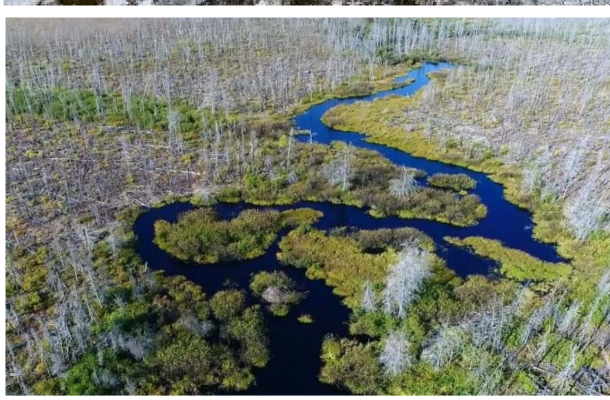
GALAXY

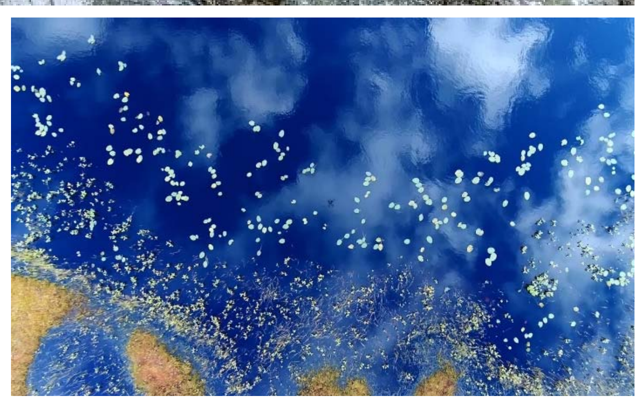
JAMES BAY LITHIUM MINE

ENVIRONMENTAL IMPACT ASSESSMENT

CHAPTER 9: ACCIDENT RISK MANAGEMENT

JULY 2021 (VERSION 2)





wsp

TABLE OF CONTENTS

TABLE OF CONTENTS (continued)

TABLES

MAPS

9 ACCIDENT RISK MANAGEMENT

During the construction, operation, infrastructure demolition and project site rehabilitation phases, there are risks that potentially hazardous events could impact environmental components.

Unexpected events occurring independently of the activities or conditions normally associated with a project's performance are considered accidents or malfunctions.

The first line of defence against accidents and malfunctions is the introduction of best practices in the areas of health and safety and environmental protection. Potential accidents and malfunctions are associated with risks that will continue to exist despite the strict implementation of exemplary management systems. Should such events occur despite prevention efforts, it will then be important to minimize environmental impacts through planning, the development of effective mitigation measures and the implementation of an ERP.

Being located a fair distance from any permanent dwellings, the James Bay Lithium Mine project poses very little risk to the populations in the area in the event of an accident, the only exception being the truck stop. An accident could nonetheless impact the persons and property at the site, as well as the environment. The site's location, far from resources that could be deployed, makes it important to identify risks and ensure that resources are put in place to be able to respond diligently and confidently in the event of a major accident.

These measures were incorporated into the design, planning and implementation phases and will therefore be in place throughout the life of the project. The purpose of implementing such measures is to reduce the likelihood of unforeseen accidents and malfunctions occurring. The implementation of preventive measures will also reduce the impact of potential accidents. This approach is part of a stewardship initiative aiming to reduce risks at the source while mitigating their impacts on the environment.

GLCI is committed to ensuring that the risk management process ensures that the plausible consequences of any accident scenarios that have been identified are sufficiently reduced to keep risk levels as low as reasonably achievable.

9.1 ASSESSMENT OF RISK OF MAJOR ACCIDENTS

9.1.1 RISK DETERMINATION METHOD

The analysis of the risks of major technological accidents associated with the project seeks to identify the major accidents likely to occur, assess their possible impacts on the community and the environment, and determine the project's acceptability in terms of risk. It also serves in the development of protective measures designed to prevent the worst-case scenarios (accidents or malfunctions) that could realistically occur or to limit their frequency and impacts.

The notion of risk comprises the following elements:

— hazards that arise in the accident scenarios;
— the severity of the consequences for the accident scenarios;
— the probability of occurrence of the accident scenarios.

The approach adopted complies with the requirements of the **MELCC**'s guide to the analysis of major technological risks, *Analyse de risques d'accidents technologiques majeurs* (Théberge, 2002) (hereinafter referred to as the **MELCC** Guide). The analysis also adheres to the main recommendations of the Conseil pour la réduction des accidents industriels majeurs' publication entitled *Guide de gestion des risques d'accidents technologiques majeurs* (2017).

The first steps consist of identifying the sensitive elements in the environment, along with the external hazards linked to the activities, infrastructure or equipment at the site, and determining the history of accidents at similar sites. The next step is to develop accident scenarios associated with the identified risks.

Subsequent steps will entail identifying the potential consequences of the scenarios identified and estimating the probabilities of occurrence. Safety measures designed to eliminate or reduce the risk of accidents will also be established. A risk management plan including an ERP will also be developed to manage any residual risks that cannot be eliminated.

The methods used during the various steps are detailed further in the following subsections.

9.1.1.1 HAZARD IDENTIFICATION AND DEVELOPMENT OF ACCIDENT SCENARIOS

Hazard identification requires drawing up a list of the hazards associated with the project. The method adopted is based on analysis of the following three categories of potentially hazardous elements:

- products that could be found inside the facilities examined;
- equipment and operations;
- external events (i.e., not connected to the processes), whether natural or not.

This identification will subsequently be used to identify worst-case scenarios along with their causes and the preventive and control measures in place.

9.1.1.2 EVALUATION OF SEVERITY OF CONSEQUENCES FOR VARIOUS ACCIDENT SCENARIOS

The severity of the consequences for each worst-case accident scenario identified was determined by experts.

9.1.1.3 ESTIMATION OF THE PROBABILITIES OF OCCURRENCE

The various accident scenarios were analyzed to determine probability. These probabilities were established mainly on the basis of accidents at similar sites in past years.

9.1.1.4 DETERMINATION OF RISK LEVELS

Risk levels are established based on criteria that take into account the incident's severity of consequences and probability of occurrence.

PROBABILITY CLASSES

Probability of occurrence signifies the likelihood that an identified hazard will result in an incident or accident.

The scores for expressing the probability of occurrence of an incident or accident were developed by taking historical events into account whenever possible. The classes are defined in Table 9-1.

Table 9-1 Classes of probability of occurrence

Probability class	Definition
Very high	Common event: can occur more than once a year Will occur in the short term
High	Highly probable event: can occur less than once a year Could occur several times during the facility's operation
Moderate	Probable event: could occur less than once every five years Could occur once during the facility's operation
Low	Improbable event: could occur less than once every 20 years Could occur; has occurred within the industry somewhere in the world
Very low	Highly improbable event: can occur less than once every 100 years Not impossible, based on what we currently know, but also not an incident encountered anywhere in the world over numerous years of operation. Would occur only in exceptional circumstances

LEVEL OF SEVERITY OF CONSEQUENCES

The elements that can be considered when determining the level of severity are as follows:

- People: health and safety of workers at the site and of people located within the impact radius at the time of the incident;
- Environment: impacts on the environment (water, air, soil, fauna, flora);
- Property: damage to infrastructure and property, and impact on operations.

The levels of severity of the consequences are established based on the descriptions in Table 9-2.

The level of severity of each element considered (people, environment and/or property), is determined. The overall level of severity, however, is the highest one. For example, a specific accident could have a low level of severity with regard to property but a high level in terms of the environment. The accident's overall level of severity would then be considered high.

RISK LEVEL

Once the probability of a risk occurring and the associated level of severity have been established, the matrix in Table 9-3 can be used to determine the risk level of a given event.

The risk level thus identified takes into consideration the preventive and mitigation measures that have been put in place, so long as these are robust and reliable.

Table 9-4 presents risk acceptability criteria.

Table 9-2 Levels of severity of consequences

Level of severity of consequences	Community	Workers	Environment	Property
Very high	• Several neighbours significantly impacted • Possible evacuation of the community • Significant impacts on lifestyle (traditional use of the land, access to roads and services)	• Loss of human life due to direct exposure	• Regional contamination of watercourses, soil, air or groundwater • Disruptions affecting animal and/or plant species at a regional level • Contamination of the aquifer and drinking water supply	• Major damage to property rendering buildings not usable • Operations interrupted for more than a month
High	• Several neighbours possibly impacted • Measurable impacts on lifestyle (traditional use of the land, access to roads and services)	• Permanent disability	• Contamination of watercourses, soil, air or groundwater over an area that extends beyond the site • Disruptions affecting animal and/or plant species over an area that extends beyond the site • Local contamination of the aquifer	• Major damage to property, rendering buildings not usable • Operations interrupted for a month
Moderate	• Some neighbours potentially impacted • Minor impacts on lifestyle (traditional use of the land, access to roads and services)	• Serious injury • Temporary disability	• Minor local contamination of watercourses, soil, air or groundwater over the short term, but which could possibly extend beyond the site • Disruptions affecting animal and/or plant species over an area close to the site, presence of habitats with sensitive elements or presence of animal or plant species with special status	• Substantial damage • Operations interrupted for a week
Low	• Some nearby individuals possibly impacted	• Injuries requiring medical assistance • Injuries resulting in modified work duties • Diminished quality of life • Minor illness	• Major incident with impacts within the site boundaries • Some of the animal and/or plant species present at the site negatively impacted	• Minor damages • Operations interrupted for a day
Very low	• No measurable impact on the community	• Injury requiring first aid • Slightly diminished quality of life (slight discomfort)	• Minor incident • No risk of contamination of sensitive environments (watercourses, wetlands) • No disruptions affecting animal and/or plant species	• No damages • Operations interrupted for 12 hours or less

Notes: In the event of a spill, levels of severity are determined in ascending order (minor, major, significant, very significant). These levels of severity consider the overall quantity spilled as well as the type and characteristics (toxicity, flammability, etc.) of the product involved.
A contained hazardous material spill is a spill that can be controlled or contained to the site itself through the onsite implementation of mitigation or preventive measures.

Table 9-3 Risk levels

Level of severity of consequences	**Very high**	Moderate	High	Very high	Very high	Very high
	High	Moderate	Moderate	High	Very high	Very high
	Moderate	Low	Moderate	Moderate	High	Very high
	Low	Low	Low	Moderate	Moderate	High
	Very low	Very low	Low	Low	Moderate	Moderate
		Very low	**Low**	**Moderate**	**High**	**Very high**
	Probability of occurrence					

Table 9-4 Acceptability criteria

RISK LEVEL	DEFINITION
Very high	Unacceptable risks that could potentially result in serious damage. Management is alerted to such risks and must ensure that alternative solutions are implemented.
High	Risks calling for preventive control measures and risk reduction plans as well as a reassessment of risks at regular intervals.
Moderate	Risks that have been reasonably reduced but that remain subject to a continuous improvement approach designed to achieve the lowest possible degree of risk while maintaining acceptable economic conditions, considering knowledge and practices, as well as the vulnerability of the facilities' environment.
Low	Acceptable risks. Control measures must exist and be in effect. Regular monitoring is necessary.
Very low	Negligible risks.

9.1.2 IDENTIFICATION OF SENSITIVE ELEMENTS IN THE ENVIRONMENT

Sensitive elements in the environment that must be taken into consideration during this technological risk analysis are those that, given their proximity, could be impacted in the event of a major accident at the project site. These include the local population, public spaces, infrastructure and sensitive or protected environmental elements. The identification of sensitive elements is limited to a radius of about 1.5 km around the project site (Map 9-1).

9.1.2.1 HYDROLOGY

The project site is located inside the Eastmain River drainage basin, which covers an area of approximately 46,000 km² and drains water from several lakes and rivers.

Three watercourses flow near the facilities (CE2, CE3 and CE4). Creek CE2 flows to the west, running north of the **main water collection pond** before joining the Eastmain River (Map 9-1). Creeks CE3 and CE4 flow to the east and also join the Eastmain River.

9.1.2.2 BIOLOGICAL ENVIRONMENT

VEGETATION

The surveys carried out as part of the EIA indicated that most of the groups (wetland and land) had a low potential of occurrence for species designated or likely to be designated as threatened or vulnerable. **No** special status plant species were identified during the surveys carried out **on the site of the project, according to the 2020 updated list of plant and wildlife species likely to be designated as threatened or vulnerable.**

TERRESTRIAL FAUNA

Three species of large mammals are likely to frequent the project zone: caribou, moose and black bear. **The grey wolf, sometimes considered to be a fur-bearing animal, is also likely to use the project zone.**

Twenty small terrestrial fauna species could also be found in the project zone. Two of these species have a special status: the least weasel, which is on the list of species likely to be designated as threatened or vulnerable in Québec, and the wolverine, a threatened species in Québec and a species considered as endangered in Canada.

