station should be operational as of 2012, and if possible during the initial years of mine operation. Based of prevailing wind direction, the station should be installed in the south-southeastern part of the mine site. Data collected during 2012-2014 and 2014-2020 should allow the project‟s effects on air quality to be determined quite accurately. The air quality monitoring station should also record TPM, $PM_{2.5}$ and PM_{10} concentrations on an ongoing basis over the life of the project. Collected data could be compared to data from the MDDEP and Environment Canada. If needed, this will provide a better understanding of changes in air quality before, during and after mining operations. This data will also provide feedback on the effectiveness and/or adjustment of mitigations measures.

b) An automatic weather station should be set up in 2012 at the mine site to measure principal meteorological parameters, such as temperature and air humidity, horizontal visibility, wind speed and direction and annual precipitation (summer and winter). BlackRock can use this data to better understand the mine site micro-climate. Although climate data from the Chibougamau-Chapais A station is of good quality, data collected at the mine site could be directly used in future atmospheric dispersion studies, particularly in the event of production from an area adjacent to the Southwest deposit.

Figure 5.7 TPM Concentrations – 24 Hours, Phase 2, Scenario 1

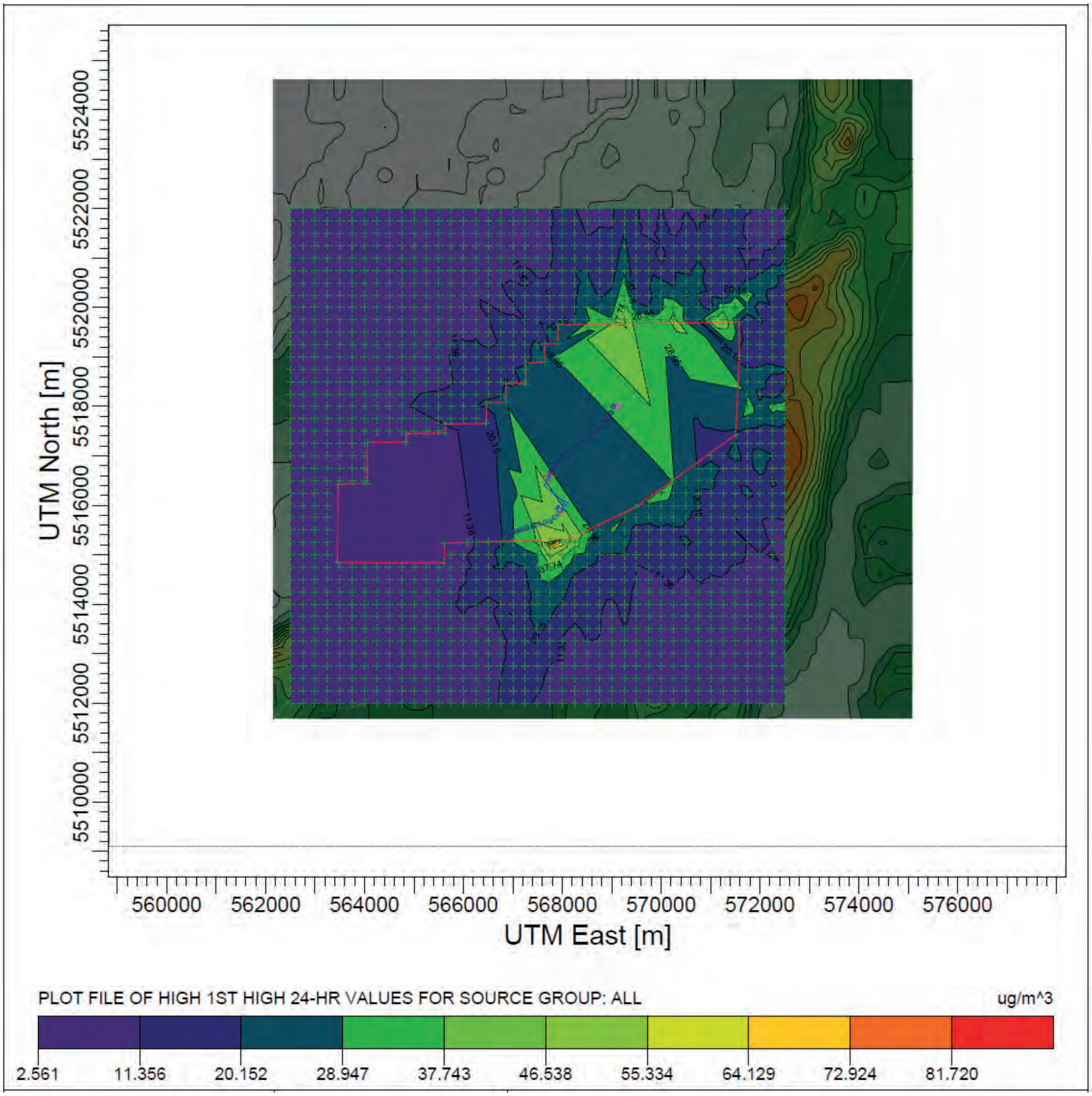


Figure 5.8 $PM_{2.5}$ Concentrations – 24 Hours, Phase 2, Scenario 1

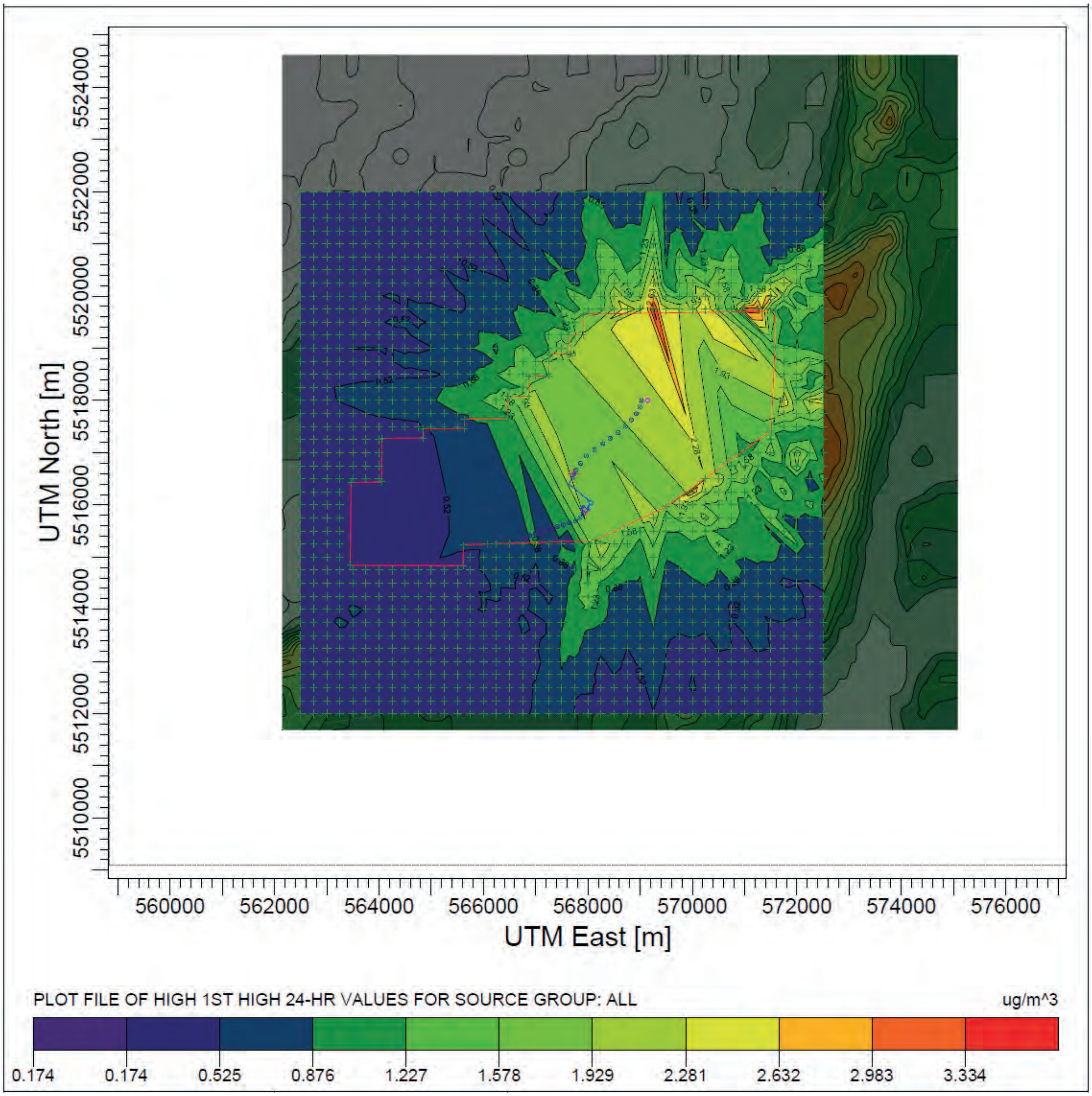


Figure 5.9 Sample TPM Contour Map for Phase 2, Scenario 1 (2014)

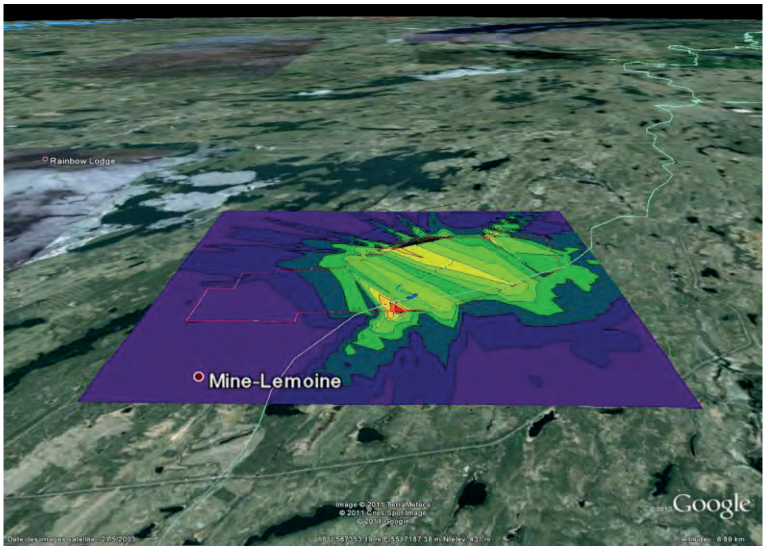


Figure 5.10 TPM Contour Map for Phase 2, Scenario 1 (2014) Concentrate Transport to the Rail Transfer Site

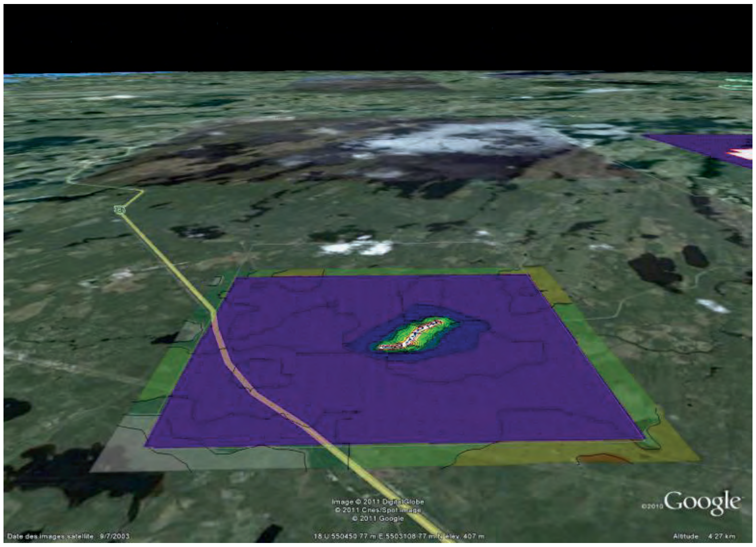


Table 5.12 Maximum Contaminant Concentrations Obtained for Phase 1 (2012-2014)

Contaminant	Time period	Max concentration computed by AERMOD ($\mu g/m^3$)	Initial concentration ($\mu g/m^3$)	Total concentration ($\mu g/m^3$)	ARQ standard ($\mu g/m^3$)	Percentage of standard (%)
Total particulate matter TPM	24 hours	1.51	40	41.51	120	34.59
	Annual	0.32	n/a	0.32		
Fine particulate matter $PM_{2.5}$	24 hours	1.16	15	16.16	30	53.87
	Annual	0.25	n/a	0.25		
Carbon monoxide CO	1 hour	177.51	600	777.51	34, 000	2.29
	8 hours	31.90	400	431.90	12, 700	3.40
Sulphur dioxide SO_2	4 minutes	67.72	40	107.72	1, 050	10.26
	1 hour	35.47	n/a	35.47		
	24 hours	4.13	10	14.13	288	4.91
	Annual	0.88	1.5	2.38	52	4.57
Nitrogen dioxide NO_2	1 hour	196.94	20	216.94	414	52.40
	24 hours	70.57	15	85.57	207	41.34
	Annual	23.24	10	33.24	103	32.27
Benzene	24 hours	0.0189	3	3.0189	10	30.19
Formaldehyde	15 minutes	0.0292	3	3.0292	37	8.19
	1 hour	0.0165	n/a	0.0165		

Notes:

1. Initial concentrations for CO, SO_2, NO_2, TPM and $PM_{2.5}$ were provided by the MDDEP.
2. Maximum formaldehyde concentrations and maximum concentrations for SO_2 over a 4-minute period were calculated using the formula proposed in the MDDEP modelling guide: $C(T)= C\ (1hour) * 0.97\ T^{-0.25}$ where C is the maximum hourly concentration and T is the time in hours.
3. n/a: not available
4. Maximum NO_2 concentrations in the table were calculated using a stack height of 3.5 metres and an annual fuel oil No. 2 consumption of 1,425,600 litres.

Table 5.13 Maximum Contaminant Concentrations Obtained for Phase 2 – Scenario 1 (2014)

Contaminant	Time period	Max concentration computed by AERMOD (µg/m³)	Initial concentration (µg/m³)	Total concentration (µg/m³)	AQR standard (µg/m³)	Percentage of standard (%)
Total particulate matter TPM	24 hours	**81.72**	40	**121.72**	120	**101.4**
	Annual	3.14	n/a	3.14		
Fine particulate matter $PM_{2.5}$	24 hours	3.33	15	18.33	30	61.1
	Annual	0.12	n/a	0.12		
Carbon monoxide CO	1 hour	197.15	600	797.15	34, 000	2.3
	8 hours	43.56	400	443.56	12, 700	3.5
Sulphur dioxide SO_2	4 minutes	10.27	40	50.27	1, 050	4.8
	1 hour	5.80	n/a	5.80		
	24 hours	0.49	10	10.49	288	3.6
	Annual	0.02	1.5	1.52	52	2.9
Nitrogen dioxide NO_2	1 hour	47.68	50	97.68	414	48.8
	24 hours	4.00	40	44.0	207	9.1
	Annual	0.14	10	10.14	103	1.4

Notes:

1. Initial concentrations for CO, SO_2, NO_2, TPM and $PM_{2.5}$ were provided by the MDDEP.
2. Maximum formaldehyde concentrations and maximum concentrations for SO_2 over a 4-minute period were calculated using the formula proposed in the MDDEP modelling guide: $C(T)= C\ (1hour) * 0.97\ T^{-0.25}$ where C is the maximum hourly concentration and T is the time in hours.
3. n/a: not available.

Table 5.14 Maximum TPM Concentrations Obtained for Phase 2 – Scenario 1 (2014) for Concentrate Transport to the Rail Transfer Site

Contaminant	Time period	Max concentration computed by AERMOD (µg/m³)	Initial concentration (µg/m³)	Total concentration (µg/m³)	AQR standard (µg/m³)
Total particulate matter TPM	24 hours	Negligible	40		120
Fine particulate matter $PM_{2.5}$	24 hours	Negligible	15		30

Table 5.15 Maximum Contaminant Concentrations Obtained for Phase 2 – Scenario 2 (2020)

Contaminant	Time period	Max concentration computed by AERMOD (µg/m^3)	Initial concentration (µg/m^3)	Total concentration (µg/m^3)	AQR standard (µg/m^3)	Percentage of standard (%)
Total particulate matter TPM	24 hours	**81.42**	40	**121.42**	120	**101.2**
	Annual	3.13				
Fine particulate matter $PM_{2.5}$	24 hours	3.10	15	18.10	30	60.3
	Annual	0.11				
Carbon monoxide CO	1 hour	191.96	600	791.96	34, 000	2.3
	8 hours	46.88	400	446.88	12, 700	3.5
Sulphur dioxide SO_2	4 minutes	10.78	40	50.78	1, 050	4.8
	1 hour	5.65				
	24 hours	0.53	10	10.53	288	3.7
	Annual	0.02	1.5	1.52	52	2.9
Nitrogen dioxide NO_2	1 hour	45.17	50	95.17		23.0
	24 hours	4.26	40	44.26	207	21.4
	Annual	0.15	10	10.15	103	9.9

Table 5.16 Maximum Trace Heavy Metals in the TPM, Phase 2 – Scenario 1 (2014) Based on Chemical Analysis of the Ore

Contaminant	Time period	Max concentration computed by AERMOD (µg/m^3)	Initial concentration (µg/m^3)	Total concentration (µg/m^3)	AQR standard (µg/m^3)	Percentage of standard (%)
Arsenic - As	Annual	1.4955E-05	2.0000E-03	2.0150E-03	3.0000E-03	67.17
Barium - Ba	Annual	1.5676E-04	2.5000E-02	2.5157E-02	5.0000E-02	50.31
Beryllium - Be	Annual	1.5676E-07	0.0000E+00	1.5676E-07	4.0000E-04	0.04
Cadmium - Cd	Annual	8.7784E-07	3.0000E-03	3.0009E-03	3.6000E-03	83.36
Chromium - Cr	Annual	9.2487E-04	3.7000E-03	4.6249E-03	4.0000E-03	115.62
Copper - Cu	24 hours	6.7010E-03	2.0000E-01	2.0670E-01	2.5000E+00	8.27
Nickel - Ni	1 hour	5.3862E-02	2.5000E-01	3.0386E-01	6.0000E+00	5.06
	Annual	2.6367E-04	1.0000E-02	1.0264E-02	1.2000E-02	85.53
Lead - Pb	Annual	4.4833E-05	2.5000E-02	2.5045E-02	1.0000E-01	25.04
Vanadium - V	Annual	5.6433E-03	5.0000E-02	5.5643E-02	1.0000E+00	5.56

Note: Maximum element concentrations are obtained by applying proportions from chemical analysis of the ore to TPM concentrations.

Table 5.17 Maximum Trace Heavy Metals in the TPM, Phase 2 – Scenario 1 (2014) Based on Chemical Analysis of the Waste Rock

Contaminant	Time period	Max concentration computed by AERMOD (µg/m^3)	Initial concentration (µg/m^3)	Total concentration (µg/m^3)	AQR standard (µg/m^3)	Percentage of standard (%)
Arsenic - As	Annual	4.3892E-06	2.0000E-03	2.0044E-03	3.0000E-03	66.81
Barium - Ba	Annual	n/a	2.5000E-02	n/a	5.0000E-02	n/a
Beryllium - Be	Annual	n/a	0.0000E+00	n/a	4.0000E-04	n/a
Cadmium - Cd	Annual	4.7027E-07	3.0000E-03	3.0005E-03	3.6000E-03	83.35
Chromium - Cr	Annual	3.0003E-04	3.7000E-03	4.0000E-03	4.0000E-03	100.00
Copper - Cu	24 hours	2.5739E-04	2.0000E-01	2.0671E-01	2.5000E+00	8.01
Nickel - Ni	1 hour	7.8124E-03	2.5000E-01	3.1123E-01	6.0000E+00	5.19
	Annual	2.9972E-04	1.0000E-02	1.0300E-02	1.2000E-02	85.83
Lead - Pb	Annual	1.5049E-05	2.5000E-02	2.5015E-02	1.0000E-01	25.02
Vanadium - V	Annual	2.1131E-03	5.0000E-02	5.2113E-02	1.0000E+00	5.21

Note: Maximum element concentrations are obtained by applying proportions from chemical analysis of the waste rock to TPM concentrations.

5.6 CONCLUSION

The effects of the construction and operation of Black Rock‟s open pit mine on ambient air quality were determined using a numerical atmospheric dispersion model recommended and approved by the MDDEP.

The data and reference values specific to the BlackRock project were taken from the technical feasibility study by BBA. Basic climate data from the Chibougamau-Chapais A station was processed and analyzed over a five-year period (2006-2010). This data was used in the various atmospheric dispersion simulations performed using the AERMOD model.

Contaminant emission rates were obtained from the project technical data and from emission factors determined and described in detail in sections of the EPA‟s AP-42 guidance.

Maximum contaminant concentrations obtained with AERMOD for the mine construction site phase comply with regulatory criteria.

If emission mitigation measures are implemented during the mine operation phase (2014 and 2020), atmospheric dispersion modelling results show that overall, expected maximum concentrations for all contaminants considered, including TPM and chromium, will comply with applicable Quebec criteria.

If the mitigation measures described in Section 5.5.4 are routinely applied, levels of particulate matter released in the ambient air could be reduced by approximately 80%. If, for example, the mitigation measures to be implemented as of 2012 succeed in reducing particulate emissions by 50%, total maximum TPM concentrations will be less than 80 $\mu g/m^3$. In this case, the criteria of 120 $\mu g/m^3$ for TPM will be met and, by inference, so will the chromium criteria. In such circumstances, the planned mine operating activities can be considered to have an acceptable impact on ambient air quality for the 2020-2029 period.

REFERENCES

Breton, Banville & Associées (BBA), August 2011. *BlackRock Project, Feasibility Study Report (Volumes 1 and 2).*

Cowherd, Jr. et al, AWMA, 1992. Air *Pollution Engineering Manual.*

ENTRACO, January 2011. *Projet minier BlackRock : Travaux préliminaires de caractérisation des minéraux, du concentré et des résidus. Évaluation des potentiels de lixiviation et acidogène.*

Environment Canada. Meteorological Service of Canada. MSC/EC. *National Climate Data and Information Archive. Chibougamau Station.*

Genivar 2008. *Projet minier aurifère Canadian Malarctic – Étude d'impact sur l'environnement – Rapport sectoriel – Modélisation de la dispersion atmosphérique. Rapport préliminaire de Genivar Société en commandite à la Corporation minière Osisko. 35 p. and Appendices.*

Heinerikson et al. 2007*. Modelling Fugitive Dust Sources with AERMOD. Natural Stone, Sand & Gravel Association.*

National Pollutant Release Inventory (NPRI), October 2009. *Guidance Document for Emissions Calculator: Airborne Contaminant Emissions from Fuel Oil Combustion.*

Ministère du Développement Durable, de l‟Environnement et des Parcs (MDDEP), Direction du suivi de l‟état de l‟environnement, April 2005. *Guide de modélisation de la dispersion atmosphérique.*

Ministère du Développement Durable, de l‟Environnement et des Parcs (MDDEP), Direction du suivi de l‟état de l‟environnement, March 2010. *Mise à jour des critères québécois de qualité de l'air.*

U.S. ENVIRONMENTAL PROTECTION AGENCY*. Compilation of Air Polluant Emission* Factors: AP-42. Fifth Edition. Volume I: Stationary Point and Area Sources. Website: http://www.epa.gov/ttn/chief/ap42/index.html, *Sections 11.9, 13.3, 11.24, 13.2.2, 13.2.4 and 13.2.5*

U.S ENVIRONMENTAL PROTECTION AGENCY. AERMOD Modeling System.
http://www.epa.gov/ttn/scram/dispersion_prefrec.htm#aermod

6. NOISE LEVELS

6.1 INTRODUCTION

Noise levels for the BlackRock mining project were assessed on the basis of information provided by BBA, which was retained to carry out the technical feasibility study. This chapter is divided into three parts:

- Identification of the main sources of outdoor noise;
- Estimation of the noise impact;
- Mitigation measures and monitoring of noise levels during the operation phase.

This study only looked at the impact of noise on the environment, and did not consider the potential effects of worker exposure to noise.

The location of the mine site relative to downtown Chibougamau and the built environment significantly limits the risk of noise impact on the population. The area in question is located in a remote area southeast of Lac Chibougamau, and the nearest residences are a dozen kilometres away. Given these circumstances, certain assumptions were made to simplify the noise study. Outdoor noise levels were roughly estimated for the sole purpose of determining the maximum distance at which noise from the mine would exceed a significant threshold.

6.2 STUDY AREA

Figure 6.1 shows the approximate area considered for the noise impact assessment. Distances depicted are very large in terms of sound propagation; for example, the mine site is located 30 km as the crow flies from Chibougamau. Logging road 210 (access road via the Lemoine mine, the orange line), which has a gravel roadway, crosses the study area. Photo 1 shows a segment of this road. The study area consists mainly of Crown land, comprising several logging and mining concessions.

The study area was visited on 17 August 2011, at which time it was unoccupied. No permanent, continuously-inhabited areas were identified. However, a seasonal camp belonging to Matthew Wapachee‟s family is located on either side of logging road 210, about 10.5 km from the junction with Route 167 (Photo 2). Talks are underway with the owner to relocate the camp outside the noise zone of influence. In light of this, it was deemed unnecessary to take the seasonal camp into consideration in this noise impact assessment.

Figure 6.1 Noise Impact Assessment Study Area

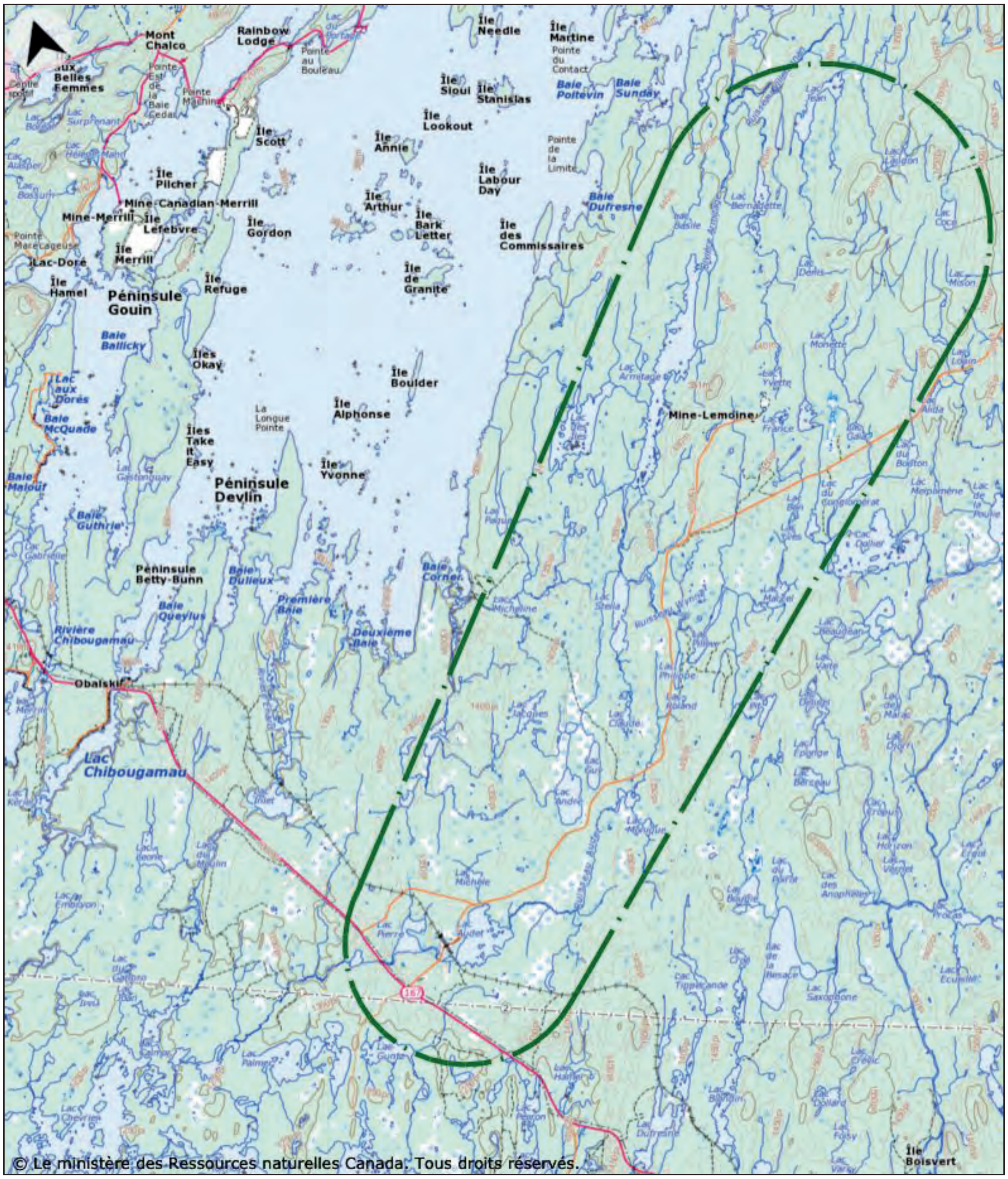


Photo 1: Logging road 210

Photo 2: Seasonal camp (Wapachee family) on logging road 210

Cadastres for the Municipality of James Bay and the town of Chibougamau do not indicate any particular zoning within the study area. The nearest permanent residences are located more than 10 km away, in the Obalski sector (Lac Chibougamau, Baie Queylus - *Pourvoirie J.C. Bou,* located 26 km from the pit and 12 km from the rail transfer point). In the regional study area, within the Domaine-du-Roy RCM, there are seasonal residences around Lac Vimont (MRNF lease to operate a commercial resort), 12 km southeast of the pit. Aside from the large distance between the mine site and the built environment, topography and vegetation will clearly also significantly mitigate any potential noise impact.