Of the small mammal species captured in the study area, only one – the rock vole – is on the list of species likely to be designated as threatened or vulnerable in Québec. **Its preferred habitat, however, seems to have disappeared between 2011 and 2017.**

FISH AND FISH HABITAT

Seven species of fish have been seen **in surveys of the watercourses in the study area**. They are brook trout **(CE1, CE2, CE3, CE4)**, lake chub **(CE2, CE3, CE5, Asiyan Akwakwatipusich Lake), white sucker (CE3, CE5, Asiyan Akwakwatipusich Lake)**, brook stickleback **(CE1, CE2, CE3, CE4, CE5, Asini Kasachipet Lake), northern pike (CE5, Asiyan Akwakwatipusich Lake), trout-perch (CE5) and yellow lake perch (Kapisikama Lake).**

AVIFAUNA

Among the bird species present in the study area, there are three species at risk in Québec or in Canada: the common nighthawk, rusty blackbird and bald eagle. The first one nests in burnt areas and on barren land, which are widely available near the project site. The second frequents swamps, beaver ponds and peatlands, all of which are still well-represented habitats in the project zone. As for the bald eagle, suitable habitats for feeding and nesting are available, although the species was not detected during the 2012 and 2017 surveys.

CHIROPTERA

The presence of *Myotis* and two other species of bats (the big brown bat and the hoary bat) has been confirmed. However, considering the survey effort (261 station nights), the number of observations recorded for the various chiroptera species was very low.

Moreover, since no natural cavity or mine opening was found in the sector, the possible presence of a bat hibernaculum in or around the project site is considered null.

9.1.2.3 HUMAN ENVIRONMENT

INFRASTRUCTURE

The Billy-Diamond highway, a 620-km stretch of road linking Matagami and Radisson, is a continuation of Route 109. Its original purpose was to provide access to major hydroelectric project sites in the 1970s. Many Aboriginal communities, among them Eastmain, Waskaganish, Wemindji and Chisasibi, can be reached by this road, which their population also uses to travel.

Except for a rest area at kilometre 381, there are no other populated areas on the outskirts of the project site. The truck stop offers travellers accommodations, food and meals, meeting facilities and vehicle repair services (SDBJ, 2017). It includes a convenience store, laundromat, cafeteria, motel, two garages and a gas station.

Composantes du projet / *Project Component*

- Route / *Road*
- Effluent minier / *Mine effluent*
- Station de pompage / *Pumping station*
- 1 Fosse / *Pit*
- 2 Halde à stériles et résidus miniers Sud-Ouest / *South West Waste Rock Tailings Storage Facility*
- 3 Halde à stériles et résidus miniers Nord-Est / *North East Waste Rock Tailings Storage Facility*
- 4 Halde à stériles et résidus miniers Ouest / *West Waste Rock Tailings Storage Facility*
- 5 Halde à stériles et résidus miniers Est / *East Waste Rock Tailings Storage Facility*
- 6 Halde à matière organique et dépôts meubles / *Overburden and Peat Storage Facility*
- 7 Halde à minerai / *ROM pad*
- 8 Usine de procédé / *Process plant*
- 9 Bassin de gestion des eaux / *Water Management Pond*
- 10 Bassin de gestion des eaux / *Water Management Pond*
- Câble de fibre optique / *Optical fiber cable*

Infrastructures / *Infrastructure*

- Route principale / *Main road*
- Route d'accès / *Access road*
- Ligne de transport d'énergie / *Transmission line*
- Lieu d'enfouissement en territoire isolé (LETI) / *Remote landfill*

Hydrographie / *Hydrography*

- Cours d'eau permanent / *Permanent stream*
- Cours d'eau à écoulement diffus ou intermittent / *Intermittent or diffused flow stream*
- Plan d'eau / *Waterbody*

Récepteurs sensibles / *Sensitive Receptor* [1]

- Campement de travailleurs / *Worker's camp*
- Relais routier / *Truck stop*
- Sentier de motoneige / *Snowmobile trail*
- Aire de chasse, de trappage ou de pêche / *Hunting, trapping or fishing area*
- Aire valorisée / *Valued area*
- Cours d'eau valorisé / *Valued stream*
- Source d'eau potable / *Drinking water source*
- Site archéologique connu / *Known archaeological site*

1 Lorsqu'il s'agit d'une aire ou d'une composante linéaire, le pictogramme représente le point le plus rapproché des infrastructures du projet.
The pictogram denotes the closest point to the project infrastructure in the case of a surface or a linear component.

GALAXY
Mine de lithium Baie-James /James Bay Lithium Mine

Carte / *Map* 9-1
Composantes sensibles du milieu / *Sensitive Environmental Components*

Sources :
Orthoimage: Galaxy, août 2017
Données du projet / Project data : Galaxy, 2021

0 300 600 m
UTM, fuseau 18, NAD83

Juilleti / *July* 2021

Dessin : A. Masson
Approbation : D. Thiffault
201-12362-00_c9-1_wspT115_RS_composante_210702.mxd

wsp

CURRENT USE OF THE LAND AND RESOURCES FOR TRADITIONAL PURPOSES

Nine Cree communities are found on the EIJB territory. One of these, the Eastmain community, is in the project zone. It has 15 traplines. The planned mining infrastructure will be located mostly on trapline RE2, which accounts for 5.8% of the total area of the Eastmain community traplines (15,668 km^2). The project will not **directly** affect any other traplines.

NATURAL AND CULTURAL HERITAGE

The truck stop zone includes a known archaeological site. In addition, 27 zones of prehistoric archaeological potential have been identified in a radius of approximately 1.5 km around the project infrastructure. These sites, illustrated on Map 6-22 in Chapter 6, represent the areas most likely to comprise remains attesting to a human presence from prehistoric times up to the twentieth century.

9.1.3 HISTORY OF ACCIDENTS

The history of accidents points to potential hazards and can be used to create accident scenarios for risk assessment purposes. This information can also help improve the design of infrastructure and the associated equipment, determine the necessary safety equipment and better define the risk management plan.

The Analyse, Recherche et Information sur les Accidents (ARIA) database of the French Ministry of Ecology and Sustainable Development's risk and industrial pollution analysis office was consulted online.[1]

This search was not meant to be exhaustive but was carried out to identify potential accident scenarios, establish their causes and possible consequences and estimate their probability of occurrence. Furthermore, all the identified accidents did not necessarily occur on sites with the same characteristics as the project site (type of mine [pit or underground], ore mined, type of process used, operating conditions, etc.).

9.1.3.1 MINING ACCIDENTOLOGY

Given that mining activity involves many more substances than merely lithium, the ARIA database search was expanded to cover mining operations in general. The search encompassed accidents that occurred since January 2000 during the following activities:

- B.07.10: iron ore mining;
- B.07-21: uranium and thorium ore mining;
- B.07.29: mining of other non-ferrous metal ores;
- B.08.99: other mining activities.

The search results are included in Table 9-5.

Accidents are classified by type of event (dike breaches, landslides or ground collapses, release of contaminated water into the environment, fires, explosions and others).

Since January 2000, **47** mining-related accidents were recorded. These accidents consisted of:

- landslides, ground collapses, slumping (13 accidents, or around 29.5% of all incidents);
- dike breaches or storage basin overflows (**8** accidents, or around **17**% of all incidents);
- explosions (**9** accidents, or around **19.1**% of all incidents);
- fires (**7** accidents, or around **14.9**% of all incidents);
- contaminant spills or leaks (**6** accidents, or around **12.7**% of all incidents);
- non-classified occurrences (4 accidents, or **8.5**% of all incidents).

1 **www.aria.developpement-durable.gouv.fr**

No incident is listed in the ARIA database for sites where extractive activities are carried out, for the following activities:

- **exposure to ionizing radiation;**
- **fire affecting a propane tank;**
- **formation of a propane vapor cloud;**
- **theft of explosive material.**

Table 9-5 Accidentology related to mining activity

Date	Country	ARIA o.	Description of incident	Causes (if known)
Dike failure				
25/01/2019	**Brazil**	**53027**	**In the early afternoon, one of three dams holding liquid waste from iron mine operations broke. A breach in the embankment structure of 86 m in height caused its destruction and resulted in a spill of 12.7 million m3 of toxic effluents. A destructive wave of mud buried the administrative buildings on the site and a part of the village downstream.**	**Poor design**
05/11/2015	Brazil	47369	At 15:30 a breach developed in an iron ore tailings dam. Emptying of the reservoir was begun, but the structure broke at 16:20. The entire impoundment emptied into the valley downstream, causing the rupture of a second dam. A mudslide (approximately 60 M tonnes) engulfed a village of 620 inhabitants. The operator alerted some residents by telephone, but its list was incomplete. It had no alarm sirens as required by good mining practice. No plan to alert or evacuate the public was in place. The incident led to 19 deaths and an environmental disaster. Weak seismic shocks were recorded in the area on the day of the accident, but no link with the rupture of these embankment dams was established. The dam, at the limit of its capacity, was in the process of having its height raised. Accident scenarios had greatly downplayed the volume of the flow of tailings in the event of a rupture: they were based on the 2008 construction height of 45 m, while the dam was twice as high on the day of the accident.	Poor design and structural failure
04/08/2014	Canada	45566	A dike at a storage pond for mining effluent at a copper and gold mine broke. The contents flooded into Hazeltine Creek and Polley Lake and Quesnel Lake downstream. The pond contained copper, nickel, arsenic, lead, selenium and cadmium. The authorities prohibited consumption and use of the water, as well as swimming. Debris was carried up to 12 km downstream. Residents complained of strong odours. The operator pumped the polluted contents of the lakes into an empty mineshaft. An investigation was launched by the mining authorities. In 2013, the pond concerned had received 326 t of nickel, 177 t of lead and 18,400 t of copper and copper compounds.	-
23/04/2009	France	36208	Two landslides occurred on the sides of a 600,000 t retention pond for ultimate wastes at an abandoned gold mine upstream of the Gourg Peyris River, a tributary of the Rieussec River, which empties into the Orbiel River. The containment dike was ripped open over a distance of 25 m in two places, leaving solid materials high in arsenic, cyanide, lead and other heavy metals exposed to the open air. Since the pond had been fitted with an impermeable bottom (geotextile), the tailings (which had been covered with vegetated soil to prevent it from being carried off by the wind) had become saturated with water during heavy rains. The pond contents became heavier, exceeding the pond's ability to contain them, leading to the landslides. During the last years of the mine's operation, the pond had been raised several metres above its original level. A dike had also been built downhill as protection in the event of landslides and subsequently enlarged following ground movement. Operations at the ore extraction and processing facility were shut down permanently in 2004. Under an agreement signed between the site operator and the French government in July 2010, the government acquired ownership of some of the most highly polluted lands as well as responsibility for decontamination of the site, in return for a substantial contribution from the operator. Remediation of the site was overseen by the ADEME (the agency overseeing the environment and energy) between 1999 and 2008, at a cost of close to €50 million. The 80 years of mining activity at the site had caused long-lasting arsenic pollution (ARIA 4446, 25267) of the soils and the Orbiel River, whose water was not fit for consumption (affecting a total of 20 municipalities). The sale of thyme and leafy vegetables was also prohibited over an area encompassing five municipalities.	Landslide

Table 9-5 Accidentology related to mining activity (cont.)

Date	Country	ARIA no.	Description of incident	Causes (if known)
30/04/2006	China	31750	At a gold mine near Miliang in Shaanxi province, the dike of a tailings pond was breached, releasing water laden with potassium cyanide (KCN) into the Huashui River, which was polluted over more than 5 km. The flooding triggered a landslide that destroyed about 20 houses at the base of the dam, and 17 people went missing. The quantity of KCN spilled is not known. Since the levels of the chemical exceeded national criteria, local authorities asked residents not to drink water from the river and ordered five towns downstream to test water quality and organize water supply for affected residents. According to mine officials, the search for missing residents did not begin until five days after measures to combat pollution of the watercourse. Calcium hydroxide and bleach were added to the water in an attempt to reduce the concentration of cyanide by converting it to cyanates through oxidation.	-
11/09/2002	Philippines	39967	On August 27, heavy rains caused two effluent holding ponds to overflow at a copper and silver mine that had been operated between 1980 and 1997. The ponds were 120 m high and had a total capacity of 110 Mm^3 of consolidated tailings. An inspection found that spillways had overflowed and suffered erosion, and that effluent had been discharged into Mapanuepe Lake and the St. Thomas River downstream. On September 5, the department of the environment and natural resources (DENR) deemed a sudden failure of the two dams unlikely and estimated that, in the event of a breach, Lake Mapanuepe would be capable of dealing with the overload caused by the release of an estimated maximum 9 Mm^3 of water. On September 11 at 13:00, a leak appeared in the damaged spillways, causing a limited volume of sludge to discharge. 250 families from three neighbouring villages were evacuated as a precaution, followed by 750 more on September 12 because of the constant rain. The operator brought in heavy pumping equipment from another mining company to pump water out of the pond and began repair work. Heavy rains in July and August had caused the volume of impounded water to increase beyond the spillway evacuation capacity. The mine had been abandoned in 1997, three years ahead of the initially planned date, because of the unstable slopes and annual flooding.	Impoundment overflow Heavy rainfall
08/09/2000	Sweden	21970	An effluent holding pond at a copper mine failed over a length of 120 m, releasing 2.3 Mm^3 of sludge into a 15 Mm^3 settling pond lying immediately downstream. The settling pond level rose by 1.2 m, and to preserve its stability the operator opened it and released 1.5 Mm^3 of slurry into the Leipojoki and Sakijoki rivers, whose beds were covered with a whitish deposit over 8 km. An estimated 23 kg of copper was released in the effluent. On December 4, a second release of 1.5 Mm^3 of liquid – containing 9 kg of copper – from the settling pond was made to lower the level of the pond by 1 m and prevent it from breaking. Repair work, which began immediately after the failure, lasted three months. Because of the resultant pollution, a judicial investigation against the operator was initiated by the public prosecutor of Lulea on September 12, 2000. On October 8, 2001, the investigating commission reported that the accident was caused mainly by shortcomings during the construction and operation of the dam and, to a lesser degree, heavy rainfall (which did not, however, exceed the values that had been taken into account in calculating the structure's dimensions). The procedure for monitoring the pond, which was in line with standards at the time of its construction (which began in 1968), proved insufficient and failed to detect the high pore pressure in the body of the dam, despite leaks and local instabilities observed on the side of the structure. The commission brought to light violations of construction permits by the operator during the building of the dam. It recommended instrumentation and tighter monitoring of mining and hydraulic structures that could cause substantial damage to property and persons at the site concerned and the rest of the country.	Poor design and heavy rainfall

Table 9-5 Accidentology related to mining activity (cont.)