The Ministère du Développement durable, de l'Environnement et des Parcs (MDDEP) defines a noise assessment point as "*a residential dwelling, a building, a campground, a recreational site* *including an outfitter, and agricultural and industrial land or land that is destined for such use in accordance with municipal by-laws, which is exposed to a noise source*".[2]

For the current project, no particular site corresponding to this definition was identified in the area in question, except the Wapachee family seasonal camp mentioned above. As such, the area affected by the project does not contain zones that are considered sensitive to noise disturbance.

Given the absence of noise assessment points, it was deemed unnecessary to do a detailed inventory of ambient noise levels prior to the start of the project. The current noise environment does not have any significant sources of noise. During the 17 August 2011 field visit, the only noticeable noises at different sites in the study area were those from rustling vegetation and birds and insects. It was not possible to conduct ambient noise surveys for reference purposes on the day of the field visit as the wind speed exceeded the 20 km/h upper limit.

6.3 NOISE ASSESSMENT CRITERIA

6.3.1 Provincial Standards

In Quebec, *Directive 019 sur l'industrie minière* issued by the Ministère du Développement Durable, de l'Environnement et des Parcs (MDDEP, April 2005) sets the applicable standards for noise produced by open pit mining. This document considers background noise to be part of the human environment to be protected so as not to cause harm. The various assessment criteria include maximum allowable noise levels depending on zoning and land use. MDDEP standards for continuous noise sources for mining projects are given in Table 6.1.

The method used to calculate noise levels is described in Annex IV of *Directive 019*. Furthermore, certain penalties apply when the noise transmits information (voice, music) or results from impact, such as mechanical shocks and pulses. Limits and zoning categories are similar to those in the MDDEP's *Note d'instruction 98-01*, a document that aims to limit noise from fixed industrial sources.

[2] Free translation from French

Tableau 6.1 Allowable Noise Levels by Zoning Category

Type of Zoning and Corresponding Description (MDDEP, April 2005)	***Level at Night, from 7pm to 7am***	***Daytime Level, 7am to 7pm***
I *Land destined for detached or semi-detached single family dwellings, or for academic or healthcare institutions. Grounds of an existing dwelling in agricultural zoning.*	40 dB(A)	45 dB(A)
II *Land destined for apartment buildings, mobile home parks, buildings or campgrounds.*	45 dB(A)	50 dB(A)
III *Land destined for commercial use or for recreational parks. However, the night noise level only applies within the property limits of buildings used for residential purposes. Otherwise, the maximum daytime noise level applies at night.*	50 dB(A)	55 dB(A)
IV *Land destined for industrial or agricultural use. However, on the grounds of an existing dwelling in an industrial zone that complied with municipal bylaws applicable at the time of its construction, standards are 50 dB(A) at night and 55 dB(A) during the day.*	70 dB(A)	70 dB(A)

Directive 019 stipulates that the maximum noise level of a new mining project must, at all times and at all noise assessment points, be less than the higher of the level indicated in Table 6.1 and the ambient level measured at the noise assessment point with no mining operations in progress. As previously mentioned, there are no sensitive zones within a 10-km radius of the pit. In this type of situation, *Directive 019* specifies that *in the case where no zoning exists and the land is not subject to any specific use, no noise requirements apply as there are no noise assessment points.* Based on the assumptions in Section 6.2, the BlackRock project is not subject to environmental noise limits. However, this does not cover maximum worker exposure to noise, which is governed by the *Regulation regarding occupational health and safety*.

In addition to sources of continuous noise, *Directive 019* also sets a maximum noise level for blasting activities. For an open pit mine, the maximum sound pressure level at any dwelling is 128 dB (linear decibels). However, there are no dwellings within 1 km of the mine. It should also be noted that this refers to a sound pressure level with a standardized frequency response referenced to 20 µPa for sound pressure in air. In comparison, sound pressure levels expressed in dB(A) correspond to values that have been adjusted with the A-weighting curve, which takes into account the sensitivity of human hearing.

Aside from the regulations enacted under the *Environment Quality Act* (RSQ, c Q-2), other provincial authorities may also have recommendations for noise. For example, the *Act respecting Occupational health and safety* (RSQ, c S-2.1) and its applicable regulations determine exposure limits, and the Ministère des Transports du Québec has its own policy on road noise. There is also a sectoral policy for noise emanating from a construction site. However, it is not pertinent to list all the technical assessment criteria for sound pressure levels as MDDEP regulations are the strictest for this type of pollution.

6.3.2 Municipal By-Laws

In addition to the regulations mentioned above, municipalities generally oversee disturbances arising from local situations. Most components of the BlackRock project are located within the Chibougamau town limits, although the access road and rail transfer point are also on land governed by the Municipality of James Bay. The two municipalities have similar ways of dealing with noise issues.

Chibougamau By-Law 005-2001, Section 19 states that *to make, provoke or incite, in any way whatsoever, noise likely to disturb the peace, tranquillity, comfort, rest or wellbeing of citizens or hamper the peaceful use of neighbouring property constitutes a nuisance and is prohibited.* Furthermore, *making noise likely to disturb the peace and wellbeing of the neighbourhood by executing, between the hours of 11 p.m. and 7 a.m., construction, demolition or repair work to a building or vehicle, using motorized equipment such as, for instance, a chain-saw, an axe, a splitter, or a compressor, except in the case of emergency work to safeguard persons or property, is considered a nuisance and is prohibited* (Section 20).

The same principles are in force in the Municipality of James Bay. Section 7 of the revised version of By-Law 149 on nuisances says that *it is prohibited to make, provoke or incite, in any way whatsoever, noise likely to disturb the peace, tranquillity, comfort, rest or wellbeing of the neighbourhood*. With regard to loud motorized equipment, *the use of loud motorized equipment between the hours of 11 p.m. and 6 a.m. without a reasonable motive is prohibited (…)*, as is *the use of motorized equipment that services a building or its contents between the hours of 12 a.m. and 6 a.m.* (Section 9). The same applies to noise from work, as Section 10 of the same by-law states that *causing noise likely to disturb the peace or wellbeing of the neighbourhood by executing construction, demolition or repair work to a building or vehicle, or any other work that generates noise between the hours of 10 p.m. and 7 a.m., except in the case of emergency work to safeguard persons or property, is prohibited.*

Although the BlackRock mining project falls entirely within the territories of the town of Chibougamau and the Municipality of James Bay, it is also located near the boundary of the Domaine-du-Roy RCM, which administers the Lac-Ashuapmushuan Unorganized Territory (Lac Vimont Lake sector - cottages). For municipal by-laws pertaining to noise and nuisances in this sector, the RCM follows government guidelines and regulations.

Prescriptive standards do not include maximum values for sound pressure level. As the nearest neighbours apt to notice the nuisances provided for in municipal by-laws reside far from the area affected by the project, the noise from construction and operation is not expected to contravene such by-laws.

6.4 SIGNIFICANT SOURCES OF NOISE

6.4.1 Mobile Noise Sources Associated with Mining

The BlackRock Inc. mine will operate year-round, 24 hours per day. Initial construction activities aside, work will essentially consist of:

- extracting the ore, waste rock and overburden
- transporting materials to storage areas
- drilling prior to blasting
- loading and hauling ore between the extraction site and the processing plant (crushing and concentration).

The project is an open pit mine that tends to use high-capacity, off-road vehicles. Table 6.2 gives a detailed list of the heavy machinery that will operate daily at the mine site.

In addition to heavy machinery, several pieces of support equipment are also included in the project. These will be used at the mine site, although some will also travel on the road from the processing plant to the rail transfer point, via the mine site. Table 6.3 lists this equipment.

Noise levels in the tables were generally taken from specifications in the technical documentation accompanying the proposed equipment, or from the *Federal Highway Administration* (FHWA) construction equipment noise database. The corresponding sound pressure values in dB(A) were estimated from average levels measured at a distance of 15 metres (50 feet).

It should be noted that the ancillary equipment is normally only used sporadically. Averaged out over time, the noise output for this equipment is necessarily lower than if it were to function on an ongoing basis. For example, the backup generators have a high electrical power rating but will only be used in the event of a power failure or for maintenance start-ups. Furthermore, the fact that they will solely operate in specially-designed enclosures will limit noise levels to 70 dB(A) at a distance of some 15 meters.

Mobile noise sources also include transportation activities. Some of the equipment listed in Table 6.3 will be directly used to transport people and material. It is nevertheless difficult to draw up a detailed list of this type of noise sources. Ore will be transported from the mine to the rail transfer point by tractor-trailers; as traffic will be constant along this 20-km route, it is preferable to treat these trucking activities as a single linear source of noise, which is the method usually used to analyze road traffic (this is addressed in Section 6.5.4).

Table 6.2 List of the Main Mobile Equipment Operating Simultaneously at the Mine Site

Description	*Typical equipment used or similar model*	*Maximum number*	*Percentage of use*	*Noise level at a 15-m distance*	*Estimated sound pressure level*
Hydraulic shovel (25 to 35 m^3)	Caterpillar 6060, Liebherr R996B or Bucyrus RH340	2	100%	90 dB(A)	123 dB(A)
Wheel loader (20 m^3)	Caterpillar 993K	1	60%	82 dB(A)	116 dB(A)
Off-highway truck (220 to 250 tonnes)	Komatsu 830E or Caterpillar 793F	10	100%	88 dB(A)	121 dB(A)
Drill (blast holes)	Atlas Copco Pit Viper 351, or Caterpillar MD6540	2	100%	92 dB(A)	125 dB(A)
Wheel dozer (627 HP)	Caterpillar 844H	2	90%	82 dB(A)	116 dB(A)
Track-type tractor (580 HP)	Caterpillar D10	1	90%	92 dB(A)	125 dB(A)
Track-type tractor (410 HP)	Caterpillar D9	2	90%	87 dB(A)	120 dB(A)
Grader (16-ft, 297 HP)	Caterpillar 16M	2	90%	78 dB(A)	111 dB(A)

Table 6.3 Summary of Main Ancillary Equipment

Description	*Equipment type or similar*	*Maximum number*	*Percentage utilization*	*Noise level at a 15-m distance*	*Estimated sound pressure level*
Hydraulic crane (75 t)	Link-Belt HT-8675	1	40%	81 dB(A)	114 dB(A)
Compressed air drill (200 HP, 80 to 100mm)	Atlas Copco AirROC D45 SH or Ingersoll-Rand ECM-370	1	40%	85 dB(A)	118 dB(A)
Wheel loader	Caterpillar 988H	1	50%	81 dB(A)	114 dB(A)
Articulated truck	Caterpillar 735	1	30%	79 dB(A)	112 dB(A)
Excavator	Caterpillar 336DL	1	40%	72 dB(A)	105 dB(A)
Fuel truck	Caterpillar 777	2	50%	84 dB(A)	117 dB(A)
Service truck (250 HP)	n/a	1	50%	85 dB(A)	118 dB(A)
Tire changer	n/a	1	25%	80 dB(A)	113 dB(A)
Minibus (12 passengers)	n/a	3	25%	75 dB(A)	108 dB(A)
4x4 pick-up truck	n/a	12	40%	75 dB(A)	108 dB(A)
Light towers (1,000 W, diesel)	n/a	6	40%	73 dB(A)	108 dB(A)
Electric submersible pump (250 HP)	n/a	2	80%	81 dB(A)	114 dB(A)
Mobile pump (125 HP, diesel)	n/a	4	80%	81 dB(A)	114 dB(A)
800 kW generator	Caterpillar XQ800	2	20%	67 dB(A)	100 dB(A)
1,200 kW generator	Caterpillar XQ1250	2	20%	70 dB(A)	103 dB(A)

6.4.2 Fixed Noise Sources

Most of the equipment listed in Tables 6.2 and 6.3 are mobile noise sources. Given the scope of the mining project, there will also be many fixed noise sources on site. These are grouped in the following areas: the crusher, concentrator and garage areas, the mining camp and the rail transfer point.

A significant proportion of this equipment will be housed inside various buildings. This should significantly reduce outdoor noise emissions. Nonetheless, some equipment will be located outdoors and may contribute to total noise emissions from the mining operation. The preliminary work carried out by BBA for the technical feasibility study provides a list of equipment likely to produce direct outdoor noise, which includes the following:

- various ore conveyors;
- several pumping units for effluent and tailings management;
- sludge concentrator;
- a number of electric transformers (2.5 to 75 MVA)

These pieces of equipment are fixed noise sources that will be scattered throughout the mine site, and for which, in most cases, noise levels are hard to anticipate. A lot of this equipment is specifically designed to meet project needs. Compared to the mobile noise sources identified earlier, it can be assumed that fixed sources will not contribute significantly to the total mine noise emissions.

6.5 POTENTIAL NOISE IMPACT ASSESSMENT

6.5.1 Noise from the Mine

Noise from mining equipment is a recognized problem. However, unlike motor vehicle noise, there are few acoustical prediction tools specifically designed for this type of noise. Software such as Traffic Noise Model (TNM), developed by the FHWA in the United States and broadly used by the Ministère des Transports du Québec (MTQ), is specifically designed to simulate noise generated by road traffic. The RCNM (Roadway Construction Noise Model) software, also developed by the FHWA, takes into account construction equipment frequency of use. On the other hand, the *Construction Noise Control Specification 721.560* formulas used to estimate noise levels do not take into account the type and topography of the terrain. There are more powerful prediction tools, such as Datakustik‟s Cadna-A software, but more initial data is needed to prepare a representative model.

Given the absence of potentially noise-sensitive zones, RCNM software version 1.1 was selected to generally assess the overall noise level from mining activities. This software is equipped with a database of heavy machinery noise levels.

The quantity and type of mining machinery needed to operate the mine were determined in the BBA technical feasibility study, having been drawn up based on forecast production rates. For analytical purposes, the various noise sources were considered to be located at a known distance from the receptor. The noise emission parameters essentially reproduce the data shown in Tables 6.2 and 6.3. An additional attenuation of 0.01 dB(A) per metre was applied to account for the vegetation cover of the surrounding forest. This value is very conservative considering that it is usually set between 0.05 and 0.08 depending on foliage density. Table 6.4 shows the analytical results.

Table 6.4 Projected Noise Levels as a Function of Distance from the Mining Zone

Distance, in metres	*Projected Noise Level, in dB(A)*
500	66.7
750	60.9
1,000	55.9
1,250	51.4
1,500	47.3
1,750	43.5
2,000	39.8
2,250	36.3
2,500	32.9
2,750	29.5

From these results, it can be determined that projected noise levels for mining operations will be less than 40 dB(A) at a distance of two kilometres, and that noise impact is is negligible even at the workers‟ camp, located more than 7 km from the mine site. The 40-dB(A) reference was chosen based on the most stringent value in *Directive 019*, which is the night level for residential zones. In a forested environment like the study area, insects and birds can increase ambient noise levels to 45-50 dB(A) naturally.

It is important to note that these estimates represent the most critical noise situation. Actual noise levels will likely be lower than those shown in Table 6.4, as calculations do not take into account sound barriers formed not only by the natural topography, but more importantly, by the length of the tailings pile and depth of the open pit, which will increase steadily over the life of the operation, not to mention the many piles of accumulated waste rock around the pit. Most of the noisy equipment will therefore quickly be confined to an area defined by the mining zone. The same holds for frequency of use, expressed as a percentage, which is for the most part overestimated as it does not take into account downtime and mobilization, particularly in the case of drill rigs.