Date	Country	ARIA no.	Description of incident	Causes (if known)
30/01/2000	Romania	17265	At a plant opened in May 1999 to reprocess gold-bearing tailings, a waste settling pond ruptured after a 25 m-long crack developed. 287,500 m³ of effluent containing cyanide (400 mg/L, or 115 t in total) and heavy metals (Cu, Zn) contaminated 14 ha of land and polluted the Sasar River. A "wave of cyanide" 40 km long flowed over the Lapus, Szamos, Tisza and Danube rivers. Cyanide levels reached 50 mg/L in the Lapus, 2 mg/L in the Yugoslav portion of the Tisza (February 12) and 0.05 mg/L in the Danube delta, 2,000 km downstream of Baia Mare (February 18). Romania, Hungary, Yugoslavia, Bulgaria and Ukraine were impacted.	Design flaw, unfavourable weather conditions
Collapse/Landslide				
01/03/2012	France	44758	A geologist was examining an outcrop uncovered during digging of an unshored trench at a gold mine. For some unknown reason, a landslide occurred and the geologist was buried at the bottom of the trench.	Landslide
08/05/2011	Turkey	42972	Internal embankments collapsed in two places at a reservoir of cyanide-containing water at a silver ore processing plant. No leak was detected on the external banks. Activity at the plant was halted and 250 residents were evacuated. The external embankment was reinforced. A group of experts determined that there was no risk of total rupture. A new reservoir was built to hold the tailings. Production resumed after 20 days of stoppage. Operating losses were estimated at $30 million (€21 million).	Embankment collapse
27/06/2010	Ghana	38555	A gold mine collapsed following heavy rainfall at Dunkwa-on-Offin. The mine, which had been abandoned by its owners, was being operated clandestinely. According to press reports, 136 miners were present at the time of the accident: 15 were found alive, 32 were found dead, and 89 were reported missing. Rescuers installed pumps to clear the mine entrance, but operations were hindered by bad weather. The three owners of the mine were taken into custody.	Collapse Heavy rainfall
21/07/2009	South Africa	36939	At midday, the ground collapsed at a platinum mine operated at a depth of over 1,000 m. Nine miners were killed.	Collapse
05/06/2009	China	36583	At around 15:00, a landslide occurred in a mining region: several million cubic metres came away from a mountainside, burying dwellings and the mining zone located in the valley over a length of 600 m and a width of 300 m and damming the Wujiang. At least a dozen dwellings were buried under 40 m of materials, and several areas of the city suffered cuts in electricity and communications. In the eight days following the disaster, major equipment was deployed for rescue operations and to re-establish the course of the river. Many shafts were drilled in an unsuccessful attempt to reach a tunnel in the mine located at a depth of between 150 m and 200 m in which the authorities estimated that miners could have survived for 5 to 7 days with air and water. On June 12, the authorities reported 42 deaths and 63 missing persons, including the 27 miners.	Landslide
23/04/2009	France	36208	This incident is described in the previous section (dike breaches).	Landslide
12/11/2008	Guinea	35532	A collapse occurred at an open-pit gold mine. At least 14 clandestine workers were killed and, according to witnesses, many others were injured. These gold washers were working illegally without safety measures in shafts abandoned by the mine operator. No official report was provided by local authorities, but this did not rule out a large number of victims given the number of clandestine workers on the site.	Collapse
06/05/2008	Indonesia	34567	A landslide occurred in the evening at a gold and copper mine; 12 miners were killed and at least 15 others were reported missing.	Landslide
13/10/2007	Colombia	33747	A rockslide occurred at an open-pit gold mine near Suarez in the southwest part of the country, killing 21 miners and injuring 24 others.	Rockslide

Table 9-5 Accidentology related to mining activity (cont.)

Date	Country	ARIA no.	Description of incident	Causes (if known)
23/07/2002	Zimbabwe	22840	Following a collapse at a gold mine that had been abandoned since 1940, between 15 and 20 clandestine miners were reported missing. Rescue operations were hindered by the instability of the land in the area.	Collapse
08/01/2002	Congo	21708	A mine collapsed at a peak time, burying dozens of diggers and merchants who had come to supply them. A total of 39 persons were killed or reported missing.	-
24/11/2001	Colombia	21710	The collapse of an abandoned gold mine resulted in numerous victims being buried under tons of mud: 47 bodies were recovered, but the number of victims was considered tentative according to local emergency services. A further 32 people were injured.	Collapse
09/04/2001	Zambia	20673	Ground movement occurred at a copper mine. A slope collapsed, burying 10 miners.	Landslide
Release of contaminated water into the environment				
04/07/2018	**France**	**56140**	**The French National Forests Office observed pollution in Kokioko Creek, where there was a gold mining site. The levels of suspended matter were 4,800 times higher than the levels permitted by law. The site ponds were open, allowing muddy water to flow directly into the creek. The mud overflow increased turbidity, which reduced oxygen levels, formed a seal over the soil, cut off the air supply to plant life and led to the destruction of natural habitat and biodiversity.**	**Site remediation in rainy weather**
06/08/2015	United States	46802	The Environmental Protection Agency was conducting a technical study to assess water release from an old gold mine, methods of treating this water and possibilities for site remediation. While agents were excavating above the old mine entrance, pressurized water began leaking and flowed into the nearby watercourse. Approximately 11,500 m³ of orange-coloured water laden with lead, copper, arsenic, iron and zinc polluted downstream watercourses over 160 km. The authorities prohibited navigation, swimming, watering of farm animals and the consumption of water from specific collection points. Lead and arsenic levels were respectively 12,000 and 26 times higher than acceptable levels.	-
06/08/2014	Mexico	45640	Approximately 40,000 m³ of sulphuric acid and heavy metals spilled from a copper mine effluent storage pond. The coloured discharge polluted two rivers over 150 km, and 20,000 people were deprived of drinking water for many days. The operator poured 100 t of calcium hydroxide into the watercourses to neutralize the effluent. Other leaks were observed during the month of September. Measuring campaigns were conducted in the adjacent border country. The mining company spent €120 million on clean-up operations. The authorities imposed a €2.5 million fine on the operator. The Mexican federal environmental agency launched an investigation into the accident. The mine operator considered that the spill was due to heavy rainfall causing the pond to overflow. Government authorities challenged this explanation.	Storage pond leak Heavy rainfall
04/06/2014	France	45987	Sulphuric acid (H_2SO_4) leaked through a flange at an abandoned uranium mine. 20 m³ of the chemical were contained in the storage pond and then pumped out by a specialist company. The pond had to be repaired. The flange concerned had been corroded by the acid. Contrary to what the operator believed, it was not made of stainless steel. The operator replaced the PE tank with another made of HDPE. The authorities responsible for inspecting classified facilities were notified.	Poor design

Table 9-5 Accidentology related to mining activity (cont.)

Date	Country	ARIA no.	Description of incident	Causes (if known)
05/05/2014	France	45256	During a transfer operation at around 23:00, almost 100 m³ of effluent of pH 1.1 laden with hydrochloric acid and metals leaked at a metallurgical plant. The spill reached a river, causing its total acidification to dip below a pH of 3 and killing over 1,000 fish. The leak was not discovered until 13:30 the next day and was stopped at 14:00. Fishing and swimming were prohibited. The classified facilities inspection authorities and elected officials visited the site. The plant was shut down temporarily. Local residents expressed their displeasure following this new spill, similar pollution having occurred in 2009. A rain advisory necessitated the use of an isolated transfer circuit for work that had not been sufficiently checked before being brought back into service. The system was partially open following removal of a valve and the leak was not discovered during the operator's routine inspection round at shift changeover.	Procedure/organization
08/03/2005	France	29390	Lead pollution was detected at a small village close to an abandoned lead and zinc mine that had been closed since 1991. According to press reports, samples revealed levels of metals 5 to 13 times higher than European standards. While awaiting additional analysis, a municipal decree banned the consumption of fruits and vegetables in the community, as well as the use of water from private springs for food-related purposes. The mayor ordered that cellar entrances be sealed off and recommended that floors be washed rather than swept while dry. As a precautionary measure, children under 10 were screened for lead poisoning.	Contaminant leak
09/07/2017	**France**	**49980**	**A fire broke out around 04:30 on fixed equipment for transporting ore over a distance of 11 km at a mining facility. Operator agents detected and extinguished the fire. The fire damaged 350 m of conveyor belt and metal frame.**	**Malice**
08/05/2012	France	42146	At an acid production unit at a nickel extraction plant, water in some pipes cause them to corrode, leading to a leak of sulphuric acid (H_2SO_4). The metal was attacked by the acid, causing hydrogen (H_2) to form. The plant was evacuated. Between 50 and 100 t of acid were collected from the plant's "first flush" ponds before being directed to the waste processing unit. The acid that could not be recovered was neutralized with calcium hydroxide and limestone and then pumped out. No environmental impact was recorded. The classified facilities inspection authorities visited the premises.	Poor condition of pipes (corrosion)
06/08/2010	China	38775	At 17:00, fire broke out at the bottom of a gold mine in which 329 miners were working: 279 managed to get out on their own. Emergency services evacuated the remaining miners, with the exception of seven who were reported missing. The human cost was nonetheless heavy: 16 deaths by asphyxiation in the mineshaft or in hospital and several dozen injured. An electrical cable may have been the cause of the fire, which was not brought under control until 08:30 the following morning. According to press reports, the manager of the mine, which was operated legally, was arrested.	Electrical defect
01/06/2009	South Africa	36550	82 miners working illegally died by asphyxiation when a fire broke out at an abandoned gold mine. 294 other illegal workers living and working at the disused mine at 1,400 m below ground were arrested during operations to recover the bodies of the victims. South African miners' unions requested a government inquiry to look into the question of whether the site had been secured by the last official operator. According to the unions, working conditions at mines in general do not comply with all legal safety requirements.	

Table 9-5 Accidentology related to mining activity (cont.)

Date	Country	ARIA no.	Description of incident	Causes (if known)
Fire				
27/09/2008	France	35578	At around 22:00, fire broke out at a disused 1,000 m² building that had been in the process of being demolished for the past two months. The building had housed the heating plant of a former potash mine. The fire, which spread through the wooden floors and electrical shafts, gave off thick smoke. After cutting off the power supply, firefighters brought in 26 men and heavy equipment, including two high-capacity tankers to address a shortage of water on the site. Aside from this water shortage, the dilapidated condition of the premises and the instability of the floors complicated the work of the emergency responders, who could not get inside the building even with the use of independent breathing apparatus. The fire was brought under control within 30 minutes, and the emergency response ended at around 02:00. The chosen hypothesis was that thieves had broken in to steal metal and set fire to rubber-sheathed cables in order to recover copper. The site had been placed under video surveillance and was equipped with an alarm system that failed to work.	Malice (fire for the purpose of theft)
26/11/2004	China	28654	Fire broke out at five iron mines: the number of casualties was estimated at 68. The fire started at a private mine and then spread to four other mines, all connected, trapping about 100 miners. Accidents are frequent in China and kill over 7,000 miners annually, according to official figures. Initial investigations suggested that an electrical cable was the cause of the fire.	Electrical defect
20/09/2000	Ukraine	18771	Two accidents occurred successively in the same region: the first fire broke out apparently because of noncompliance with safety rules. It caused the death of a miner, who was asphyxiated by gases. The second fire led to the evacuation of 24 miners. It was quickly contained and there were no victims.	Human error
01/10/2013	Germany	44844	A controlled explosion was set off 700 m deep at a potash mine at 13:10. The release of carbon dioxide killed three employees; four others were rescued. The dust rose to the surface and settled in the surrounding area. Activity at the site was halted. The operator ventilated the entrances and repaired the technical facilities.	-
20/06/2009	China	36397	At around 03:20, a violent explosion rocked a plant producing quartz sand (300,000 t/year) and processing quartz crystals located in the Fengyang district of eastern China. 16 employees were killed and 44 people, most of them local residents, were injured. The plant was destroyed, leaving behind a crater. According to a Chinese official agency, the manager, who was arrested, had illegally stockpiled 7 t of explosives in the offices.	Illegal storage of explosives
12/12/2008	Russia	35883	An explosion occurred at an apatite mine (apatite is a calcium phosphate mineral used in fertilizer production). 12 workers were killed and 6 others were injured. 55 t of explosives made up of a mixture of ammonium nitrate, aluminum powder and used oils, placed at several points in the mine for use in blasting, were reportedly set on fire accidentally during excavation work. A judicial inquiry was opened to look into the alleged violation of safety rules during mining work.	Human error, failure to comply with health and safety rules
26/11/2007	Ecuador	34188	A dynamite store at a gold mine exploded; 7 miners were killed, 40 injured, and 30 reported missing. Rescuers suggested a short-circuit in the mine's electrical network as a possible cause.	Dynamite store Electrical short circuit
20/04/2005	Zambia	29698	An explosion occurred at an explosives factory located on the site of a copper mine. Initial reports stated that more than 50 people were killed. Preliminary findings suggested that those in charge had not observed basic safety rules. The authorities requested that an investigation be opened.	Human error, failure to comply with safety rules

Table 9-5 Accidentology related to mining activity (cont.)

Date	Country	ARIA no.	Description of incident	Causes (if known)
Explosion				
15/12/2003	Poland	26061	43 miners were injured, two of them seriously, in an explosion at a copper mine at a depth of 670 m. The apparent cause of the accident was the transportation of 2 t of dynamite. Fire spread to a vehicle carrying 2 t of dynamite (domino effect). Temperatures were thought to have reached 1,000 °C.	Transportation of explosives
08/05/2001	South Africa	20682	An explosion at a gold mine at a depth of 800 m killed at least 12 miners. A search for missing workers was launched, but the work of rescuers was complicated by the absence of a list of personnel present at the bottom of the mine at the time of the accident. An investigation was launched to determine the causes of the explosion.	-
15/03/2001	Russia	18804	Two miners were killed and two others injured when 21 t of explosives stored in a mine at a depth of 200 m exploded accidentally. An investigation was launched to determine who was responsible for the accident.	-
15/05/2000	South Africa	19205	An explosion at a gold mine killed 7 workers.	-
Other				
18/11/2014	Russia	46033	A flood caused a 40 m diameter crater to form at a potash mine. Employees were evacuated and operations stopped. This mine extracts 10% of global production, approximately 3 Mt per year.	-
15/03/2012	Finland	43054	An employee taking samples close to an ore-processing plant at a nickel, zinc, cobalt and copper mine died after being asphyxiated by hydrogen sulphide (H_2S). The victim was not wearing a gas detector or respiratory protection. Atmospheric measurements in the area indicated 50 to 300 ppm of H_2S. An investigation was carried out by the police and the government body responsible for investigating industrial accidents. The plant was shut down. The H_2S, used to purify the solution produced by bacterial leaching of ore stockpiles, had leaked outside the plant after a sample that had been taken was left open on a pre-neutralization tank. In the tank, lime sludge had reacted with the effluent already present and formed carbon dioxide (CO_2), which pushed out the H_2S that was already present. No gas detector was installed outside the buildings, despite the fact that in the two weeks preceding the accident high levels of H_2S had been detected in the area of the accident. The area was marked out, but not all personnel likely to be in the area had been warned of the danger. In addition, the absence of preventive maintenance meant that H_2S measuring systems were not functioning properly. It also transpired that the ore purification process was new and that the operator, seeking to obtain an extremely pure finished product, had used excessive quantities of H_2S.	Human error and the absence of protective measures
08/10/2009	China	37188	At around 09:15, an accident occurred at a tin mine involving two elevators carrying workers. A cage crashed to the bottom of the shaft, killing 26 of the 31 miners present and injuring the remaining five. A malfunction of the braking system reportedly caused the two elevator cages to collide and then one of them to fall. The vice-governor visited the site and the government ordered an immediate check of workplace safety throughout the province.	Technical failure
03/02/2002	China	21858	Six miners died of carbon monoxide poisoning at a gold mine and 30 others were hospitalized. Some workers lost consciousness after they had come to rescue other workers located at a depth of 270 m.	

9.1.3.2 ACCIDENTS AT THE AUSTRALIAN MT CATTLIN SITE

Between April 2016 and December 2017, 26 spills of more than one litre occurred **at the Galaxy Ressources' Mt. Cattlin site in Australia**. These spills involved hydraulic oil (15), diesel (5), used oil (2), gear oil (1), metal (1), process water (1) or slurry (1). The largest volume spilled was 150 litres. No spills reached the boundaries of the site.

No information has been sent to us about environmental incidents occurring after December 2017.

9.2 IDENTIFICATION OF HAZARDS

External hazards are events from natural or anthropogenic sources that may affect the proper functioning or integrity of a site.

9.2.1 EXTERNAL HAZARDS OF NATURAL ORIGIN

9.2.1.1 EARTHQUAKES

Eastern Canada is in a stable continental region of the North American plate and therefore has relatively low seismic activity. On the Natural Resources Canada simplified Québec seismic hazard map (NRCan, 2017*a*), the study area is part of zone 1 (very low risk) on a scale of 5 (very high risk).

A magnitude 3 earthquake is strong enough to be felt in the surrounding area, while a magnitude 5 earthquake generally marks the threshold at which an event is likely to cause damage.

In the study area, the *2015 National Building Code* established the probability of a seismic event at 0.000404 per year. This means that, for a 50-year recurrence interval, there is a 2% chance that an earthquake will cause greater than expected ground motion (NRCan, 2017*b*).

NRCan has listed all earthquakes in Canada between 1663 and 2012 (NRCan 2017*c*). Earthquakes with a magnitude greater than 5 and where the epicentre was closest to the study site occurred approximately 630 km from the site, one to the southeast and the other to the southwest. They were 5.9 (1988 – Saguenay) and 6.1 (1935 – Québec border – Ontario – Temiskaming region) magnitude earthquakes respectively.

It should be noted that all the project's structural facilities will meet the earthquake resistance standards of the *Québec Construction Code* and the *National Building Code of Canada*. Therefore, the risk of an earthquake with major consequences in the study site is considered low.

9.2.1.2 FLOODING

Flooding typically occurs upstream of a crest (rise in water levels or narrowing of banks) that impedes water drainage. The formation of ice jams can also contribute to flooding by obstructing water drainage, particularly at the points where watercourses narrow during the spring freshet.

There are no significant watercourses near the project site that could produce a major flood. In the event of heavy precipitation, local accumulations could occur. The water would then be drained by the drainage system in place.

9.2.1.3 TERRAIN INSTABILITY

Terrain instability can generally be attributed to relief and the nature of the soils (Landry, 2013). Sloping may lead to a landslide when the materials in place do not provide sufficient shear strength. This phenomenon depends on both the steepness of the slope and the composition of the soil. Some other soil instability phenomena, such as earthflow, are related to soil types, made of plastic or heterogeneous materials. Moreover, areas filled with heterogeneous materials may be prone to soil instability as a result of settlement or subsidence.

Given the small difference in elevation in the study area, there are no problems with regard to the stability of surface deposits.

9.2.1.4 EXCEPTIONAL WEATHER CONDITIONS

Exceptional weather conditions in the form of heavy rainfall, hail or high winds may occur during the summer. In winter, such conditions may include heavy snowfall, high winds and ice storms. These phenomena are caused by particular conditions associated with temperature and humidity gradients between different air masses.

The consequences of these exceptional weather conditions may be direct or indirect. In fact, wind, precipitation, snow and ice may result in overloads and directly jeopardize the integrity of buildings or equipment.

Building and equipment designs will be in accordance with the current codes and regulations to withstand the overloads created by extreme weather conditions. In addition, excessive snow and ice loads will be removed, as needed. Extreme weather conditions, however, remain a plausible accident scenario that should be considered.

9.2.1.5 FOREST FIRES

The MFFP is the entity that deals with forest fire management in Québec. The ministry is supported by the Société de protection des forêts contre le feu (SOPFEU) on fire prevention, detection and firefighting. It should nonetheless be noted that, at this latitude, forest fire control is partial (northern protection zone). The fight against forest fires in this area is carried out through agreements only or in support of emergency preparedness. Therefore, control operations take place mainly near infrastructures such as villages, energy production and processing facilities, etc.

The project area is considered to be a region in which forest fires are the most active and in which some of the largest fires were recorded. From 1840 to 2013, a fire occurred on average every 3.5 years somewhere along the Billy-Diamond highway over a distance of 340 km. Burnt areas cover 2.4% of the land area each year over the past century, and fires spanning over 90 km have occurred every 20-30 years (Erni and coll., 2016).

The MFFP keeps annual records of forest fires in Québec. These records were consulted and show the following:

- In 2005, forest fires reached within one kilometre of the project site from the northeast and the south. These fires affected 23,208 ha and 39,267 ha respectively. The km 381 truck stop had been impacted.
- In 2009, many forest fires were observed to the west and southwest of the project site and one reached within approximately one kilometre to the southwest.
- In 2013, a forest fire burned an area of 501,689 ha, forming a tongue facing southwest/northeast and reaching the km 381 truck stop. The fire passed within one kilometre of the project site.

Map 6-13 shows the areas impacted by these fires in the project area.

In addition, many studies indicate that increasing GHG concentrations in the atmosphere should increase the conditions conducive to forest fires, increasing both the number of fires and their severity (Girardin and Terrier, 2015). Therefore, the risk of a forest fire in the project area is considered very high.

9.2.2 ANTHROPOGENIC EXTERNAL HAZARDS

9.2.2.1 AIR TRANSPORT

No active airport is located near the site. The airfields closest to the project site are the airports located at the Eastmain River (97 km), Nemiscau (88 km) and the Eleonore Mine, which are located to the northeast of the Opinaca Reservoir (85 km).

The risk of a plane crash is higher in the landing and take-off zones. For large aircraft, this area extends over approximately 8.5 km from the end of the runways and is approximately 5 km wide. For small aircraft, this area corresponds to a circle of approximately 4 km around the centre of the runway (De Grandmont, 1994). The project site is located outside any aerodrome landing or take-off zones.

In addition to these areas covering the immediate periphery of an airport, the risk of an accident is also higher in corridors used for air traffic. With the exception of these areas, the probability of a plane crash at a specific location is considered very low.

9.2.2.2 POWER TRANSMISSION LINES

Two transmission lines are present near the site. From north to south, the 4003-4004 circuit (450 kV) runs along the Billy-Diamond highway and cuts it in two. The 614 circuit (69 kV) crosses the territory from east to west, approximately 7 km to the south.

9.2.2.3 REMOTE LANDFILL

A remote landfill is located to the south of the planned pit. It is connected to the activities at the km 381 truck stop. The site has been used for residual materials management since December 5, 1983. Before this use, a quarry was located at the same place. MRNF (now MERN) issued a lease in 2012 to the SDBJ. This site will be fenced.

9.2.3 HAZARDS RELATED TO THE ACTIVITIES ON SITE

The main hazards identified on the site are related to the following activities:

- operation of an extraction pit;
- operation of a spodumene mill;
- using radioactive sources;
- operation of a water treatment plant;
- storage and use of petroleum products;
- storage and use of propane;
- storage and use of chemical products;
- storage and use of explosives;
- mechanical maintenance activities;
- use of oil-filled electrical transformers;
- storage areas for ore, overburden, topsoil and waste rock;
- presence of a containment dike;
- transporting of hazardous materials and concentrates.

9.3 ACCIDENTS AND MALFUNCTIONS

The following sections detail the hazards that have been identified and the assessment of their severity and probability. Table 9-10 presents a risk analysis summary for the project.

9.3.1 OPEN-PIT MINING

This section covers the risks associated with the extraction pit. Two accident scenarios have been identified:

- pit flooding;
- falling rocks along the walls of the pit.

9.3.1.1 PIT FLOODING

Water ingress is an inherent hazard in mining operations. With respect to the pit, surface water or groundwater may enter the pit as a result of rock damage caused by blasting or damage to the rock structure showing excessive cracking, leading to a flow of water into the pit or major flooding. Excess water ingress into the pit will then have to be pumped, requiring operations at the pit to be interrupted.

Prevention and control measures

The following prevention and mitigation measures will be put in place to reduce the risk of pit flooding:

— completion of geological and geotechnical studies to characterize the site;
— monitoring of effects of blasting (in pit) for the formation of excessive cracking;
— installation of pumps to bring back the water to the surface;
— diversion of rainwater from areas not affected by mining operations to the extent possible to prevent them from reaching the mine pit;
— the designer's operating work guide will be followed;
— an inspection program based on the designer's specifications will be implemented.