6.5.2 Blasting Noise

Blasting activities are among the most significant sources of noise at the mine, and present an impact risk. The minimum distance for which the sound pressure level should not exceed the applicable threshold can be broadly estimated (Richard and Moore, 2006). While this technique is subject to some variability (expressed as the calibration factor k_s) compared to practical tests, the following empirical formula provides a value based on the planned blasting pattern:

$$D_{120} = \left(\frac{k_s \times d}{SH} \right)^{2.5} \sqrt[3]{m}$$

In this formula, „d" corresponds to the blast hole diameter in mm, „SH" to the collar height in mm, and „m" to the subtotal, in kg, of the charge of explosives fired simultaneously (detonated on the same delay). The result, D_{120}, is the distance from the work face at which the sound pressure level should not exceed 120 dB. The BBA technical feasibility study provides the following data for ore extraction:

- hole diameter: 8½" (216 mm);
- burden: 6.0 m;
- hole depth: 11.5 m (including 1.5 m of sub-drill)
- collar height: 4.2 m;
- explosives density: 1.25 g/cm^3;
- number of holes per blast: 150;
- blasting frequency: every three days.

Other data required is not specified. For analytical purposes, it is assumed that „m" is about 335 kg (about 1 hole per delay) and k_s is 180 (typical maximum factor). Calculation yields a distance of 1,810 m. Given that the *Directive 019* standard for sound pressure level is 128 dB, it can be reasonably assumed that beyond a radius of about 2 km, noise from blasting should be tolerable and not cause a major disturbance.

6.5.3 Rail Transfer Point Noise

The ore mined will be brought to the rail transfer point for shipment by rail. Maximum production is estimated at some 7, 200 tonnes per day, which means daily loading of 72 freight cars. Canadian National will oversee shipment to the Quebec City or Saguenay port.

To control the moisture content of the concentrate, transfer operations will take place inside a heated garage. It can therefore be assumed that this building will mitigate some of the noise produced. In addition to a motor, the rail transfer point is equipped with two blowers and an unloading station for incoming trucks. Once again, these constitute noise sources that will operate sporadically and at a low intensity compared to the CN trains passing nearby. At this stage of the project, the rail transfer point does not appear to present any particular risk of noise impact. The information available on this is preliminary, and the noise impact can be reassessed if needed once the rail transfer point design is finalized.

6.5.4 Transportation Noise

According to the current access road trajectory, a distance of 25 km separates the mine from the rail transfer point, which is located 2 km from Route 167. The plan is to use logging road 210 for heavy vehicle traffic. Mine construction and operation will inevitably generate a significant increase in traffic along this road. In addition to the transportation of workers, there will be multiple deliveries of materials to the mine and the camp.

Despite all this traffic, the most significant transportation activity remains the trucking of concentrate from the mine to the rail transfer point. Standard semi-trailer dump trucks were selected for this operation. Preliminary estimates suggest that a full load will have to leave the processing plant every six minutes to move the thousands of tonnes of concentrate produced daily. In reality, this will translate into a total of about 20 trips per hour (10 trucks back and forth) on the access road. This traffic represents about 500 heavy vehicle trips per day, and constitutes a potentially disturbing noise source, as the distance is substantial. Average speed is estimated at 50 km/h given that it is a gravel road with fairly rugged relief and a number of curves.

Given this information, the noise impact of the traffic can be roughly estimated. The noise related to transport of iron ore concentrate to the rail transfer point was therefore determined using TNM software, version 2.5, which includes a category for heavy vehicles with more than three axles. Results are presented in Table 6.5.

Table 6.5 Projected Noise Levels as a Function of Distance from the Haulage Road from the Mine Site to the Rail Transfer Point

Distance, in metres	*Project Noise Level, in dB(A)*
50	50.5
100	45.3
150	42.4
200	40.1
250	38.2
300	36.7
350	35.5
400	34.5
450	33.7
500	33.1
550	32.0
600	31.6
650	31.2
700	30.8

According to these results, the impact from noise related to the transport of ore concentrate is negligible beyond 250 m on either side of the access road, as projected sound levels are less than 40 dB(A). Once again, this assessment does not take into account natural noise barriers or vegetation cover. In this context, the workers" camp should be laid out in such a way that rest areas are far away from the road and zones that are less sensitive to noise, such as common areas or a parking lot, are used as buffers. This point is further discussed in the next section.

6.6 NOISE MONITORING AND MITIGATION

Although anticipated impact from noise is low, there are ways to enhance worker protection and comfort and reduce environmental noise emissions.

6.6.1 Noise Emission Monitoring

Given the MDDEP"s expectations in terms of monitoring of the actual effects of the project during the construction and operation phases, it would be appropriate to monitor noise emissions. A preventive plan for environmental noise management could be implemented and amended as mining operations progress.

A first step would be to validate the predictive estimate of noise levels once construction begins. As a minimum, noise emissions should be checked once a year for the first three years (from 2012 to 2014). Afterwards, a noise survey could be done once every four years or whenever significant equipment is added. The noise assessment should be done in accordance with applicable MDDEP guidelines, but should also include a compilation of all noise emissions encountered in areas used for mining activities.

It should also be recalled that the MDDEP"s *Directive 019* requires the owner of an operating mine located more than one kilometre away from any assessment point to self-monitor blasting operations to ensure that the 128-dB sound pressure threshold is not exceeded. These measures can be included as part of the prevention plan for environmental noise management, if applicable.

6.6.2 Noise Impact Mitigation

Section 6.5 shows that the anticipated impact from noise is low or negligible, and it would therefore seem unnecessary to plan for noise mitigation measures ahead of time. Nonetheless, it is always preferable to control noise disturbance by adopting a proactive approach. MDDEP directives indicates that BlackRock should take measures to emphasize the project"s positive effects on the environment and minimize its negative effects.

To achieve this, it is recommended that sound pressure level be added to the selection criteria for the noisiest equipment. For example, a particular off-road truck model may be favoured against its noisier counterpart. Caterpillar offers the 793C-XQ (Extra Quiet) model that comes with a number of noise mitigation devices. Using a dump truck with flexible liners, such as the Duratray Suspended Dump Body, can also enhance performance. This approach can be used for most machinery and equipment.

The camp layout should also be given careful consideration in terms of noise protection. BlackRock plans to build the camp at the junction of the new mine access road (Lac France road) at kilometre 21.9 of logging road 210. Camp facilities are not directly subject to the standards applicable to residential building as they are an integral part of the BlackRock mining project. However, the comfort of occupants in the various relaxation areas should be optimized, and the more sensitive premises should be built away from local noise sources and roads. Sensitive premises include bedrooms and dormitories, dining halls and recreational areas. Construction of a protective berm between the camp and the road would significantly reduce noise from heavy vehicle traffic, as long as the berm is sufficiently high and long (minimum space required). All residential buildings should also be designed to meet generally-recognized comfort criteria for noise.

6.7 CONCLUSION

The impact assessment for noise generated by the BlackRock project indicates that noise levels are significant and exceed the 40-dB(A) threshold in the area outlined in Figure 6.2.

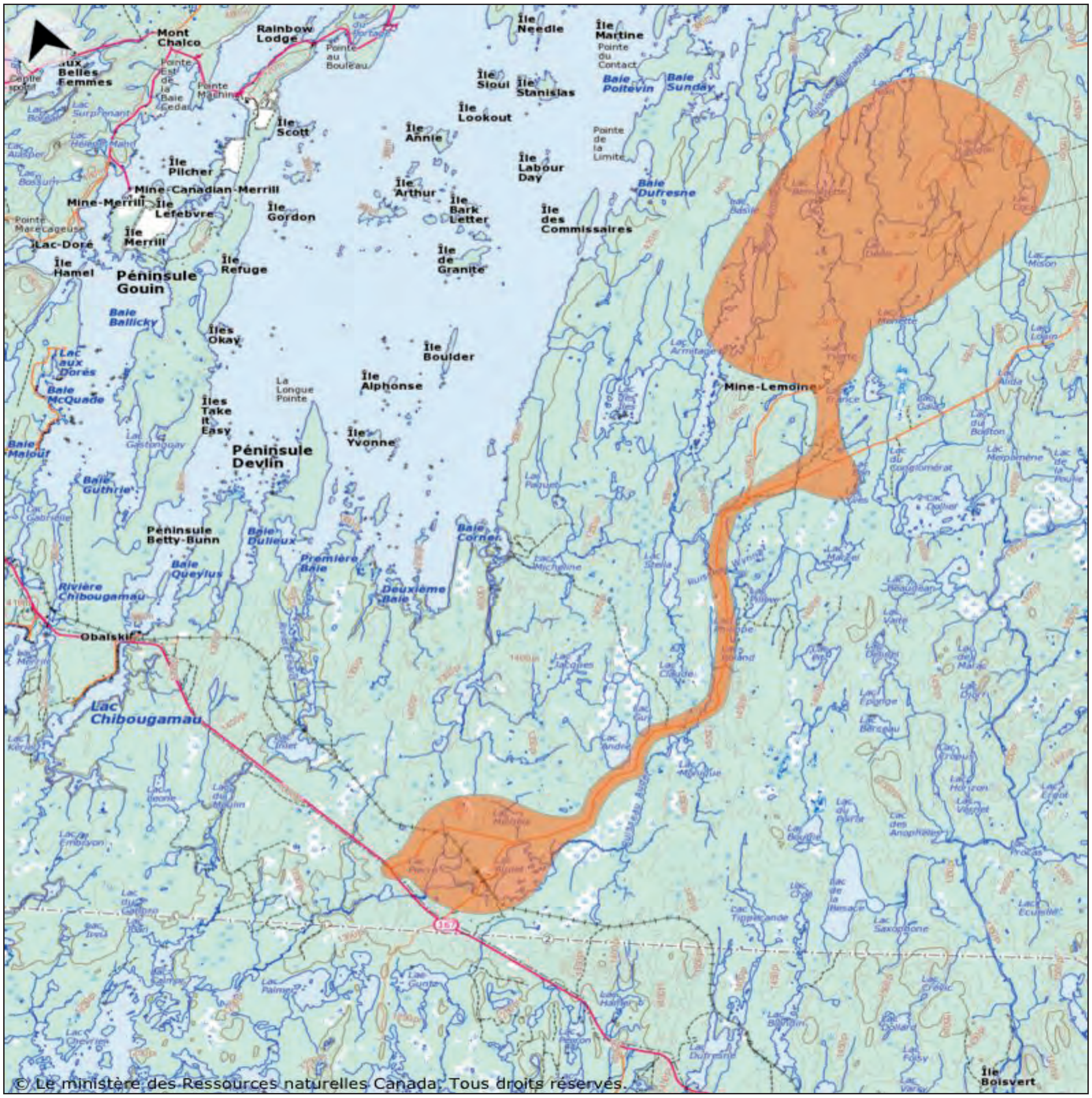
This area affected by noise corresponds to a 250-m wide band on either side of the access road and camp plus the area within a radius of about 2-km from other planned facilities (rail transfer point, mine, tailing facilities). Previous sections describe the context in which environmental noise was assessed. The noise assessment can be summarized as follows:

- The nearest sensitive zones are located more than 10 km away from the planned facilities;
- No noise assessment points are expected to be found within the area in question;
- Mining equipment in operation constitutes the most significant source of noise. Related noise levels are negligible beyond a distance of 2 km at a threshold of 40 dB(A);
- Road noise from the transport of concentrate along the access road is considered negligible beyond 250 m, with sound pressure levels below 40 dB(A);
- Blasting constitutes an inevitable source of noise, but its relative impact is mitigated by the fact that blasting activities will only take place one day out of three; the 128-dB standard is met at an approximate distance of 2 km from the blast site.

Given the specific setting of this project, several factors were considered in the noise assessment:

- the information used in the noise assessment is based on design and engineering work as at August 2011;
- the detailed engineering for the facilities will allow noise levels for certain sectors and equipment to be determined more accurately;
- no noise assessment points, as defined in the regulations, are found in the study area; if the Wapachee family seasonal camp on logging road 210 is not relocated outside the study area at the start of the project, ambient noise levels will have to be surveyed and the noise assessment redone to make sure that noise impacts remain within acceptable limits;
- the addition of a freight train between the transfer point and the Quebec City or Saguenay port should not have a significant noise impact considering the overall impact from the existing railway, for which Canadian National is responsible;
- the effects of noise on the health, comfort and wellbeing of people working at the mine or mining facilities are not within the scope of the elements considered for the environmental impact study;
- the impact that noise will have on wildlife cannot be commented on; however, it is well known that new sources of noise and occasional blasting will affect certain species, but this aspect is not sufficiently documented to be assessed.

Figure 6.2 Preliminary Assessment of the Zone of Influence for Noise from Mining Activities



While the risk of noise disturbance from the project is limited, attention should still be paid to minimizing environmental noise emissions. Section 6.6.2 gives general ways to mitigate noise. It is recommended that a noise management policy be adopted to control this type of impact.

REFERENCES

Breton, Banville & Associées (BBA), August 2011. *BlackRock Project, Feasibility Study Report (Volumes 1 and 2).*

Ministère du Développement Durable, de l‟Environnement et des Parcs, Direction des politiques de l‟eau, Service des eaux industrielles ENV/2005/0120. April 2005. *Directive 019 sur l'industrie minière*.

Ministère du Développement Durable, de l‟Environnement et des Parcs, Rev. June 2006. *Note d'instructions 98-01 sur le bruit.*

Richards, A.B. and A. J. Moore, 2006. *Airblast control techniques in open cut mines. Proceedings of The 32nd Annual Conference on Explosives and Blasting Technique, Dallas, Texas, USA*.

U.S. Department of Transportation, Federal Highway Administration (FHWA). *Construction equipment noise database.*
www.fhwa.dot.gouv

7. WETLANDS, THREATENED OR VULNERABLE SPECIES AND MIGRATORY BIRDS

The presence of wetlands or species-at-risk habitats on the project sites has ecological implications. The relative scope of these implications must be put in perspective at different spatial scales in order to constrain the environmental effects of the project and, more specifically, to conform to the spirit of the *Species at Risk Act* (SARA).

In this same habitat protection context, the *Migratory Birds Convention Act* and the Protocol amending it set out a cooperation framework between Canada and the United States for the protection of migratory birds and their critical habitats.

The goal of this chapter is to qualify and quantify sensitive ecosystems affected by the project, including migratory bird ecosystems, and to assess the likelihood of the presence of threatened or vulnerable species.

7.1 WETLANDS

An analysis of wetlands was performed to obtain a picture of their abundance at different spatial scales. Results are shown as maps at the regional and local project scale. This analysis provides a detailed description of the different types of wetlands and their respective abundance. The environmental functions of these wetlands as well as the likely performance of each of these functions were also constrained.