Probability of occurrence

Pit flooding by water ingress could occur, as this type of incident occurred at similar sites. The probability of occurrence is deemed **low**.

Severity

The consequences of such a flood could potentially entail injuries, including permanent disability and the cessation of pit operations for up to one month. The severity level is deemed **high**.

Estimated risk level

The inclusion of components and severity brings the level of risk of pit flooding by water ingress to **moderate**. The risk level is based on risks for workers and property.

9.3.1.2 FALLING ROCKS AND LANDSLIDES ALONG PIT WALLS

PREVENTION AND CONTROL MEASURES

The following prevention and mitigation measures will be put in place to reduce the risk of falling rocks and landslides along pit walls:

— completion of geological and hydrogeological studies to characterize the site;
— design of pit slopes in accordance with the *Regulation respecting occupational health and safety in mines* (R.S.Q. c. S-2.1 r.14);
— monitoring of potential of landslides or falling rocks in the pit;
— sizing of horizontal and vertical bearings so as to ensure the stability of the extraction pit's slope.

PROBABILITY OF OCCURRENCE

Falling of rocks or unconsolidated deposits along the walls of the pit may occur. The accident history has shown that this type of accident has already occurred a number of times at similar sites. Given the preventive measures taken, the probability of occurrence is deemed **low**.

SEVERITY

This type of accident may cause injuries that can lead to permanent disability and significant economic losses. The severity level is deemed **high**.

ESTIMATED RISK LEVEL

Inclusion of the probability and severity components brings the level of risk of falling rocks or landslides along the walls of the pit to **moderate**. The risk level is based on risks for workers and property.

9.3.2 ORE PROCESSING

This section covers the risks associated with ore processing.

The ore processing approach planned for the site will entail a spodumene concentration process. The selected process involves crushing of the ore followed by dense-media separation (DMS).

Three accident scenarios have been identified:

— fire;
— exposure to ionizing radiation;
— dust emissions.

9.3.2.1 FIRE

A fire could occur at the ore processing facilities. The causes could be:

— welding on equipment with an interior rubber lining;
— conveyor belt friction;
— short-circuit or overheating of an electric motor;
— use of defective heating equipment or supplementary heating systems;
— negligence during hot work.

PREVENTION AND CONTROL MEASURES

The following prevention and mitigation measures will be put in place to reduce the risk of fire:

— maintenance of conveyors to prevent belt slippage and friction;
— Installation of thermally controlled sprinklers on conveyors and a water flow alarm system connected to the fire station;
— monitoring of welding on equipment with interior rubber lining;
— design based on National Fire Protection Association (NFPA) standards;
— fire extinguishers at each drive unit for conveyors as well as in all areas with a risk of fire;
— hydraulic firefighting system and fire hydrants;
— sprinkler systems in offices and shops;
— creation of a fire brigade;
— continually updated emergency response plan that includes a fire response procedure.

PROBABILITY OF OCCURRENCE

A fire could occur at the future facilities, as this type of incident has already occurred at similar sites. However, it is not likely given the preventive measures in place. The probability of occurrence is deemed **low**.

SEVERITY

Generally speaking, when a fire takes place at a building, the consequences primarily concern the health effects associated with thermal radiation and toxic fumes. The severity level of a fire may vary, but it can lead to severe injuries or permanent disability.

It can also cause economic losses (cessation of operations, substantial damage to expensive equipment, etc.).

In the event of an incident that spreads beyond the buildings and infrastructure, the natural environment could be impacted. The main impacts anticipated would be dead vegetation, disruption of forest growth as well as short- or long-term habitat loss or loss of plant species conducive to the presence of a number of wildlife species. Wildfires affect the ecological role of forests in all respects: species, stand and landscape. Water quality at affected watercourses may also be impacted by spills of particulate matter and other contaminants into the water.

The severity level is deemed **high**.

ESTIMATED RISK LEVEL

Inclusion of the probability and severity components brings the level of risk for a fire to **moderate**. The risk level is based on risks for workers, the environment and property.

9.3.2.2 EXPOSURE TO IONIZING RADIATION

Nuclear gauges will be used to measure pulp density at the ore treatment plant (concentrator). Between 10 and 15 gauges of different sizes are expected to be used. They will all use gamma rays. This equipment is governed by regulations administered by the Canadian Nuclear Safety Commission.

An incident resulting in exposure to ionizing radiation could occur in the event of a fall or collision involving a nuclear gauge or during a fire.

PREVENTION AND CONTROL MEASURES

The following prevention and mitigation measures will be put in place to reduce the risk of exposure to ionizing radiation:

- periodic leak tests on nuclear gauges;
- securing of gauges by double fastening to a fixed and supporting structure;
- installation of gauge protection from shocks;
- identification of nuclear gauges using notices in compliance with regulations;
- application of radiation safety manual requirements;
- preventive maintenance of gauges to prevent breakage and premature wear;
- training for the fire brigade and certification for firefighters as first responders in the event a nuclear gauge breaks;
- continually updated emergency response plan comprising a procedure for an incident involving a nuclear gauge.

PROBABILITY OF OCCURRENCE

Accidental exposure to ionizing radiation may occur in exceptional circumstances. This is a very unlikely event. As a result, the probability of occurrence is deemed **very low**.

SEVERITY

Exposure to ionizing radiation could cause injury to exposed workers, up to and including permanent disability. The severity level is therefore deemed **high**.

ESTIMATED RISK LEVEL

Inclusion of the probability and severity components brings the level of ionizing radiation exposure risk to **moderate**. The risk level is based on risks for workers.

9.3.2.3 DUST EMISSIONS

Dust will be released during crushing and conveyance operations.

The ore processing plant will be equipped with dust extractors, where required, to control emissions of dust into the air. However, a breakdown or improper handling could lead to the accidental emission of dust into the air.

PREVENTION AND CONTROL MEASURES

The following prevention and mitigation measures will be put in place to reduce the risk of exposure to dust:

- preventive dust extractor maintenance;
- monitoring of pressure inside filters;
- channelled dust extraction system;
- water spray in tailing handling areas and on roads;
- inspection program.

PROBABILITY OF OCCURRENCE

Dust emission and exposure could occur during the facility's operation. This is therefore a probable incident. As a result, the probability of occurrence is considered **moderate**.

SEVERITY

Such emission is likely to affect the health of nearby workers. Spodumene is the most likely product to be emitted, but it is not highly toxic.

Dust emitted in manoeuvring and handling areas may reduce visibility. Environmental impacts will be limited to the property. Vegetation around manoeuvring and handling areas could be affected locally. The severity level is therefore considered **low**.

ESTIMATED RISK LEVEL

The inclusion of the probability and severity components brings the level of dust exposure risk to **moderate**. The risk level is based on risks to workers and the environment.

9.3.3 WATER TREATMENT PLANT

A WTP will be built **when deemed necessary to the east of the main water management pond**, in the northern part of the site. It will be designed to treat **all drainage water from the site that is collected in the main water management pond**, when its quality does not meet regulatory criteria.

A water treatment system malfunction could cause the accidental discharge of harmful substances into the final effluent. A discharge of untreated or partially treated mine water could contaminate stream CE2 waters and violate the MDMER and D019. This non-compliant discharge could be due to a design or operation flaw, human error or mechanical failure.

PREVENTION AND CONTROL MEASURES

The following prevention and mitigation measures will be put in place to reduce the risk of non-compliant discharge into the final effluent:

- verification of treatment effectiveness through periodic analyses;
- ongoing pH and turbidity monitoring: instrumentation connected to the site automation network, available in the plant control room.

PROBABILITY OF OCCURRENCE

A non-compliant discharge into the final effluent could potentially occur, as this has already happened at similar sites. The probability of occurrence is therefore considered to be **low**.

SEVERITY

Spills of substances harmful to the environment could impact animal and/or plant species over an area that extends beyond the site.

Potential impact on wetlands

The discharge of raw (untreated) effluent will have a potential impact on the quality of CE2 stream waters.

Potential impact on benthic fauna

The potential effects on the benthic community would be contamination potentially leading to mortality, decreased benthic abundance and diversity, as well as lower recruitment (eggs and larvae), food consumption and growth rates.

Potential impact on fish fauna and its habitat

Fish may ingest very toxic substances and transmit them to the predators that eat them. A hazardous material spill in an aquatic environment may seriously hinder the next generation of fish.

Generally speaking, fish populations can be affected by a spill at different times of the year if their habitat or their prey is affected in terms of reproduction, rearing, feeding, migration and wintering.

Fish capable of moving within their habitat and potentially relocating to an environment less exposed to contaminants in the event of a spill are less likely to feel the effects of such an event, except during the reproduction and egg incubation period.

The severity level is therefore considered **high**.

RISK LEVEL

The inclusion of the probability and severity components brings the level of risk of non-compliant discharge into the final effluent to **moderate**. The risk level is based on risks to the environment.

9.3.4 STORAGE AND USE OF PETROLEUM PRODUCTS

During the construction phase, diesel will be supplied by truck. There are no plans to install a diesel tank.

Three diesel tanks will then be used, each with an 80,000 L capacity. Installation of these tanks is expected to happen in the southeastern part of the industrial sector. These tanks will be above ground. Annual diesel consumption is expected to be 14.8 million litres.

Fuel will be delivered by tanker trucks. Table 9-6 shows the diesel characteristics.

Table 9-6 Diesel characteristics

Product	State	Flash point (°C)	Self-ignition temperature (°C)	Flammable limits		Reactivity	Classification
				LFL	UFL		
Diesel	Liquid	>40	>225	0.7	6	Strong oxidizers and strong acids	

Produced during the distillation of oil, diesel is composed of various hydrocarbons in series C_{10} and higher. It is a clear, yellow liquid. It is not very volatile at ambient temperature, but may emit vapours that form an explosive mix with the air when heated. Diesel is less dense than water (density of 0.85) and is water-insoluble.

The danger of flammability associated with flammable products is related to:

— the product's emission into the air in proportions found within the flammability range;
— the presence of an ignition source.

Diesel is not currently listed in the *Environmental Emergency Regulations* (EER) as a substance with potential to cause a major technological accident. However, it is listed in an amended version of this regulation. The stated threshold quantity is 2,500 metric tonnes. The quantity expected to be stored is therefore lower than this threshold.

Hydraulic and lubricating oils as well as greases will also be used. These oils are hydrocarbons and come from a fairly heavy petroleum fraction. This means they are viscous and have high flash points.

This section covers the potential risks associated with the transportation, storage and use of petroleum products. Three accident scenarios have been identified:

— spill of petroleum products;
— fire and/or explosion of petroleum products;
— spill of oils and greases.

9.3.4.1 SPILL OF PETROLEUM PRODUCTS

Factors likely to cause an accidental spill of petroleum products include mainly:

— an accident during transport of a petroleum product by truck on the site;
— a collision causing a fuel tank failure (vehicle, machinery or other);
— a leak from a valve, pipe or connection;
— a machinery breakdown;
— corrosion of equipment;
— overflow of a tank or another container during filling;
— human error.

PREVENTION AND CONTROL MEASURES

The following prevention and mitigation measures will be put in place to reduce the risk of petroleum product spills.

During the construction phase

— Ensure that a sufficient number of emergency kits for the recovery of petroleum products and chemicals are available in sensitive locations.
— Through frequent inspections, ensure that machinery is in good working order (clean with no contaminant leaks) and that fuel and lubricant tanks are perfectly sealed. Any discovered leaks require immediate repairs to the tank in question.
— The usual precautions should be taken during maintenance (draining, greasing, etc.) and refuelling of machinery on site to avoid any accidental spills. Maintenance is to be permitted only in authorized locations intended for that purpose (garage, mechanical workshop); refuelling is to take place in specifically designated areas.
— Equip all fixed equipment containing oils and/or fuel (e.g. lighting tower, generator, crusher, sifter, etc.) located less than 60 m from a watercourse or body of water with a leakproof recovery system. Equipment must be equipped with absorbents for quick and effective response in the event of an accidental spill.
— Prohibit any vehicle and machinery maintenance outside the designated areas.
— Mark out access, paths and work areas before undertaking work, and prohibit parking and movement of machinery and vehicles outside those areas.
— Machinery fuel will be supplied by ground transportation. All suppliers must comply with the *Transportation of Dangerous Goods Act* and the *Regulation respecting hazardous materials*. They will be required to develop safety and emergency procedures.

- The contractor will be required to hold a permit for the use of high-risk petroleum equipment if installing or using an aboveground tank with a capacity of 10,000 L or more of diesel fuel or a tank with a capacity of 2,500 L or more of gas. This permit comes with inspection and servicing obligations.

During the operation phase

- Transfer, equipment and tank areas will be designed in compliance with regulations, standards, applicable codes and industrial best practices.
- Tanks will be installed on a concrete slab.
- The tanks will be double-walled with a secondary containment tank that can hold 110% of the stored volume.
- A level detection system will be installed in fuel tanks: an instrument panel showing the tank level to prevent overfilling and confirm the integrity of the double wall.
- A petroleum product receiving and distribution procedure will be developed.
- Tanks and related equipment will undergo preventive maintenance against breakage and premature wear.
- Workers responsible for bulk petroleum hydrocarbon transfer and handling will be trained.
- Spill kits containing absorbents will be available near transfer and handling points.
- A regular inspection schedule will be established for petroleum product transfer and storage locations.
- The emergency response plan will include a procedure for responding to spills of petroleum products.

PROBABILITY OF OCCURRENCE

A spill of petroleum products, regardless of the quantity spilled, may occur multiple times during the life of the mine. As a result, the probability is considered **high**.

SEVERITY

A spill of petroleum products in a containment tank or on a waterproof surface, such as a concrete slab, will have no effects once cleaned up.

In the event of an uncontained spill of petroleum products, the product could drain into the ground under the effects of gravity and accumulate in a depression. In a worst-case scenario, which is highly unlikely, the spill could reach a wetland or the creek CE3.

A spill of petroleum products could also cause a fire if the oil slick is ignited. This scenario is explored in the next section.

Although potentially major, this type of spill would be controlled at the site of the incident, given the prevention (double-walled tanks, containment system, etc.) and response (spill kit and means of containment) measures in place. The affected environment may include soil, a wetland or, at worst, a watercourse, depending on the location of the spill. The severity level may vary from low (soil) to **moderate** (wetland or watercourse).

ESTIMATED RISK LEVEL

The inclusion of the probability and severity components brings the risk of a petroleum products spill to **moderate**. The risk level is based on risks to the environment.

9.3.4.2 FIRE AND/OR EXPLOSION OF PETROLEUM PRODUCTS

Petroleum products may catch fire in the diesel storage area or during transport and distribution.

PREVENTION AND CONTROL MEASURES

The following prevention and mitigation measures will be put in place to reduce the risk of fire and/or explosion of petroleum products:

- design of transfer, equipment and tank areas in compliance with regulations, standards, applicable codes and industrial best practices;

- installation of tanks on a concrete slab;
- fuel tank level detection: an instrument panel showing the tank level to prevent overfilling and confirm the integrity of the double wall;
- development of a petroleum product receiving and distribution procedure;
- preventive maintenance of tanks and related equipment against breakage and premature wear;
- training of workers responsible for bulk petroleum hydrocarbon transfer and handling;
- training of a fire brigade;
- assessment of risks and compliance of petroleum product transfer and storage locations as part of internal inspections;
- dedicated water reserve for fire protection;
- update of an emergency response plan comprising a fire response procedure.

PROBABILITY OF OCCURRENCE

A fire or even an explosion involving petroleum products could occur in exceptional circumstances, such as during a fire near petroleum product tanks or if fuel ignites during a spill. As a result, the probability of occurrence is considered **very low**.

SEVERITY

Fire

If petroleum product tanks catch fire, the fire is not very likely to spread to nearby infrastructure given their location. Therefore, the only impacts would be on the people present, on infrastructure and on vegetation due to the heat release.

Explosion

An explosion is a physical phenomenon leading to the significant release of energy in a very short amount of time in the form of high-pressure, high-temperature gas production. It is a wave of excessive pressure accompanied by projection effects (blasts) and/or thermal effects (heat emission). The impact distances are difficult to assess because they depend on the topography, the presence of obstacles and/or buildings and the quantity of explosive substance involved.

An explosion of petroleum products may cause flammable materials to ignite due to the thermal effect or the projection of burning debris. In such a case, the impacts on environmental components as well as the prevention and control measures will be those set forth in the preceding section.

However, this type of incident could lead to permanent disability, or even loss of human life, within the impact radius as well as significant damage to nearby buildings and infrastructure, requiring an interruption in production and causing considerable economic losses.

With respect to environmental impacts, vegetation near the explosion site (petroleum product storage area) could be destroyed by the heat. Further away from the explosion site and in the absence of fire, the potential impacts on vegetation will be related to blast and projection effects. As for the wildlife within the impact perimeter, the potential outcome would be injuries or even death.

The severity level is therefore considered **very high**.

ESTIMATED RISK LEVEL

The inclusion of the probability and severity components brings the risk of a petroleum product fire and/or explosion to **moderate**. The risk level is based on risks to workers and property.

9.3.4.3 SPILL OF OILS AND GREASES

A spill of petroleum products such as lubrication oils and greases could occur. The causes could be an equipment failure, operator error or an equipment spill.

PREVENTION AND CONTROL MEASURES

The following prevention and mitigation measures will be put in place to reduce the risk of spills of oils and greases:

— design of transfer, equipment and tank areas in compliance with regulations, standards, applicable codes and industrial best practices;
— containment systems for spills in storage, distribution and usage areas;
— environmental protection and awareness training for workers;
— availability of spill kits containing absorbents near transfer and handling points;
— update of an emergency response plan comprising a petroleum product spill procedure.

PROBABILITY OF OCCURRENCE

An oil and grease spill is not very likely given the prevention measures in place. However, it may occur. The probability of occurrence is considered **low**.

SEVERITY

The severity level for the natural environment is considered **low** given the quantities involved, the fact that these products are used and stored in buildings and the mitigation measures in place. The impact will therefore be highly localized.

ESTIMATED RISK LEVEL

The inclusion of the probability and severity components brings the risk of an oil or grease spill to **low**. The risk level is based on risks to the environment.

9.3.5 PROPANE STORAGE AND USE

This section covers the risks associated with the storage and use of propane.

Propane is planned to be used for the workers' camp heating system and the emergency heating system of buildings in the administrative and industrial sector.

A tank is expected to be installed next to the camp. The tank will have a capacity of 113,562 L. Annual consumption is expected to be 1,250,972 L. Table 9-7 shows the propane characteristics.

Table 9-7 Propane characteristics

Product	State	Flash point (°C)	Self-ignition temperature (°C)	Flammable limits		Reactivity	Classification
				LFL	UFL		
Propane	Liquefied gas	-103	430	2.1	9.5	Strong oxidizers, chlorine dioxides	

Propane is a flammable, explosive liquefied gas. It is a substance that appears on the list of hazardous materials in the MDDELCC guide with potential to cause a major technological accident. It is also an EER-regulated substance. However, since the threshold quantity is 4.5 metric tonnes and the density of propane is approximately 2.01 kg/m^3, the threshold will not be exceeded.

Two accident scenarios have been identified:

- propane tank fires;
- propane vapour cloud formation.

9.3.5.1 PROPANE TANK FIRES

Propane leaks caused by a broken flexible hose, broken pipes or a vehicle colliding with the tank could result in a fire or explosion of the tank. A building or forest fire could also cause a propane fire/explosion.

PREVENTION AND CONTROL MEASURES

The following prevention and mitigation measures will be put in place to reduce the risk of a propane tank fire:

- facilities in accordance with CSA B149.2-05 (Propane Storage and Handling Code);
- installation of shock protection devices around tanks, aboveground pipes and related equipment;
- area surrounding propane tanks free of combustible materials, vegetation, debris, etc.;
- ground under propane tanks sloped toward the periphery to avoid the accumulation of combustible liquid under the tank in case of accidental leakage;
- qualified propane supplier;
- training of workers responsible for propane transfer and handling operations;
- portable fire extinguishers located near tanks;
- update of emergency response plan including an accident response procedure for incidents involving propane.

PROBABILITY OF OCCURRENCE

A propane tank fire/explosion could occur in an exceptional situation. The probability of occurrence is considered **very low**.

SEVERITY

The exposure of a propane tank to flame leads to a rise in tank pressure, a weakening of the tank walls and rupture resulting in a fireball, a shock wave and projection of fragments. The situation develops very fast. Such an incident could lead to loss of life and significant damage to the surrounding infrastructure, leading to a major operations interruption and economic loss.

The severity level is therefore considered **very high**.

ESTIMATED RISK LEVEL

The inclusion of the probability and severity components brings the risk level for a propane tank fire/explosion to **moderate**. The risk level is based on risks to workers and property.

9.3.5.2 PROPANE VAPOUR CLOUD FORMATION

Propane vapour cloud formation could occur because of a propane leak in a pipe or valve due to equipment failure. The vapours are likely to concentrate to explosive levels. The explosive range for propane is 2.4% v/v to 9.5% v/v.

PREVENTION AND CONTROL MEASURES

The following prevention and mitigation measures will be put in place to reduce the risk of propane vapour cloud formation:

- facilities in accordance with CSA B149.2-05 (Propane Storage and Handling Code);
- installation of shock protection devices around tanks, aboveground pipes and related equipment;

- ground under propane tanks sloped toward the periphery to avoid the accumulation of combustible liquid under the tank in case of accidental leakage;
- qualified propane supplier;
- training of workers responsible for propane transfer and handling operations;
- update of emergency response plan including an accident response procedure for incidents involving propane.

PROBABILITY OF OCCURRENCE

Propane vapour cloud formation could occur in an exceptional situation. The probability of occurrence is considered **very low**.

SEVERITY

A flammable propane vapour cloud formation could result in a fire and/or explosion causing loss of life and significant damage to the surrounding infrastructure, leading to major operations interruption and economic loss. The severity level is therefore considered **very high**.

ESTIMATED RISK LEVEL

The inclusion of the probability and severity components brings the risk level for propane vapour cloud formation to **moderate**. The risk level is based on risks to workers and property.

9.3.6 STORAGE AND USE OF NON-PETROLEUM PRODUCTS

Table 9-8 lists the main products used, how they are stored and quantities expected. Table 9-9 shows product characteristics.

This section covers the potential risks associated with the transportation, storage and use of non-petroleum products. An accident scenario was identified, i.e. a chemical spill.

Accidental chemical spills may occur during the transportation, use, handling or storage of these products. Equipment failure or human error can also cause a spill.

Table 9-8 Main products used

Product	Use	Storage method	Annual quantity used (t)	Maximum quantity stored (t)
Ferrosilicon	Added to the DMS process to separate spodumene	One-ton bags, stored outside next to the DMS product warehouse	845	200
Hydrated lime	Added during production stoppages to prevent corrosion in the DMS process	20 Kg bags, stored on pallets in the DMS product warehouse	40	10
Flocculant	Added to the thickeners to precipitate suspended solids before recycling the water back into the DMS system	Inside the DMS product warehouse	2	0.5

Table 9-9 Characteristics of main products used

Product	Characteristics			
	State	Colour	Reactivity	Classification
Ferrosilicon	Solid (granulated)	Grey	Releases flammable gas on contact with water (hydrogen) Oxidizing agent	 
Hydrated lime (calcium hydroxide)	Solid	Colourless or white	Reacts violently in the presence of strong acids, maleic anhydride, nitro-alkanes, phosphorus, ammonium salts, hydrides, nitrides, sulphides and peroxides. It attacks certain metals (aluminum, copper, zinc and certain steels).	
Sulfamic acid	Solid in crystal form	White	Incompatible with acids, chlorine, fuming nitric acid. Becomes corrosive when wet. Reacts quickly with alkalis and metals.	 

PREVENTION AND CONTROL MEASURES

The following prevention and mitigation measures will be put in place to reduce the risk of chemical spills.

Storage

Storage will respect the compatible product classes defined by the Workplace Hazardous Materials Information System (WHMIS) as well as the *National Fire Code* (NFC) and *Regulation respecting hazardous materials.*

Storage areas will be established, and storage conditions will take into account incompatibilities between products.

Secondary containment systems at transfer points will be designed to contain the worst-case spill scenario. Containment volume will be established for each chemical reagent delivered in bulk, based on transfer rates and supplier recommendations.

All used and non-reusable chemicals will be stored for up to one year in accordance with the *Regulation respecting hazardous materials.* Used hazardous materials will be recovered by companies authorized to recover the products concerned. Secure collection areas with specialized waste disposal and hazardous materials containers separated by category will be provided at appropriate locations, depending on the production site. Temporary storage areas will be inspected on a regular basis and all employees will be instructed as to their use to avoid mixing errors or overfilling.

Handling

Chemicals will be employed in accordance with supplier instructions as well as applicable regulations. When handling chemicals, wearing appropriate protective equipment is mandatory (e.g. safety glasses or goggles, chemical resistant gloves [neoprene, butyl rubber, rubber or leather], appropriate protective clothing [e.g. full face mask]). Equipment required in critical areas will be indicated by posters. They will also be defined beforehand in a health and safety program. National Institute for Occupational Safety and Health (NIOSH)-approved respirators may also be required to reduce worker exposure to dust and/or fumes when handling certain chemicals.

Training

Employees responsible for the handling and transportation of hazardous materials will have first undergone specialized handling and related hazards training, such as Transportation of Dangerous Substances, WHMIS or other appropriate instructions. Employees must be informed about the contents of the hazardous products material safety data sheets.

Transport

It is expected that chemicals will be transported to the site by truck. Transportation arrangements will comply with the *Transportation of Dangerous Substances Regulation* and the Transportation of Dangerous Substances Guide (MTMDET, 2017). Hazardous products will be placed in compliant, leak-proof containers to minimize the risk of a spill if they are tipped over by the carrier.