7.1.1 Wetlands at Various Spatial Scales

Natural Province Scale

The mining project is located within the Mistassini Highlands natural province. This 82,500-km^2 area comprises a large, relatively low-relief plateau with scattered hills reaching up to 500 m in elevation. From a hydrological standpoint, it is characterized by the presence of large water bodies, such as Lac Chibougamau, Lac Matagami and Lac Mistassini, and the predominance of large peatbog complexes. In total, wetlands represent 7.3% (6,037 km^2) of this area.

Level 1 Watershed Scale

Northern Québec comprises 120 level 1 watersheds. The mining project is located within the Rivière Nottaway watershed, a 47,174-km^2 area that includes the Chibougamau, Chapais, Lebel-sur-Quévillon and Matagami regions. Wetlands represent 13.9%, or nearly 6,551 km^2, of the area. Although most wetlands are not classified (6,414 km^2), 137 km^2 are occupied by natural peatbogs, 0.54 km^2 by marshes and 0.20 km^2 by wet prairies.

Local Study Area Scale

For a better picture of wetland distribution and types in the local study area, a map analysis (see Figure 7.1) was done over a 3,115-km^2 area bounded as follows:

- by the Lac Chibougamau watershed drainage divide to the east;
- by Lac Chibougamau and Route 167 to the west;
- by the Lac Audet watershed to the south;

- by the Ruisseau Villefagnan watershed to the north.

Wetland analysis was based on ecoforestry maps resulting from the fourth forest resource inventory carried out as part of the forest resource knowledge acquisition program (© MRNF 2011 - 32G09-0201, 32G09-0202, 32G16-0102, 32G13-0101), and on data from Ducks Unlimited Canada (DUC) on forests in Quebec (maps derived from analysis of data from the third forest inventory). Eight wetland categories have thus been identified. They are described below based on MDDEP[3] definitions, as well as the DUC and MRNF classification scheme.

- **Ponds:** stagnant, unconfined bodies of water smaller than 8 ha, natural or man-made, that may or may not be connected to a drainage system. Plant cover generally consists of submerged and floating aquatic plants.
- **Marshes:** habitats dominated by herbaceous plants on a mineral substrate that is partially or completely submerged during the growing season. Trees represent less than 25% of plant cover. Marshes can be riparian (most cases) or isolated. They include meadow marshes, emergent marshes and other types of wetlands which may have been classified as “bare wetlands”.
- **Open bogs:** wetlands covered by peat in which trees represent less than 25% of the plant cover. Water supply to these wetlands is mainly from precipitation. The water table is generally at or near the surface. These are poorly-drained areas in which organic matter accumulation prevails over decomposition and humification. In general, open bogs are very acidic and extremely nutrient-poor. The peat layer is usually more than 40-cm thick and generally composed of sphagnum.
- **Open fens:** wetlands covered by peat in which trees represent less than 25% of plant cover. Water supply to these wetlands is from mineral water from below the water table, which is at or just above ground level. These settings are therefore more nutrient-rich than bogs. Internal drainage is very slow and by seepage. Vegetation comprises sedges, mosses, shrubs and, in some cases, a few scattered trees.
- **Floodplain swamps:** wetlands dominated by standing dead trees, generally associated with beaver dams. They form on mineral or organic soil and are subjected to seasonal flooding or have a high water table.
- **Shrub swamps:** riparian wetlands acting as overflow plains along watercourses. They are mainly dominated by shrubs, in particular speckled alder (*Alnus rugosa*). They form on mineral or organic soil and are subjected to seasonal flooding.

[3] Ministère du Développement durable, de l‟Environnement et des Parcs (MDDEP). (2006). Guide d‟analyse des projets d‟intervention dans les écosystèmes aquatiques, humides et riverains assujettis à l‟article 22 de la Loi sur la Qualité de l‟environnement. Identification et délimitation. Ministère du développement durable, de l‟Environnement et des Parcs. 14 p.

- **Poor conifer swamps:** wetlands in which more than 25% of plant cover consists of trees higher than 10 m. Conifers represent more than 75% of the basal area. They form on mineral or organic deposits with ombrotrophic drainage. These swamps include wooded bogs.
- **Rich conifer swamps:** forest swamps in which more than 25% of plant cover consists of trees higher than 10 m and conifers represent more than 75% of the basal area. They form on mineral or organic deposits and are fed by nutrient-rich mineral water from internal oblique flow (minerotrophic regime). These swamps include wooded fens.

Analysis of the spatial distribution of these different types of wetlands was carried out for the local study area as a whole. The distribution of these wetlands is shown in Figure 7.1. The total surface area and the proportion of the total study area for each wetland category are presented in Table 7.1.

The analysis shows that wetland abundance is higher at the scale of the local study area than at other spatial scales. Thus, wetlands account for 28.6% (89.1 km^2) of the 311.5-km^2 study area. They mainly include marshes (45.65 km^2) and poor conifer swamps (37.41 km^2), which represent 51% and 42%, respectively, of all wetlands present. Together, these two types of wetlands occupy nearly 27% of the study area.

Table 7.1 Surface area, Proportion and Relative Abundance of Wetland Types in the Study Area

Wetland Type	Total Surface Area (ha)	Proportion of Area Occupied by Wetland Type (%)	Relative Abundance (%)
Pond	242.4	0.78	2.7
Marsh	4,564.5	14.65	51
Open bog	48.8	0.16	0.4
Open fen	0.0	0.00	0.5
Floodplain swamp	48.08	0.16	0.5
Shrub swamp	32.5	0.10	0.0
Poor conifer swamp	3,740.7	12.01	42
Rich conifer swamp	231.0	0.74	2.6
TOTAL	**8,908.4**	**28.6**	**100**

Project Site Scale

The project comprises two separates sites: the mine site, which includes the planned access road (Lac Bernadette subsystem), and the rail transfer site (Lac Audet and Lac Pierre subsystem). An analysis was done specifically to constrain the abundance of wetlands at the two sites (Figures 7.2 and 7.3). A 30-m wide buffer strip around the sites was included in the analysis to account for boundary disruptions. The estimated surface area of the two sites is nearly 16 km^2. Wetland surface areas and proportions are shown in Table 7.2.

Table 7.2 Surface Area, Proportion and Relative Abundance of Wetland Types at the Mine and Rail Transfer Sites

Wetland Type	Total Surface Area (ha)	Proportion ofSites Occupied by Wetland Type (%)	Relative Abundance (%)
Pond	13.02	0.82	4.0
Marsh	176.02	11.02	53.9
Shrub swamp	0.05	0.00	0.0
Floodplain swamp	0.75	0.05	0.2
Poor conifer swamp	111.80	7.00	34.2
Rich conifer swamp	24.85	1.56	7.6
TOTAL	**326.50**	**20.45**	**100**

The analysis shows that wetlands in the two sites cover 326.5 ha, or 20.45% of the total area of the sites. The most abundant wetland types are marshes, which account for 54% of all wetlands in the impacted area, and poor conifer swamps (34.2%). Some rich conifer swamps (7.6%) and ponds (4.0%) are also present. The other types of wetlands are very rare. In fact, no bogs or fens were observed.

Figure 7.1 Spatial Distribution of Wetlands in the Study Area

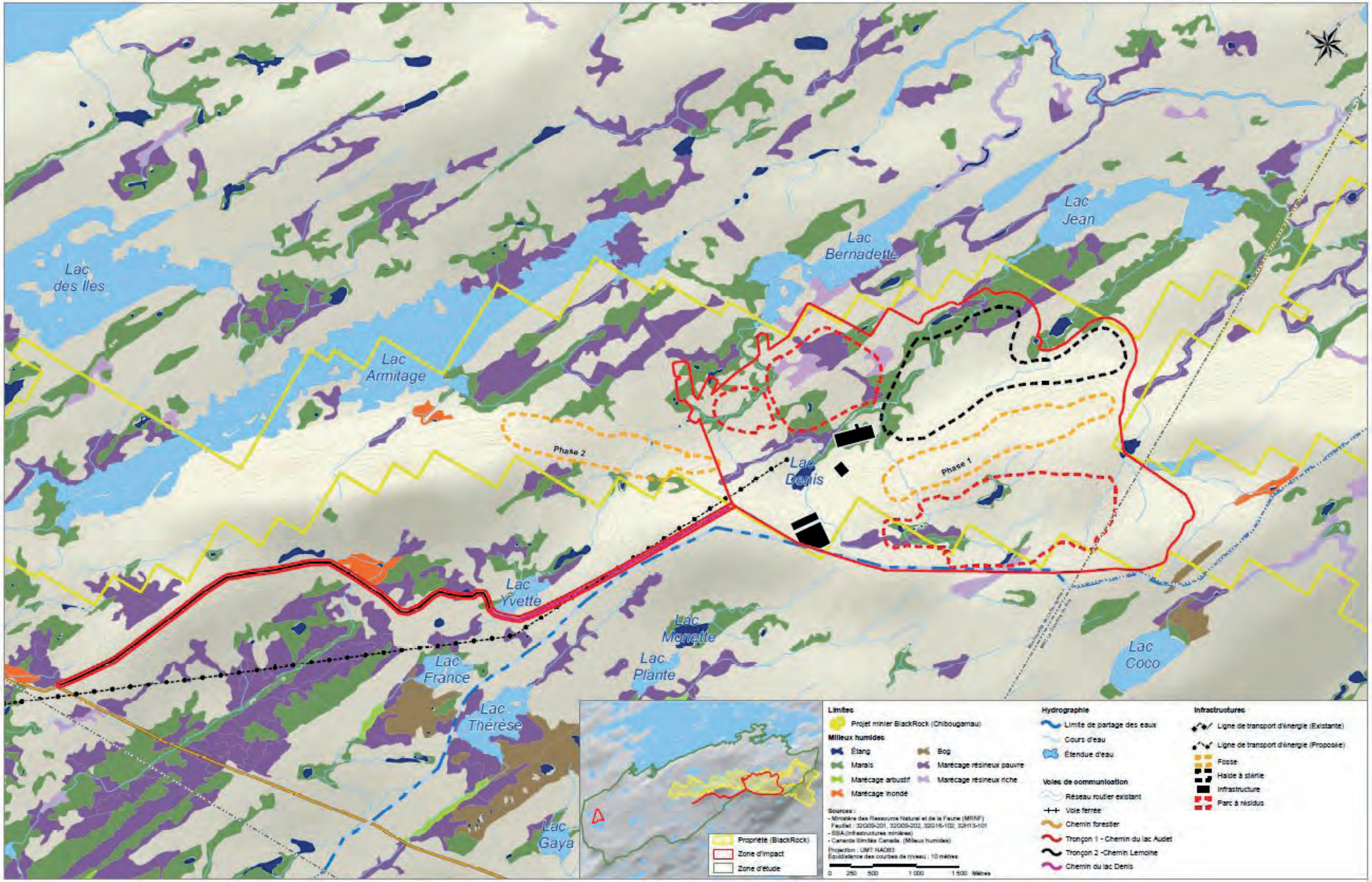


Figure 7.2 Spatial Distribution of Wetlands at the Rail Transfer Site

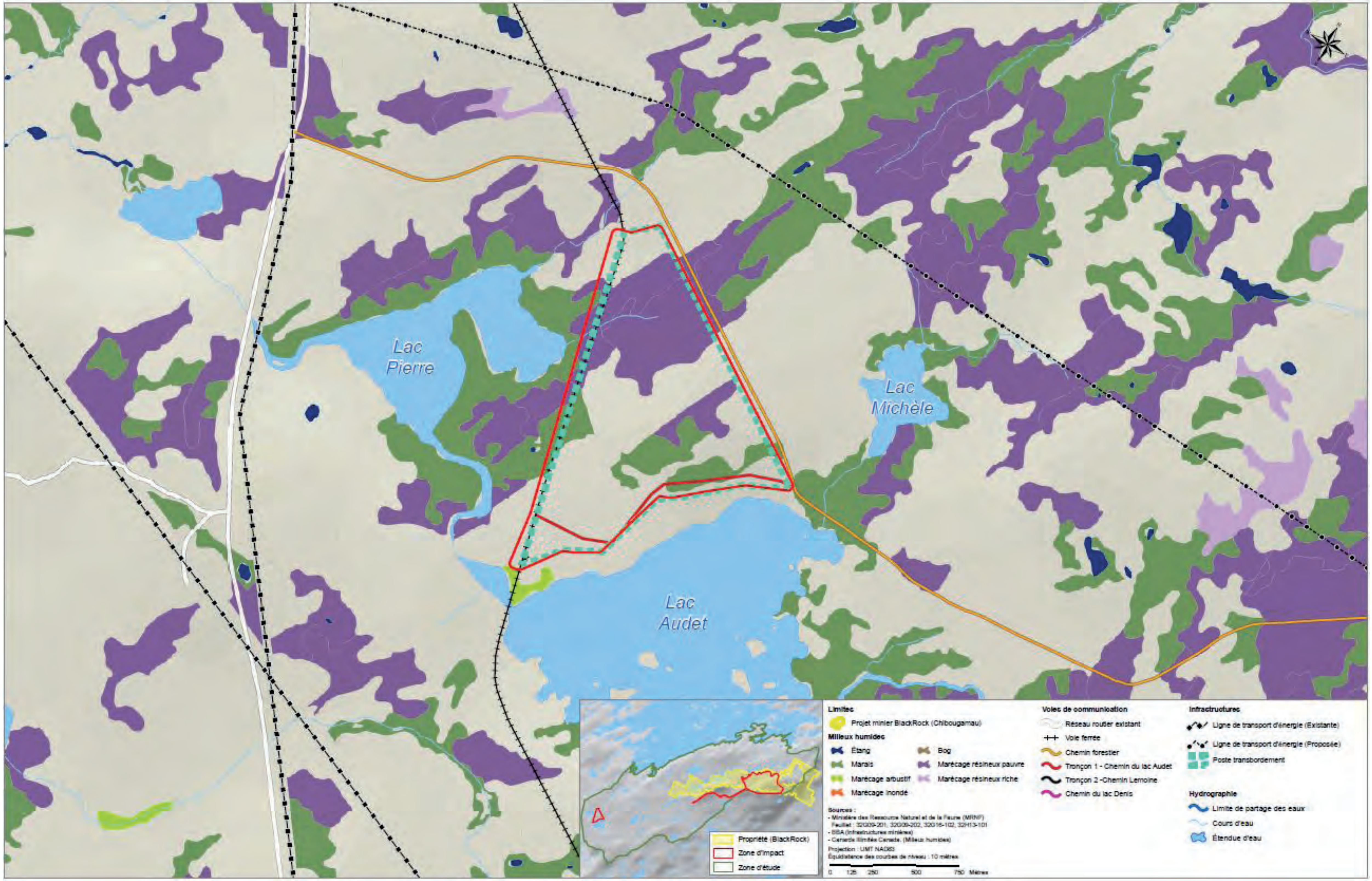
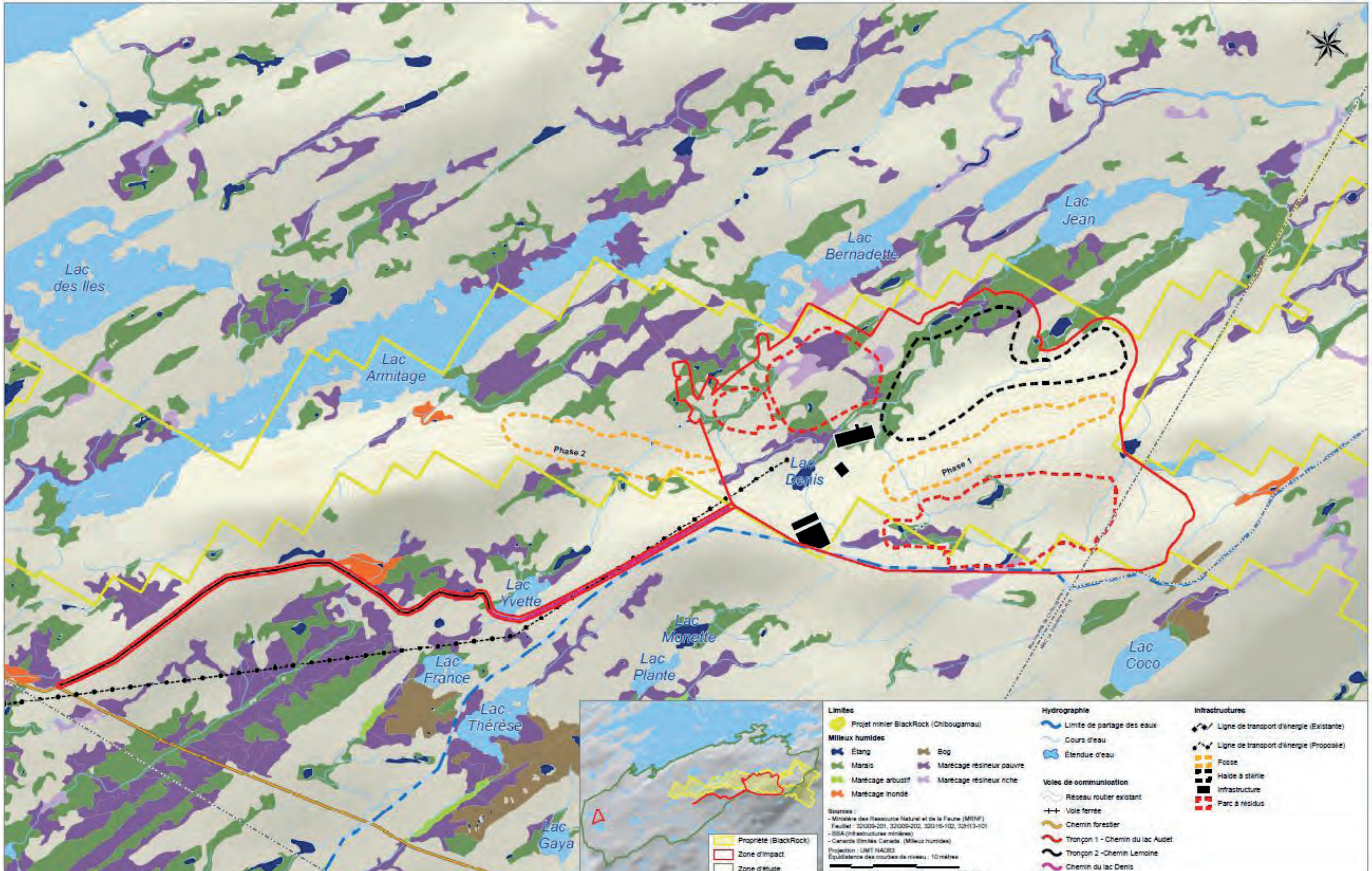


Figure 7.3 Spatial Distribution of Wetlands at the Mine Site



7.1.2 Relative Abundance of Wetlands at Different Scales

The relative abundance of wetlands varies greatly according to the way the area of interest is defined. For instance, wetlands account for 7.3% of the land of the Mistassini Highlands natural province, while they represent 13.9% of the Rivière Nottaway watershed area. At the project site scale, wetlands occupy an even greater fraction, namely 28.6%. Finally, the rail transfer site and the mine site as delineated on Figures 7.1 and 7.2 are 20.5% wetlands.

As can be seen from Table 7.3, wetlands are two to three times more abundant in the project study area than in the natural province and the level 1 watershed. Wetlands that could be directly affected by the project represent 0.04% and 0.07% of all wetlands in the natural province and level 1 watershed (Rivière Nottaway), respectively.

Table 7.3 Surface Area and Relative Abundance of Wetlands at Different Scales

	Mistassini Highlands Natural Province	Rivière Nottaway Watershed	Project Study Area	Project Sites
Total surface area (km^2)	82,500	47,174	3,115	16.0
Wetlands (km^2)	6,037	6,551	89.1	3.3
Percentage (%)	7.3%	13%	28.6%	20.4%

<u>Rail Transfer Site</u>

Two types of wetlands are found at the rail transfer site: poor conifer swamps and marshes. Until 1994, there was a working sawmill on this property, which is now owned by the *Ministère des Ressources naturelles et de la Faune (MRNF)*. A large part of the property is developed and does not contain any of the wetlands mentioned above. BlackRock intends to prioritize the use of areas that are already developed for industrial purposes. As a result, most of the wetlands on the property will not be affected.

As the detailed engineering for the rail transfer site has not yet been done, it is too early to know the precise extent of potential encroachments on wetlands.

<u>Mine site</u>

The access road to be built or upgraded between logging road 210 and the mine site (see Figure 7.2) is divided in two sections. The first section, a 3.5-km long stretch between road 210 and Lac Yvette, lies along an old logging road. Reusing this existing infrastructure will minimize encroachment on wetlands. The old logging road skirts a poor conifer swamp over less than 200 m. The second, 5-km long section of the access road between Lac Yvette and the mine site already exists and is operational. It has to be upgraded and does not cross any wetlands.

Wetlands located on the mine site itself are, in order of decreasing abundance, marshes, poor conifer swamps and rich conifer swamps. They are located below and on either side of the deposit ridge, in all low-lying areas and topographic lows. It is therefore impossible to protect all of them, even by minimizing the project footprint to the greatest extent possible.

7.1.3 Wetland Functions at the Project Sites

All wetland types found in the project area are shown and qualified in Table 7.4. They were assessed in accordance with the Canadian Wildlife Service Technical Report on Wetland Ecological Functions Assessment.[4] A brief definition of each ecological function as well as the factors that affect them is presented below.

Hydrological functions refer to the contribution of wetlands to the volume of surface and groundwater. They include the following:

- Flow moderation: wetlands limit flooding in periods of high precipitation and maintain flow in dry periods; the flow-moderating capacity of a wetland depends on the difference between maximum and mean water volumes in the wetland, as well as its surface area relative to the size of the watershed;
- Groundwater recharge: wetlands contribute to recharging aquifers in seasonal dry periods; their contribution is highly variable and depends on basin shape, location within the watershed, nature of the substrate and local groundwater gradient; typically, wetlands in topographic lows are sites of groundwater discharge, while wetlands at higher elevation raise the local water table through recharge.
- Shoreline erosion protection: riparian wetlands help reduce flow velocity and the amount of suspended sediments; the risk of shoreline erosion depends on the substrate and the energy of the watercourse; shoreline protection is particularly important where adjacent lands are developed.

[4] A. Hanson, L. Swanson, D. Ewing, G. Grabas, S. Meuer, L. Ross, M. Watmough, and J. Kirby. 2008. Wetland Ecological Functions Assessment: An Overview of Approaches. Canadian Wildlife Service, Technical Report Series Number 497, Atlantic Region, 59 p.

Table 7.4 Probable Performance of Main Wetland Types at the Project Sites

	Probable Performance of Each Function							
	Hydrological Functions			Biogeochemical Functions		Ecological Functions		
Type of wetland	**Flow moderation**	**Groundwater recharge**	**Erosion protection**	**Water quality improvement**	**Nutrient and organic export**	**Biological productivity and maintenance of biodiversity**	**Climate regulation through evapo-transpiration**	**Carbon sequestration**
Pond	Variable	Unknown	Moderate due to hydrological connectivity	High	High	Variable, high for waterfowl	Moderate	Variable
Marsh	High due to hydrological connectivity	Low to moderate	High due to hydrological connectivity	High	Variable	Variable	High	Moderate to high
Poor conifer swamp	High due to hydrological connectivity	Low	High due to hydrological connectivity	Moderate	Variable	Variable	Low to moderate	Moderate to high
Rich conifer swamp	Moderate	Variable	Variable	High	Variable	Variable	Moderate	Moderate to high

Biogeochemical functions refer to the contribution of wetlands to surface and groundwater quality and biological productivity. They include the following:

- Water quality improvement through nutrient and pollutant transformation: wetlands can decompose, confine or immobilize certain pollutants and absorb nutrients present in runoff water, thus helping to improve the physical, chemical, and biological properties of water; wetland performance depends on hydroperiodicity, hydrological budget, substrate and plant communities.
- Nutrient and organic export: wetlands contribute to biomass production by exporting soluble organic matter and nutrients towards watercourses located downstream; they also indirectly contribute to the productivity of the entire food chain.

Ecological functions refer to the contribution of wetlands to maintaining ecosystem function by maintaining biodiversity and climate conditions. They include the following:

- Biological productivity and maintenance of biodiversity: wetlands contribute to biological productivity and the maintenance of plant and animal biodiversity by providing critical habitats for facultative and obligate wetland plant species; many animal species, particularly waterfowl and many amphibians, also depend on wetlands for their survival; the importance of a wetland as a habitat depends on the presence and abundance of imperilled species and species of interest for recreation or subsistence;
- Climate regulation: wetlands contribute to climate regulation through evapotranspiration, which increases rainfall and atmospheric moisture; the rate of evapotranspiration depends on cover percentage for the various vegetation strata.
- Carbon sequestration through biomass production: wetlands are generally productive settings that contribute to carbon fixation through absorption of atmospheric carbon in the biomass (peat, trees and shrubs) for long periods of time ranging from decades to millennia; the carbon storage capacity of a wetland depends on productivity and degree of decomposition.

Most wetlands in the project sites are marshes or poor conifer swamps (Figures 7.2 and 7.3, and Table 7.2). Their most important hydrological and biogeochemical functions are the following:

- flow moderation;
- erosion protection;
- water quality improvement;
- carbon sequestration.

Indeed, wetlands, watercourses and lakes located downstream depend on the proper functioning of upstream environments to maintain their current state. Because the same types of wetlands are very abundant in the surrounding areas (Figure 7.1 and Table 7.3), the relative importance of their ecological functions (biological productivity, maintenance of biodiversity, climate moderation and carbon sequestration) is reduced.

From a socioeconomic standpoint, these wetlands do not have any features which make them highly valuable. They are not of interest for recreational and tourism purposes, offer no potential for commercial activity, are not used for scientific purposes and are not located in a designated conservation area.

The assessment of the project‟s impact on wetlands, mitigation measures and residual effects are addressed in Volume 2, Chapter 12.

7.2 THREATENED OR VULNERABLE SPECIES

Pursuant to an agreement signed in 1996, the Canadian and Quebec governments work together to protect species at risk. The two levels of government also administer laws and policies pertaining to endangered species protection. Laws enacted by both levels of government aim to prevent species from becoming extinct, contribute to their recovery and manage species deemed to be of special concern.

Ultimately, governments can specifically protect targeted species as well as sites and habitats that are critical to their survival. Plant and animal species that are vulnerable to human activity because of their rarity, their restricted range or the unique nature of their habitat must therefore be afforded special attention.

7.2.1 Threatened or Vulnerable Vascular Plant Species

There is a low likelihood that plant species at risk, or even threatened or vulnerable plant species or plant species likely to be so designated, are present in the study area. According to the Canada Species at Risk Public Registry,[5] 23 vascular plant species with a status pursuant to the *Species at Risk Act* are found in Quebec. Given the habitat and range of each of these species, it can be stated that the potential of their presence in the study area is nil, because they are all restricted to southern Quebec or areas near the St. Lawrence River, and their habitats do not coincide with those available in the study area.

The *Centre de Données sur le Patrimoine Naturel du Québec* (CDPNQ) does list three imperilled species present within a 100-km radius of the study area, namely Dicranella crispa (candidate), dragon‟s mouth (likely to be designated), and resupinate bladderwort (likely to be designated). However, the likelihood that these species are present in the study area is deemed low.

Dicranella crispa is a moss that was reported from Chibougamau, near Lac Bourbeau, in 2009. It is found on rock outcrops or in exposed sandy terrain. Given the local geomorphology, the likelihood of its being present in the study area is low.

Dragon‟s mouth is an orchid that was reported in the 1970s in a peatbog in the Ashuapmushuan Wildlife Reserve and near the Rivière Rock Nord. It grows in sphagnum swamps, conifer marshes, open marshes and wet, acidic, sandy prairies. Although habitats for this species are

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[5] http://www.registrelep.gc.ca, viewed on August 9th, 2011.

found in the study area, reports are more than 40 years old, and the only reported occurrence is from about 100 km away.

Resupinate bladderwort was reported from the Balete Township, at Lac de la Mule, in the 1990s. It is found in ponds and lakes, in shallow waters, and in mud or organic matter along exposed banks. Although its habitat is found in the study area, the likelihood of it being present is low, as the only reported sighting of the species was almost 85 km from the project site. In addition, this type of habitat is very common in the surrounding areas, and the study area is therefore not a unique habitat for this species.

Dragon‟s mouth and resupinate bladderwort were not observed during the detailed aquatic wildlife surveys carried out in wetlands between May and August 2011. None of these species is designated by the CPDNQ as a conservation target.

7.2.2 Animal Species At Risk, Threatened or Vulnerable or Likely to be So Designated

Some animal species at risk, threatened or vulnerable or likely to be so designated have a moderate likelihood of being in the study area. The Government of Canada‟s Species at Risk Public Registry[6] lists 162 animal species in Quebec that have designated status under the *Species at Risk Act* (SARA). In order to compile a list of species at risk likely to be in the study area, a number of requests for information were submitted to relevant government bodies and organizations, including:

- the Canadian Wildlife Service (CWS);
- the SOS-POP Quebec Breeding Bird Atlas for bird species at risk;
- the *Centre de Données sur le Patrimoine Naturel du Québec* (CDPNQ);
- the *Regroupement Québec Oiseaux* for data on the study of Quebec bird populations (ÉPOQ database);
- the *Portrait faunique de la Baie-James* 2010;[7]
- BirdMap.

Information from the CDPNQ does not mention any animal species with designated status under SARA in the study area region. However, two species likely to be so designated found within a 10-km radius are mentioned: the rock vole and the silver-haired bat. CWS, SOS-POP, and ÉPOQ data include no mention of imperilled species in the area. Other imperilled species likely to be in the area were identified based on the Quebec Bird Breeding Atlas and the *Portrait faunique de la Baie-James* report. The federal status of these species under the *Species at Risk Act* (SARA, updated in July 2011) was then confirmed. The likelihood of the presence of these species was assessed at the scale of the study area based on their habitat and range.

[6] http://www.registrelep.gc.ca, viewed on August 9, 2011.

[7] Commission régionale sur les ressources naturelles et le territoire de la Baie-James (2010). *Portrait faunique de la Baie-James* C09-07.