Response equipment

Spill response kits, customized to the type and quantity of substance, will be placed at strategic locations on the site (storage and refuelling areas). The contents of the kits will be checked periodically.

Emergency showers and eyewash fountains will also be installed where chemicals are used.

Emergency response plan

An emergency response plan will be developed and updated. It will include response strategies in the event of a chemical spill.

PROBABILITY OF OCCURRENCE

A chemical spill is unlikely due to existing safety measures. However, it could occur as it has on similar sites. The probability of occurrence is considered **low**.

SEVERITY

In the case of a chemical spill, the product, if not contained, could reach the ground by gravity and accumulate in a depression. It's unlikely that it could reach a waterway. The level of severity on the environment is therefore considered low due to the quantities involved, the fact that the products will be used and stored in buildings and the existing mitigation measures. The impact would therefore be very localized.

However, in the case of a spill:

- Ferrosilicon, when in contact with water, emits a flammable, highly explosive and toxic gas: phosphine (or hydrogen phosphide).
- Lime, with its very basic pH, poses a risk to aquatic life if it reaches a watercourse.
- Sulfuric acid's highly acidic pH poses a risk to aquatic life if it reaches a watercourse.

The impact level is considered **high** because of the reactivity of ferrosilicon.

ESTIMATED RISK LEVEL

The inclusion of the probability and severity components brings the risk level for chemical product spills to **moderate**. The risk level is based on risks to workers and the environment.

9.3.7 EXPLOSIVES HANDLING AND STORAGE

Pit blasting will be carried out using an emulsion explosive consisting of ammonium nitrate, fuel oil and surfactant. Storage will be at three sites: the explosives warehouse (ammonium nitrate), the emulsion warehouse and the detonator warehouse.

The expected amounts of explosives used are:

- detonators: 27,000;
- ammonium nitrate: 159 kg;
- emulsion: 76.5 kg.

A specialized supplier will be responsible for the procurement, operation and maintenance of the explosives transfer site.

This section covers the risks associated with explosives. Two hazards that can lead to major accidents have been identified:

- explosion of explosive material;
- theft of explosive material.

9.3.7.1 EXPLOSION OF EXPLOSIVE MATERIAL

An accidental explosion could occur due to an accident involving a transport vehicle, an explosives warehouse fire or a poorly controlled blast.

PREVENTION AND CONTROL MEASURES

The following prevention and mitigation measures will be put in place to reduce the risk of aboveground explosions.

Use

- To prevent negligence or error, the handling and use of explosives will be entrusted to an authorized and specialized supplier.
- Workers handling explosives must hold an explosives certificate issued by the Sûreté du Québec.
- Heat sources and open flame and other pyrotechnic or flammable materials will be removed before a spill clean-up, because an explosive can explode when located near a fire source.
- Specific controls will be put in place to check drill hole dimensions, depth and direction as well as the charges.
- Weather conditions (e.g. rain, wind) can influence the effectiveness of an explosion. If water is present in the blast holes, the detonation will not be as effective as in dry weather. Some of the explosives, such as ammonium nitrate, could also be converted into a nitrogen oxide vapour, a toxic gas. Thus, the blasting schedule will be based on weather conditions to reduce the risk of faulty blasting and to protect workers.
- Blasting must comply with the requirements of the *Regulation respecting occupational health and safety in mines* (R.S.Q., c. S-2.1 r.14).
- Signs prohibiting smoking will be posted in the explosives assembly facility and within the blasting zone.
- Particular attention will be paid to emissions when wet explosives are detonated or in the event of faulty blasting in order to not impact worker health and the environment.

Storage

Storage facilities and explosives preparation management will also be the responsibility of a specialized contractor. Contractors must ensure that:

- Storage methods (location, distance, size, etc.) will comply with applicable provincial and federal provisions, including the *Regulation respecting hazardous materials* (R.S.Q., c. Q-2, r.32), Explosives Regulatory Division (ERD) quantity-distance principles and the *Guidelines for Bulk Explosives Facilities* (NRCan, 2014).
- Explosives are stored in warehouses. They will be secured to prevent unauthorized personnel from trespassing and will comply with provincial and federal explosives laws (R.S.Q., c. E-22 and R.S.C., c. E-17) regarding construction standards, safety distances from site facilities, protection measures, well-ventilated areas and areas protected from moisture.
- The products used are clearly identified.
- Emulsions and detonators are stored separately.

Transport

Explosives will also be transported by a specialized supplier as specified in the *Regulation respecting hazardous materials*. Vehicles used to transport explosive agents will be marked, and the people transporting explosives will have the necessary training and skills.

PROBABILITY OF OCCURRENCE

An explosion could occur, but in exceptional circumstances; thus, the probability is considered **very low**.

SEVERITY

Ammonium nitrate is used in explosives and is accompanied by gas emissions, namely carbon dioxide (CO_2), nitrogen (N_2), hydrogen (H_2), nitrogen oxides (NO_x), sulfur dioxide (SO_2) and carbon monoxide (CO). Under normal operating conditions during blasting, none of these gases represent health risks to workers. However, nitrogen oxide vapours from burning ammonium nitrate are extremely toxic.

An explosion is a physical phenomenon leading to the significant release of energy in a very short amount of time in the form of high-pressure, high-temperature gas production. It is a wave of excessive pressure accompanied by projection effects (blasts) and/or thermal effects (heat emission). The impact distances are difficult to assess because they depend on the topography, the presence of obstacles and/or buildings and the quantity of explosive substance involved.

A petroleum product or explosive material explosion may cause flammable materials to ignite due to the thermal effect or the projection of burning debris. In such a case, the impacts on environmental components as well as the prevention and control measures will be the same as a fire situation.

Such a situation would result in serious injury or in a worst-case scenario, loss of life. Depending on the location of the explosion, it could also have a significant impact on property and bring operations to a halt for around a month.

Vegetation near the site of the explosion could be destroyed by the heat. Further away from the explosion site and in the absence of fire, the potential impacts on vegetation will be related to blast and projection effects. As for the wildlife within the impact perimeter, the potential outcome would be injuries or even death. It is expected the number of feeding areas and shelters will decrease when habitats are disturbed. Finally, the water quality could also be affected by the introduction of debris and contaminants.

The severity level is considered **very high**.

ESTIMATED RISK LEVEL

The inclusion of the probability and severity components brings the risk level for an explosion of explosive material to **moderate**. The risk level is based on risks to workers and property.

9.3.7.2 THEFT OF EXPLOSIVE MATERIAL

Stolen explosives could be used for criminal purposes.

PREVENTION AND CONTROL MEASURES

The following prevention and mitigation measures will be put in place to reduce the risk of explosive material theft:

— explosives deliveries supervised at all times;
— maintenance of inventory records for explosives and detonators;
— warehouses located in enclosed areas.

PROBABILITY OF OCCURRENCE

Explosive material theft could occur, but in exceptional circumstances, thus, the probability is considered **very low**.

SEVERITY

Misuse of stolen explosives could result in serious injury and/or loss of life. The severity level is therefore considered **high**.

ESTIMATED RISK LEVEL

The inclusion of the probability and severity components brings the risk level for explosive material theft to **moderate**. The risk level is based on risks to workers and property.

The level of severity could also be considered "very high" in the case of human loss. In order to get the risk level, the severity level must be combined with the probability of occurrence. In this case, the likelihood of the theft of explosives by malicious people who succeed in injuring people is obviously very unlikely; the probability of occurrence is therefore considered "very low". Combined with a high or very high severity of consequences, a very low probability of occurrence results in a moderate level of risk. As the estimate of the risk level therefore remains unchanged, the resulting assessment remains unchanged.

9.3.8 USE OF ELECTRIC TRANSFORMERS

An electrical substation will be built in the area of the treatment plant. A 69/4.16-kV, 10-MVA transformer will be installed. In addition, five 4.16/0.6-kV, 2.5-MVA transformers will be installed on the site. These transformers will contain mineral oil.

The transformers will not contain polychlorinated biphenyls (PCBs).

This section covers the risks associated with the presence of electric transformers. Two hazards that can lead to major accidents are:

— dielectric oil spills;
— a fire or explosion involving a transformer.

9.3.8.1 DIELECTRIC OIL SPILL

Dielectric oil spills could be caused by equipment corrosion, breakage or human error.

PREVENTION AND CONTROL MEASURES

The following prevention and mitigation measures will be put in place to reduce the risk of dielectric oil spills:

— transformer and related equipment preventive maintenance to prevent breakage and premature wear;
— lightning protection;
— a catch basin for transformers containing dielectric fluid;
— an emergency generator at the treatment plant and at the workers' camp;
— update of an emergency response plan including an incident response procedure in the case of a spill.

PROBABILITY OF OCCURRENCE

A dielectric oil spill could possibly occur, because it has already happened at similar sites. However, the probability of occurrence is considered **low**.

SEVERITY

The impact on the environment is considered to be **low** because of a catch basin confining the spill to the incident site.

ESTIMATED RISK LEVEL

The inclusion of the probability and severity components brings the risk level for dielectric oil spills to **low**. The risk level is based on risks to the environment.

9.3.8.2 TRANSFORMER FIRE/EXPLOSION

Transformer fire is a potential risk. Possible causes are contaminated dielectric oil, a short circuit and overheating.

PREVENTION AND CONTROL MEASURES

The following prevention and mitigation measures will be put in place to reduce the risk of transformer fire:

- preventive maintenance of transformers and related equipment to prevent breakdowns and premature wear;
- lightning protection;
- an emergency generator for the workers' camp and drinking water treatment system that will be used in case of a breakdown so as to avoid interruptions in production;
- update of an emergency response plan comprising a fire response procedure.

PROBABILITY OF OCCURRENCE

A transformer fire could occur as this has already happened at similar sites. The probability of occurrence is therefore deemed **low**.

SEVERITY

An explosion could result in the projection of debris causing serious injury and damage to equipment and infrastructure. The risk is therefore deemed **high**.

ESTIMATED RISK LEVEL

The inclusion of the likelihood and severity components brings the level of risk of a transformer fire and/or explosion to **moderate**. The risk level is based on risks to workers.

9.3.9 ACCUMULATION AREAS

Accumulation areas **will be provided to hold organic matter and unconsolidated deposits as well as waste rock and tailings. A stockpile for organic matter and unconsolidated deposits will be set up in the northern part of the project site. Four additional stockpiles for waste rock and tailings will be set up: two to the north of the creek CE3 and two to the south of this watercourse. Runoff will be pumped and redirected to a main water management pond, located to the north of the organic matter and unconsolidated deposit stockpile.**

A runoff collection pond **will also be set up to the east of the east waste rock and tailings stockpile. This intermediate pond will collect part of the runoff before it is pumped into the main pond** (Map 9-1).

This section addresses the risks associated with the accumulation areas. The risks are:

- stockpile collapse;
- failure of a retaining dike.

9.3.9.1 STOCKPILE COLLAPSE

An unstable stockpile slope could cause the materials to collapse (slide) outside the containment area. The instability could be caused by extreme weather or errors and omissions during construction.

PREVENTION AND CONTROL MEASURES

The following prevention and mitigation measures will be put in place to reduce the risk of stockpile collapse:

- hydrogeological and geotechnical studies will be carried out;
- a slope stability analysis will be carried out;
- a monitoring program will be implemented.

PROBABILITY OF OCCURRENCE

The stockpile could collapse but this is unlikely. The probability of occurrence is therefore deemed **low**.

SEVERITY

Since there will be dikes around the stockpile containment areas, the collapse of a stockpile would have little or no effect on infrastructure (buildings, power lines, roads, etc.), with the exception of the road between the accumulation areas. The presence of workers at the time of the collapse would, however, increase the severity of the incident. The severity level is therefore deemed **high**.

ESTIMATED RISK LEVEL

The inclusion of the likelihood and severity components brings the level of risk of a stockpile collapse to **moderate**. The risk level is based on risks to workers.

9.3.9.2 FAILURE OF A RETAINING DIKE

A retaining dike could fail as a result of:

— extreme weather (heavy flooding, very heavy rains, strong winds, etc.);
— an earthquake;
— errors or omissions during its construction;
— ageing of the structure.

PREVENTION AND CONTROL MEASURES

The following prevention and mitigation measures will be put in place to reduce the risk of dike failure:

— an analysis of dike failure risks and potential consequences will be carried out;
— retention structures will be designed according to the criteria of the Canadian Dam Association and the *Dam Safety Act* and its regulation;
— geological and hydrogeological studies, including dike stability, will be carried out;
— dike design will take into consideration seismic data for the area;
— the dike designer's operating guide will be carefully followed at all times;
— an inspection and maintenance program will be implemented for the retention structures;
— monitoring instrumentation will be used;
— an emergency response plan laying out a response procedure in the event of dike failure will be kept up to date.

PROBABILITY OF OCCURRENCE

Collapse could occur but this is extremely unlikely. The probability of occurrence is therefore deemed **very low**.