Overall, research indicates the potential presence of 22 threatened or vulnerable species or species likely to be so designated under the *Act respecting threatened or vulnerable species*. Only 10 of these have designated status under SARA. For each of the 22 species, Table 7.5 shows the likelihood of their presence in the study area in light of their respective habitat and range in the James Bay region.

Mammals

Nine species of mammals with imperilled status may be present at the regional scale. Two of these, the wolverine (endangered) and the woodland caribou (threatened), have designated status under SARA and could possibly be found in the area. The likelihood that the wolverine is present in the area is deemed low, as this animal is fond of relatively undisturbed, large, open spaces. All project components are located in areas where logging and industrial and mining activities have taken place in the past.

The likelihood of woodland caribou in the area is deemed moderate. Although its habitat is present, its density in the region is low (2 to 3.5 individuals/100 km^2; Table 7.5). In addition, caribou are extremely mobile animals, and similar habitats are abundant at the regional scale.

The rock vole, a species likely to be designated threatened or vulnerable, also has a high likelihood of being present in the study area. Four other species likely to be designated have a moderate likelihood of being present. They are the southern bog lemming, the silver-haired bat, the hoary bat and the eastern red bat. If these species were indeed present, they could be affected by the project.

Birds

Eleven species of birds with designated status may be present at the regional scale, eight of which are on the SARA list. However, in light of their habitats and the nature of the project sites, only two of those species have a high likelihood of being affected by the project: the bald eagle (not at risk) and the rusty blackbird (of special concern). There are also two species with a moderate likelihood of being present: the Barrow‟s goldeneye (of special concern) and the short-eared owl (of special concern).

Amphibians

Only one species likely to be designated, the striped chorus frog, has been reported from the James Bay region, more specifically from Rupert Bay. This species has no status under SARA and its likelihood of being in the region is low.

Fish

The lake sturgeon, a species likely to be designated, is the only imperilled species reported from the James Bay region. This species has no status under SARA. It is found in large James Bay tributary rivers and lakes. Its likelihood of being present in the watercourses and lakes in the study area is nil because there are no large rivers or lakes at the mine site or the rail transfer site. The depth and aerial extent of water bodies that will be affected by the project do not allow lake sturgeon survival. Finally, there are no lake sturgeons in Lac Chibougamau.

In conclusion, 22 threatened or vulnerable species or species likely to be so designated could theoretically be affected by the project, 13 of which have a low to nil likelihood of being present at the project sites (Table 7.6). Furthermore, significant factors restrict their presence or limit their vulnerability.

Table 7.5 Species with Provincial or Federal Status in the James Bay Region: Likelihood of Presence in the Study Area

Species	Provincial / Federal Status	General Range and Reports from the James Bay Region	Habitat	Likelihood of Presence
MAMMALS				
Wolverine (***Gulo gulo***)	Threatened/ Endangered	Range is circumboreal. In Canada, the wolverine ranges from the Yukon to Newfoundland-and-Labrador, including the Arctic Archipelago, the Northwest Territories, the western provinces and northern Ontario; its current range seems mainly restricted to north of 49°N.	Large, undisturbed open spaces, mature and submature coniferous forests. Remote areas with an abundance of mammal carcasses. Persistent snow cover in springtime is crucial for setting up of birthing sites by females.	**Low**
Woodland caribou, **forest-dwelling ecotype (*Rangifer tarandus caribou*)**	Vulnerable/ Threatened	Spruce-lichen and spruce-moss bioclimatic domains. Population density is estimated to be 3.5 ind./100 km^2 south of James Bay and 2 ind./100 km^2 at Lac Mistassini[8]	Mature black spruce forests, recently burned areas, peatbogs, conifer-lichen stands and young conifer stands.	**Moderate**
Least weasel **(Mustela nivalis)**	Vulnerable/ No federal status	Range is circumboreal, but only one catch, at Eastmain (in 2000), for the entire James Bay region. It thrives in a wide range of habitats.	Tundra and coniferous forests in northern part of range. Further south, prairies, wet meadows, swampy areas, watercourse banks and brush.	**Low**
Cougar (***Puma concolor***)	Likely to be designated/ No federal status	North America, south of 50°N. Only a hundred or so sightings in Quebec since 1955. Only one report from the Chibougamau area since 2004.	Varied habitats, particularly where white-tailed deer abound, in particular boreal forests.	**Low**
Rock vole (***Microtus chrotorrhinus***)	Likely to be designated/ No federal status	Range in Quebec and Ontario. Sugar maple-yellow birch and spruce stand bioclimatic domains. Confirmed presence in the Chibougamau area in 2002, 2003, and 2004. In addition, the CDPNQ reports the presence of the species within less than 10 km of the study area, near Lac Stella (Ruisseau Wynne, 2001).	Cliffs and rock outcrops, clearings in mountainous areas, wet taluses, moss-covered rock near water, recently logged areas (disturbed habitats).	**High**
Southern bog lemming (***Synaptomis cooperi***)	Likely to be designated/ No federal status	Eastern and central North America. Spruce stand bioclimatic domain. Confirmed presence in the Chibougamau area in 2003 and 2004.	Sphagnum-heath bogs, grassy swamps and mixed-wood forests around peatbogs.	**Moderate**

[8] The Forest-Dwelling Caribou Recovery Team (2008). The Forest-Dwelling Caribou (Rangifer tarandus) Recovery Plan in Quebec - 2005- 2012, Ministère des Ressources naturelles et de la Faune, Québec, Direction de l'expertise sur la faune et ses habitats. 75 p.

Species	Provincial / Federal Status	General Range and Reports from the James Bay Region	Habitat	Likelihood of Presence
Silver-haired bat (***Lasionycteris noctivagans***)	Likely to be designated/ No federal status	Present in Quebec up to the spruce stand domain. Only one sighting in the James Bay region, in the Chibougamau area (in 1999). This report is detailed in information provided by the CDPNQ.	Wooded areas along lakes and ponds.	**Moderate**
Hoary bat (***Lasiurus cinereus)***	Likely to be designated/ No federal status	Range encompasses all of North America. Present in Quebec up to the spruce stand domain. Confirmed presence at several localities in the James Bay region.	Wooded and semi-wooded areas, clearings and waterbodies.	**Moderate**
Eastern red bat (***Lasiurus borealis)***	Likely to be designated/ No federal status	Range encompasses North and Central America. Present in Quebec up to the spruce stand domain. Confirmed presence at several localities in the James Bay region.	Crown of tall trees that dominate the forest canopy.	**Moderate**
BIRDS				
Yellow rail (***Coturnicops noveboracensis***)	Threatened / Of special concern	Large range in North America. Present along the St. Lawrence and Saguenay rivers. Summer sightings reported from the Abitibi-Temiscamingue, Rupert Bay and Boatswain Bay regions. No report from the Chibougamau area.	Large marshes, waterlogged soils, low and dense vegetation, wet meadows, flood plains, herbaceous meadows in peatbogs and upper storeys of estuarine marshes.	**Low**
Golden eagle (***Aquila chrysaetos***)	Vulnerable/ Not at risk	Holarctic range. Present in the tundra, taiga and boreal forest.	Mountainous regions incised by rocky and steep valleys and canyons. Nesting habitat: rock faces or rocky cliffs.	**Low**
Harlequin duck (***Histrionicus histrionicus***)	Vulnerable/ Of special concern	Range along the Atlantic and Pacific coasts. From northern New Brunswick to Nunavut, islands of eastern North America, from Newfoundland-and-Labrador to Maryland, and southwest coast of Greenland. (A subpopulation breeds on the lower North Shore.)	Nests in freshwater settings along fast-flowing rivers and streams and winters on rocky cliffs.	**Low**
Peregrine falcon (***Falco peregrinus anatum***)	Vulnerable/ Threatened	Range in the Americas, Europe, Africa and Asia. Boreal forest down to Mexico. This species migrates through the James Bay region.	Nesting habitat: cliffs and man-made sites (buildings, bridges, quarries). Hunting grounds include large open spaces such as watercourses, marshes, beaches, mudflats, and fields.	**Low**
Barrow‟s goldeneye (***Bucephala islandica***)	Vulnerable/ Of special concern	Labrador, New Quebec, northern part of the Eastuary and Gulf of St. Lawrence, in the boreal forest around large lakes. One sighting near Lac Mistassini.	Nesting habitat: small alkaline lakes devoid of fish (< 15 ha) in headwater areas, at higher elevation (> 500 m). Nests in cavities in trees	**Low**

Species	Provincial / Federal Status	General Range and Reports from the James Bay Region	Habitat	Likelihood of Presence
			less than 1 km from a lake.	
Bald eagle (***Haliaeetus leucocephalus***)	Vulnerable/ Not at risk	East-to-west range throughout North America, down to Baja California. In Quebec, breeding was confirmed in many localities throughout most of the area south of 55°N. Reported from many localities in the James Bay region. In addition, this species was sighted near Ruisseau Villefagnan during surveys done in 2001.	Mature forests near large water bodies (e.g. large lakes, rivers with high discharge, Estuary and Gulf of St. Lawrence, large reservoirs and islands).	**High**
Rusty blackbird (***Euphagus carolinus***)	Likely to be designated/ Of special concern	The 7.6 million-km² breeding range covers most Canadian provinces and territories, Alaska, and several Great Lakes and New England States. Although no specific data are reported in the Portrait de la Baie-James report, BirdMap data indicate that this species breeds in the region.	Coniferous (spruce) forests near marshes and peatbogs.	**High**
Short-eared owl (***Asio flammeus***)	Likely to be designated/ Of special concern	Cosmopolitan species. Many sightings in the James Bay region.	Upper part of marshes (where grasses reach 50 cm to 1 m in height), peatbogs, wet meadows, some farmlands and arctic tundra. Large territory (> 10 ha).	**Moderate**
Nelson‟s sharp-tailed sparrow (***Ammodramus nelsoni***)	Likely to be designated/ No federal status	In Quebec, it is mainly found in the fluvial section of the St. Lawrence River. A population of the *Ammodramus n. alterus* subspecies is found along the James Bay coast, up to Eastmain (north of 52°N). The species was sighted at various localities in the James Bay region.	Upper storey of salt or brackish marshes along coastlines or islands, and freshwater marshes or wet prairies with high grasses (dominated by phalaris).	**Low**
Bicknell‟s thrush (**Catharus Bicknelli**)	Vulnerable/ No federal status	East coast of North America. In Quebec, the range is restricted to a few localities; south of the St. Lawrence, it is mainly found in the Appalachians (Estrie, Bellechasse, Lower St. Lawrence and Gaspé Peninsula); on the north shore, it is mainly found along the southern edge of the Canadian Shield (Laurentides Wildlife Reserve, Charlevoix and Monts Vallin area).	Closed conifer stands in mountainous areas and closed regenerating stands at least two meters in height and at elevation above 600 m, where fir is generally the main forest species.	**Low**
Barn swallow (***Hirundo rustica***)	None[9]	Range in North America, Asia, Europe and northern part of Africa. Common in Quebec, but in decline since the 1980‟s. Breeds in the region encompassing	Usually nests on or in farm buildings, under bridges, in caves or on cliffs, as isolated pairs	**Low**

[9] The barn swallow currently has no legal status in Quebec or Canada. However, COSEWIC designated it as threatened in May 2011 (www.cosewic.gc.ca)

Species	Provincial / Federal Status	General Range and Reports from the James Bay Region	Habitat	Likelihood of Presence
		the study area.	or small colonies.	
AMPHIBIANS				
Striped chorus frog **(Pseudacris Maculata)**	Likely to be designated/ No federal status	Central United States, northern Ontario, Manitoba, Saskatchewan, and Alberta, north to the Northwest Territories along the Mackenzie River valley. In Quebec, the range is restricted to the southern end of James Bay, more specifically in the Rupert Bay area.	Shallow water bodies and dense plant cover: prairie grass lands and shrubby willow stands in coastal plain, marshes and peatbogs.	**Low**
FISH				
Lake sturgeon **(*Acipenser fulvescens*)**	Likely to be designated/ No federal status	Western Quebec, from James Bay to the north, to the brackish water limit in the St. Lawrence River. In the James Bay region, lake sturgeon is likely present in James Bay tributary lakes and rivers, the latter including the La Grande, Eastmain, Opinaca, Rupert, Broadback, Nottaway and Harricana rivers.	Lakes and large rivers.	**Low to nil**

Table 7.6 Species with a Low Likelihood of Being Present

Species	Factors restricting presence or mitigating vulnerability
Wolverine **(Gulo gulo)**	• No appropriate habitat
Least weasel **Mustela nivalis)**	• Circumpolar range
Cougar **(Puma Concolor)**	• Range across North America • Large home range
Yellow rail **(Coturnicop noveboracentis)**	• Range across North America
Golden eagle **(Aquila chrysaetos)**	• Holarctic range • Large home range
Harlequin duck **(Histrionicus histrionicus)**	• Outside known range
Peregrine falcon **(Falco peregrinus anatum)**	• No appropriate habitat • Range on all continents • Large home range
Barrow's goldeneye **(Bucephala Islandica)**	• Outside known range
Nelson's sharp-tailed sparrow **(Ammodramus nelsoni)**	• Outside known range
Bicknell's thrush **(Catharus Bicknelli)**	• Outside known range
Barn swallow **(Hirundo rustica)**	• No appropriate habitat • Range on all continents
Striped chorus frog **(Pseudacris Maculata)**	• Outside known range
Lake sturgeon **(Acipenser fulvescens)**	• No appropriate habitat

The likelihood of eight species being present in the project area is deemed to be higher (moderate to high). However, their vulnerability is mitigated by their large ranges, as seen in Table 7.7.

Tableau 7.7 Species with a Moderate to High Likelihood of Being Present

Species	Factors mitigating vulnerability	Factors increasing vulnerability
Woodland caribou forest-dwelling ecotype **(Rangilfer tarandus caribou)**	Large home range Range encompassing the boreal forest	
Rock vole (Microtus chrotorhinus)	Diverse home range Range in Ontario and Quebec	Very restricted home range
Southern bog lemming (synaptomis cooperi)	Large range in eastern and central Canada and the United States	Very restricted home range
Silver-haired bat (Lasionycteris noctivagans)	Range across North America Northern limit of range	
Hoary bat (Lasiurus cinereus)	Range across North America	
Eastern red bat (Lasiurus borealis)	Range in North and Central America	
Rusty blackbird (Euphagus carolinus)	Range encompassing most of Canada and the United States	
Short-eared owl	Global range	

All species listed in Table 7.7 have very large ranges. The importance of their possible presence in the mining project sites must therefore be put in perspective. In addition, the home range of most of these species is such that they can easily relocate. This is not the case, however, for the rock vole and the southern bog lemming, which have very limited home ranges. If indeed present at the work sites, those two species would be directly affected by the project. Finally, no vulnerable species were sighted during field work done in the spring and summer of 2011.

7.3 MIGRATORY BIRDS

Data from the following sources were screened to determine which species of migratory birds are present in the boreal forest and possibly at the project sites:

- the Canadian Wildlife Service (CWS);
- the *Centre de Données sur le Patrimoine Naturel du Québec* (CDPNQ);
- the Quebec Breeding Bird Atlas;
- the SOS-POP program (*Suivi de l'occupation des stations de nidification des populations d'oiseaux en péril du Québec*);
- data from the *Étude des populations d'oiseaux du Québec* (ÉPOQ, Quebec Bird Populations Study);
- the *Portrait faunique de la Baie James* (2010);
- BirdMap Canada (breeding bird monitoring, route # 76076);
- Avibase.

The BlackRock mining project is located in Bird Conservation Region (BCR) #8, Boreal Softwood Shield. Bird Conservation Regions are ecologically distinct areas of North America with similar bird communities, habitats and resource management issues. These ecoregions encompass areas that have essentially similar biotic and abiotic characteristics. The Boreal Softwood Shield comprises vast forested areas that are more than 80% covered by closed stands of conifers, largely black and white spruce, balsam fir and larch. The region is a mosaic of uplands and wetlands, dotted with numerous lakes.

It should be noted that the mining project is not located in a currently protected or ecologically important area.

The ÉPOQ database maintained by *Regroupement Québec Oiseaux* (RQO) contains no information about the study area. The only available data are from sightings in the town of Chibougamau. For this reason, other more regional information sources had to be used, including Avibase, in which roughly 197 migratory bird species are listed for Northern Quebec. Based on the various information sources used, 80 of those species are confirmed to be present in the Chibougamau region, although only 64 are confirmed to breed in the region. Some migratory bird species which have not been sighted could, however, be breeding in the study area. Of those species confirmed to be breeding in the region, only two have a status under the law, namely the Barrow‟s goldeneye and the Bicknell‟s thrush. The Breeding Bird Survey program coordinated by the Canadian Wildlife Service has some data on the abundance of these species. Table 7.8 shows the 64 migratory bird species confirmed to be in the area, as well as a short description of their habitats.

Table 7.8 Migratory Birds Breeding in the Region

English Name	Latin Name	Nom français	Habitat	Sighting and Scale
Alder Flycatcher	Empidonax alnorum	Moucherolle des aulnes	Alder groves	
American Bittern	Botaurus lentiginosus	Butor d'Amérique	Marshes	
American Black Duck	Anas rubripes	Canard noir	Ponds and shallow parts of lakes	Project sites
American Redstart	Setophaga ruticilla	Paruline flamboyante	Deciduous forests (wet, with shrub stratum)	
American Robin	Turdus migratorius	Merle d'Amérique	Forests, farm and urban areas	
Bank Swallow	Riparia riparia	Hirondelle de rivage	Sand shores	
Barn Swallow	Hirundo rustica	Hirondelle rustique	Buildings, scarps	
Barrow's Goldeneye	Bucephala islandica	Garrot d'Islande	Rivers and bays (cavicolous)	
Bay-breasted Warbler	Dendroica castanea	Paruline à poitrine baie	Mature coniferous forests (closed, with small clearings)	
Black Scoter	Melanitta americana	Macreuse à bec jaune	Ponds (nests in grass tuft)	
Black-and-white Warbler	Mniotilta varia	Paruline noir et blanc	Mature deciduous or mixed-wood forests	
Black-throated Green Warbler	Dendroica virens	Paruline à gorge noire	Large, mature coniferous or mixed-wood forests (white pine, hemlock)	
Blue-headed Vireo	Vireo solitarius	Viréo à tête bleue	Mixed-wood forests	
Bufflehead	Bucephala albeola	Petit Garrot	Lakes and rivers (cavicolous)	
Canada Goose	Branta canadensis	Bernache du Canada	Grassy or swampy areas near water	Overall project area
Cape May Warbler	Dendroica tigrina	Paruline tigrée	Mature coniferous forest	
Chipping Sparrow	Spizella passerina	Bruant familier	Open forests and grassy forest edges	
Common Goldeneye	Bucephala clangula	Garrot à oeil d'or	Shallow lakes, beaver ponds, and rivers (cavicolous)	Overall project area
Common Loon	Gavia immer	Plongeon huard	Large lakes in forested areas	Overall project area
Common Merganser	Mergus merganser	Grand Harle	Deep rivers and lakes (cavicolous)	Overall project area
Common Yellowthroat	Geothlypis trichas	Paruline masquée	Wet open areas (grassy or bushy)	Project area
Dark-eyed Junco	Junco hyemalis	Junco ardoisé	Coniferous or mixed-wood forests	
Evening Grosbeak	Coccothraustes vespertinus	Gros-bec errant	Mixed-wood forests	
Golden-crowned Kinglet	Regulus satrapa	Roitelet à couronne dorée	Mature coniferous forests	
Great Blue Heron	Ardea herodias	Grand Héron	Brooks and pond banks, wet	Overall project area

English Name	Latin Name	Nom français	Habitat	Sighting and Scale
			meadows (colony in trees)	
Greater Scaup	Aythya marila	Fuligule milouinan	Lakes	
Greater Yellowlegs	Tringa melanoleuca	Grand Chevalier	Pond banks (muddy)	Project sites
Green-winged Teal	Anas crecca	Sarcelle d'hiver	Ponds, lakes, marshes with shallow water, flooded fields	Overall project area
Herring Gull	Larus argentatus	Goéland argenté	Fields, landfills, water	Overall project area
Hooded Merganser	Lophodytes cucullatus	Harle couronné	Ponds (cavicolous)	Overall project area
Horned Lark	Eremophila alpestris	Alouette hausse-col	Open areas (bare or nearly devoid of grass)	
Killdeer	Charadrius vociferus	Pluvier kildir	Open areas (pebbly)	
Lesser Scaup	Aythya affinis	Petit Fuligule	Ponds and lakes	
Lincoln's Sparrow	Melospiza lincolnii	Bruant de Lincoln	Open (bushy) areas near water	
Magnolia Warbler	Dendroica magnolia	Paruline à tête cendrée	Coniferous forests (closed and second growth)	
Mallard	Anas platyrhynchos	Canard colvert	Ponds and shallow parts of lakes	
Mourning Warbler	Oporornis philadelphia	Paruline triste	Thickets (alder, blackberry) in clearings (moist forest), regenerating openings	
Nashville Warbler	Oreothlypis ruficapilla	Paruline à joues grises	Open and bushy regenerating forests	
Northern Flicker	Colaptes auratus	Pic flamboyant	Forests with openings	Project site
Northern Mockingbird	Mimus polyglottos	Moqueur polyglotte	Open (bushy) areas, fields, suburbs	
Northern Waterthrush	Parkesia noveboracensis	Paruline des ruisseaux	Stagnant or slow-moving water/shrubs	
Palm Warbler	Dendroica palmarum	Paruline à couronne rousse	Peatbogs	
Philadelphia Vireo	Vireo philadelphicus	Viréo de Philadelphie	Deciduous forests	
Pine Siskin	Spinus pinus	Tarin des pins	Open forests (birch, alder, pine)	
Purple Finch	Carpodacus purpureus	Roselin pourpré	Moist coniferous (or mixed-wood) forests, forest edges, bushes, and urban areas	
Red-eyed Vireo	Vireo olivaceus	Viréo aux yeux rouges	Deciduous forests	
Ring-necked Duck	Aythya collaris	Fuligule à collier	Lakes and ponds in forests	
Ruby-crowned Kinglet	Regulus calendula	Roitelet à couronne rubis	Mixed-wood or coniferous forests	
Ruby-throated Hummingbird	Archilochus colubris	Colibri à gorge rubis	Forests (mixed-wood and deciduous) and forest edges	

English Name	Latin Name	Nom français	Habitat	Sighting and Scale
Savannah Sparrow	Passerculus sandwichensis	Bruant des prés	Open (grassy) areas	
Song Sparrow	Melospiza melodia	Bruant chanteur	Wood edges and bushy areas near water	
Spotted Sandpiper	Actitis macularius	Chevalier grivelé	Pond and watercourse banks (pebbly)	
Surf Scoter	Melanitta perspicillata	Macreuse à front blanc	Ponds	
Tennessee Warbler	Oreothlypis peregrina	Paruline obscure	Open or young forests	
Thrush: Swainson's Thrush	Catharus ustulatus	Grive à dos olive	Mixed-wood and coniferous forests	Thrushes sighted, species not identified
Thrush: Bicknell's Thrush	Catharus bicknelli	Grive de Bicknell	Fir stands at elevation (>600 m)	
Thrush: Hermit Thrush	Catharus guttatus	Grive solitaire	Oak and pine forests (dry and bushy areas)	
Tree Swallow	Tachycineta bicolor	Hirondelle bicolore	Cavities in trees, nesting boxes	
White-throated Sparrow	Zonotrichia albicollis	Bruant à gorge blanche	Mixed-wood forests and regenerating clearings	Project sites
Wilson's Snipe	Gallinago delicata	Bécassine de Wilson	Pond banks (grassy) and wet fields	
Winter Wren	Troglodytes hiemalis	Troglodyte des forêts	Coniferous forests (moist undergrowth)	
Yellow Warbler	Dendroica petechia	Paruline jaune	Bushy wetlands (willow stands)	
Yellow-bellied Flycatcher	Empidonax flaviventris	Moucherolle à ventre jaune	Spruce forests	
Yellow-rumped Warbler	Dendroica coronata	Paruline à croupion jaune	Open coniferous forests	

Many of the breeding migratory birds present in the area are aquatic species, including 14 species of Anatidae (geese and ducks), whose habitat is closely associated with water bodies and shores, as well as the common loon, great blue heron, spotted sandpiper, greater yellowlegs, Wilson‟s snipe and American bittern, which are also associated with aquatic environments (ponds, lakes, watercourses) and wetlands (marshes, grassy banks, etc.). Most of the other bird species are passerines (39 species), which are generally associated with woodlands.

There are many high priority terrestrial bird species in the Bird Conservation Region where the project is located. Their regional and continental importance was established based on factors such as population size, breeding range size, population decline, etc. Only 18 of those species are amongst the breeding migratory birds previously identified for the study area. They are the following:

- northern flicker;
- yellow-bellied flycatcher;
- alder flycatcher;
- solitary vireo;
- Philadelphia vireo;
- winter wren;
- ruby-crowned kinglet;
- Bicknell‟s thrush;
- Tennessee warbler;
- Nashville warbler;
- magnolia warbler;
- Cape May warbler;
- black-throated green warbler;
- bay-breasted warbler;
- mourning warbler;
- white-throated sparrow;
- purple finch;
- evening grosbeak.

Three species in the above list are of special concern at the continental or regional scale: the Bicknell‟s thrush, the bay-breasted warbler and the purple finch.

The Bicknell‟s thrush is found in closed conifer stands dominated by fir (regenerating, at least 2 metres high) and at elevations above 600 m. Not only are elevations in the project area below 600 m, but there are no subalpine closed fir forests, of which this species is generally fond. As the typical habitat is also characterized by a wet, cool and windy climate, the likelihood of this species being present in the project area is very low.

Although the bay-breasted warbler is found in mature coniferous forests, populations fluctuate greatly as a function of spruce budworm abundance. As the region has a fair proportion of mature (>80 years) conifer stands, any loss of habitat loss due to the project would not affect this species. The fact that the project development area has been the site of intense logging in the past should also be taken into consideration.

The purple finch is found in moist coniferous (or mixed-wood) forests, forest edges, regenerating areas and urban areas. Coniferous, regenerating and edge habitats are abundant in the project area, and those habitats which will be affected only account for a small fraction of available habitats. The impact of the project on this species is therefore considered negligeable.

The number of bird species observed at the two project sites is relatively low. Furthermore, the types of habitat affected by the project are abundant at all scales of analysis. Except for an osprey pair that nests near Lac Coil, the project is not expected to have any significant impact on birds.

REFERENCES

BirdMap Canada: www.bsc-eoc.org/birdmap_f.htm

Ducks Unlimited Canada, 2009. *Plan régional de conservation des milieux humides et de leurs terres hautes adjacentes de la région administrative du Nord-du-Québec*. Prepared in partnership with the Ministère des Ressources Naturelles et de la Faune (MRNF), Ministère du Développement Durable, de l'Environnement et des Parcs (MDDEP), Ministère des Affaires Municipales et des Régions (MAMR), Environment Canada (SCF/EC), and Fisheries and Oceans Canada (MFO).

Ducks Unlimited Canada, Québec office, 2009. *Classification des milieux humides et modélisation de la sauvagine dans le Québec forestier.*

Commission Régionale sur les ressources naturelles et le territoire de la Baie-James, 2010. *Portrait faunique de la Baie James C09-07.*

Environment Canada, Quebec Region, Environmental Assessment Division and Canadian Wildlife Service, May 1997. *Guide for Impact Assessment on Birds.*

Environment Canada, Canadian Wildlife Service, 1991. *Federal Policy on Wetland Conservation.*

Gauthier and Aubry, 1995. Atlas des oiseaux nicheurs du Québec méridional. www.quecoiseaux.org

Hanson, A. & al. Environment Canada, Technical Report Series Number 497, October 2008. *Wetland Ecological Functions Assessment: An Overview of Approaches*

Lynch-Stewart & al. Environment Canada, Wildlife Conservation Branch, Canadian Wildlife Service, 1996. *Federal Policy on Wetland Conservation: Guide for Federal Land Managers*

Lynch-Stewart & Associates, for Environment Canada, Canadian Wildlife Service, February 2004. *Environment Assessment Best Practice Guide for Wildlife At Risk in Canada.*

Lynch-Stewart & Associates, Canadian Environmental Assessment Agency, 2000. *Using Ecological Standards, Guidelines and Objectives for Determining Significance: An Examination of Existing Information to Support Significance Decisions Involving Wetlands.*

Milko, R., Environment Canada, Biodiversity Protection Branch, Canadian Wildlife Service, 1998. *Environmental Assessment Guidelines for Forest Habitat of Migratory Birds*.

Milko. R, Environment Canada, Biodiversity Protection Branch, Canadian Wildlife Service, 1998. *Migratory Birds Environmental Assessment Guidelines.*

Milko. R, Environment Canada, Biodiversity Protection Branch, Canadian Wildlife Service, 1998. *Wetland Environmental Assessment Guidelines*

Ministère du développement Durable, de l'Environnement et des Parcs (MDDEP), 2006. *Guide d'analyse des projets d'intervention dans les écosystèmes aquatiques, humides et riverains assujettis à l'article 22 de la Loi sur la Qualité de l'environnement. Identification et délimitation.*

Regroupement QuébecOiseaux: Programme de Suivi de l'occupation des stations de nidification des populations d'oiseaux en péril du Québec (SOS-POP)
www.quebecoiseaux.org

Species at Risk Public Registry: http://www.registrelep.gc.ca, page consulted August 9, 2011.

Rocky Mountain Bird Observatory:
http://www.rmbo.org/pif/jsp/BCRBreed.asp?BCR_NUM=BCR08&BCR_Name=Boreal Softwood Shield

Tardif. B & al. Ministère du développement Durable, de l'Environnement et des Parcs (MDDEP), March 2005. *Atlas de la biodiversité du Québec : Les espèces menacées ou vulnérables*