SEVERITY

Dike failure could result in heavy property damage and the release of contaminants (suspended solids, leachate, residual reagents, debris, etc.) into the environment, thus violating the MDMER and D019.

A failure in the **main water management pond** retaining dike would affect environmental components north of the site, particularly in the vicinity of the creek CE2 and subsequent watercourses to the north.

An analysis of dike failure risks and potential consequences will be carried out following completion of the project's detailed engineering. This study will make it possible to define areas where human and biological environments would be affected.

However, at this stage, the risk is deemed **very high** for the environmental components.

It should be noted that the runoff collection pond set up to the east of the east waste rock and tailings stockpile will most often be empty, or nearly empty, because this pond will be a transfer point, where a pump will redirect water into the main water pond. So, the risk that this dike will fail is low. If this dike were to fail, it would impact the creek CE4.

ESTIMATED RISK LEVEL

The inclusion of the likelihood and severity components brings the level of risk of a retaining dike failure to **moderate**. The risk level is based on risks to workers, the environment and property.

9.3.10 ROAD TRANSPORT

This section covers the risks associated with road use, particularly Billy-Diamond highway. Two accident scenarios have been identified:

- an accident involving hazardous materials;
- an accident involving a truck carrying spodumene concentrate.

9.3.10.1 ACCIDENT INVOLVING HAZARDOUS MATERIALS

Hazardous materials and other chemicals will be transported by tank trucks and 53-foot closed trucks. An accident involving hazardous materials on Billy-Diamond highway could be the result of a spill from a tank truck carrying petroleum products (diesel, gasoline) or chemicals. The causes can be:

- loss of vehicle control by the driver due to poor weather, **an animal on the road,** human error or a health issue;
- collision with another vehicle.

PREVENTION AND CONTROL MEASURES

The following prevention and mitigation measures will be put in place to reduce the risk of hazardous material spills on the road:

- Drivers assigned to transport hazardous materials **will have received training on the transport of hazardous materials (THM). Drivers will also be made aware of the risks related to the use of the Billy-Diamond highway as well as the risks related to winter driving and night driving and must respect the number of hours of transport applicable**.
- A preventive maintenance program will be put in place to prevent vehicle breakdowns and premature wear.
- The emergency response plan will include a procedure for road spills.

Also, Billy-Diamond highway is designed according to the MTQ standards for heavy truck transport.

PROBABILITY OF OCCURRENCE

Hazardous materials could spill on the road as this type of situation has already happened. It is, however, unlikely. The probability of occurrence is therefore deemed **low**. **Indeed, if we consider a driver (regardless of the load), the probability that he loses control of his vehicle (malaise, human error or collision with another vehicle) to the point of releasing his load is considered low. This type of accident happens once or less in the professional life of a driver.**

SEVERITY

The severity of the incident will depend on the product involved and location of the spill. Depending on its location, the spill could reach a watercourse or just contaminate the soil.

Spill in a terrestrial environment

Some of the product will seep into the soil until it encounters an impermeable layer or an area saturated with water such as an aquifer. The proportion of product flowing versus the amount that infiltrates depends on the permeability of the soil and the characteristics of the spilled product. Some compounds of the spilled product may eventually escape into the air. Upon contact with groundwater, some of the product is also likely to dissolve.

The magnitude of the effect in a terrestrial environment will depend, among other things, on the time of year, weather, characteristics of the spilled product, amount spilled and the depth of its penetration into the soil.

Potential impact on vegetation

A hazardous materials spill would probably affect vegetation in the following manner:

- foliage depigmentation, patches on leaves, decrease in density, stem height and number of leaves on the stem;
- alteration of plant reproduction strategy;
- mortality of exposed vegetation;
- loss, over time, of habitat or plant species favourable to the presence of several species of wildlife.

Potential impact on wetlands

In the event of a hazardous material spill in wetlands, the product would come into contact with plants, sediment and the underlying soil. A spill in such an environment would harm the ecosystem, i.e. aquatic fauna and flora, including the loss over time of habitats or plant species favourable to the presence of wildlife. It would also lead to the use of complex rehabilitation techniques and subsequently, wetland replacement. The cost of wetland rehabilitation is high and depends mainly on the volume of product spilled, reaction time and effectiveness of the response strategies. The environmental impact will depend on the ecological value of the affected wetland.

Potential impact on terrestrial fauna and avifauna and their habitats

Hazardous material spills can cause health problems for any animal that comes in direct or indirect contact with the product. Mammals, reptiles and bird species that come into direct physical contact with the spilled product may, depending on the product, suffer skin and eye damage or chemical burns that may result in death.

Animals affected by the spilled product may experience reproductive problems due to disease or interference with normal breeding patterns. Birds may see a reduction in the number of eggs laid and their thickness. In general, mammalian and bird populations can be affected by a land spill if their habitat or prey is affected in terms of reproduction, juvenile rearing, feeding and/or wintering.

However, mammals and birds capable of moving within their habitat and relocating to an environment less exposed to contaminants in the event of a spill are less likely to feel the effects of such an event.

Potential impact on herpetofauna and its habitat

Herpetofauna populations associated with land environments may be affected by this type of spill if their habitat or prey is affected in terms of reproduction, juvenile rearing, feeding and/or wintering.

The herpetofauna group has a limited ability to move and has a harder time relocating to an environment that is less exposed to contaminants in the event of a spill. These animals are therefore more likely to feel the effects of such an event, especially during reproduction, egg incubation and larval stages.

The potential effects on herpetofauna are:

- mortality of individuals that came into contact with the product;
- lower egg and larva production;
- deterioration in the quality of breeding and feeding sites, as well as shelters.

Spill in an aquatic environment

As previously mentioned, if a hazardous material spills on the ground, it will flow under the effect of gravity and could reach a watercourse. The environments likely to be affected would then be the hydrous environment as well as benthic fauna, fish and their habitats.

Potential impact on hydrous environments

Several watercourses and bodies of water are present along the routes to the site.

Petroleum products are mostly insoluble in water. When they are poured in water, they spread to the surface where they form an oily film or fall to the bottom in the case of heavy oil products. Chemicals are mostly soluble in water and are rapidly diluted. In all cases, alteration of water quality is expected, including sediment contamination.

Potential impact on benthic fauna and its habitat

The potential effects on the benthic community would be contamination potentially leading to mortality, decreased benthic abundance and diversity, as well as lower recruitment (eggs and larvae), food consumption and growth rates.

Potential impact on fish and their habitat

Fish and shellfish may ingest toxic substances and transmit them to the predator that eats them. A hazardous material spill in an aquatic environment may have a dire impact on the next generation of fish and shellfish.

Generally speaking, fish populations can be affected by a spill at different times of the year if their habitat or prey is affected in terms of reproduction, hatching, feeding, migration and wintering.

Fish capable of moving within their habitat and potentially relocating to an environment less exposed to contaminants in the event of a spill are less likely to feel the effects of such an event, except during the reproduction and egg incubation period.

Severity level

In light of the foregoing, the severity level is deemed **high**.

ESTIMATED RISK LEVEL

The inclusion of the likelihood and severity components brings the level of risk of a hazardous material spill on the road network to **moderate**. The risk level is based on risks to the environment.

9.3.10.2 ACCIDENT INVOLVING A TRUCK CARRYING ORE CONCENTRATE

The spodumene concentrate will be transported by a closed semi-trailer truck. Moving trucks carrying spodumene could lead to road accidents with spodumene spills.

The causes can be:

- loss of vehicle control by the driver due to poor weather, **an animal on the road,** human error or a health issue;
- collision with another vehicle.

PREVENTION AND CONTROL MEASURES

The following prevention and mitigation measures will be put in place to reduce the risk of hazardous material spills on the road:

- drivers assigned to transport hazardous materials will be trained;
- a preventive maintenance program will be put in place to prevent vehicle breakdowns and premature wear;
- the emergency response plan will include a procedure for road spills.

Also, Billy-Diamond highway is designed according to the **MTQ** standards for heavy truck transport.

PROBABILITY OF OCCURRENCE

A spodumene spill on the road network could occur. It is, however, unlikely. The probability of occurrence is therefore deemed **low**.

SEVERITY

Such an incident could lead to injuries that do not cause disability but temporary discomfort through inhalation. The effects on the natural environment will be at the site of the spill. Since it is solid, spodumene will spread only if it reaches a watercourse, in which case it will tend to settle at the bottom. The severity level is therefore deemed **low**.

ESTIMATED RISK LEVEL

The inclusion of the likelihood and severity components brings the level of risk of a spodumene spill on the road network to **low**. The risk level is based on risks to workers and the environment.

9.3.11 RISKS ASSOCIATED WITH EXTERNAL HAZARDS

9.3.11.1 FOREST FIRES

There have been several forest fires near the project site in the past. Forest fires can be the result of human activity but lightning is the main cause.

PREVENTION AND CONTROL MEASURES

The following prevention and mitigation measures will be put in place to reduce the consequences of a forest fire:

— the peat will be removed down to the mineral soil over a 35 m radius around the processing facilities, mine water treatment unit and explosives warehouse;
— the site will be cleared;
— a periodic inspection program will be implemented;
— personnel will be educated about forest fires;
— an agreement will be made with SOPFEU;
— SOPFEU will provide periodic advice concerning fire hazards;
— there will be a dedicated water reserve for fire protection;
— a water supply network with a fire hydrant will be installed;
— a fire brigade will be formed and trained in fighting forest fires;
— an emergency response plan comprising a procedure for responding to forest fires will be kept up to date.

PROBABILITY OF OCCURRENCE

Given the history of forest fires in the project area, the probability of occurrence is deemed **high**.

SEVERITY

A forest fire threatening the facilities could result in serious firefighter injury as well as heavy damage to infrastructure if it were to catch fire. However, these risks will be reduced due to the mitigation measures in place.

The effects on the environmental components will vary depending on the magnitude of the fire and its spread.

Potential impact on vegetation

There are several types of fires with different effects on land vegetation:

— crown fires burn trees up their entire length to the top. These are the most intense and dangerous vegetation fires;
— surface fires burn only surface litter and humus. These are the easiest fires to extinguish and those that cause the least forest damage;

— ground fires (sometimes called underground or subsurface fires) occur in deep accumulations of humus, peat and similar dead vegetation that become dry enough to burn. These fires move very slowly but can become difficult to fully put out or suppress. Occasionally, especially during prolonged drought, such fires can smoulder all winter underground and then emerge at the surface again in spring.

In the event of fire, the anticipated impacts are vegetation mortality, disturbance in the evolution of the forest and loss over time of habitats or plant species favourable to the presence of several species of wildlife. In forests, wildfires have an ecological influence at all levels: species, stand and landscape.

Potential impact on terrestrial fauna and avifauna and their habitats

Fires affect populations of terrestrial and avian species, whose need for cover and food forces them to move as the type of forest changes. Highly dependent on the vegetation in its habitat, terrestrial wildlife responds to fire by evacuating and avoiding the area during the fire and following changes in vegetation cover.

In the event of fire, the effects on terrestrial and avifauna are potential mortality during juvenile rearing, a reduction in the availability of foraging areas and shelter when habitats are disturbed and egg destruction during nesting season.

Potential impact on hydrous environments

A fire can alter water quality by adding particulate matter and other contaminants to the water and allowing them to spread.

Potential impact on herpetofauna and its habitat

Fires affect herpetofauna populations, whose need for cover and food forces them to move as the type of forest changes. Highly dependent on the vegetation in its habitat, herpetofauna responds to fire by evacuating and avoiding the area during the fire and following changes in vegetation cover.

In the event of fire, the potential effects on herpetofauna are mortality, egg destruction during the incubation period and a reduction in the availability of foraging areas and shelter when habitats are disturbed.

Severity level

In light of the foregoing, the severity level is deemed **moderate**.

ESTIMATED RISK LEVEL

The inclusion of the likelihood and severity components brings the level of risk of a forest fire threatening the facilities to **high**. The risk level is based on risks to persons, property and the environment.

9.3.11.2 EXTREME WEATHER

Unusual or extreme weather could occur, including strong winds, heavy snowfalls and ice storms, among others.

PREVENTION AND CONTROL MEASURES

The following prevention and mitigation measures will be put in place to reduce the risks associated with extreme weather:

- infrastructure will be designed in accordance with applicable laws, regulations and codes;
- the camp will be equipped with generators;
- spare electrical equipment will be kept on site;
- an emergency response plan laying out an evacuation procedure for mine personnel will be developed.

PROBABILITY OF OCCURRENCE

Although extreme weather could occur, it is highly unlikely. Consequently, the probability of occurrence is deemed **very low**.

SEVERITY

The consequences of such weather can vary but could go as far as heavy damage to infrastructure and damage to Hydro-Québec's 450-kV line or to the internal line, depriving the site of power for a long time and seriously disrupting activities. Such a situation could require evacuation of workers from the mine to ensure their safety.

The severity level is therefore deemed **high**.

ESTIMATED RISK LEVEL

The inclusion of the likelihood and severity components brings the level of risk for extreme weather to **moderate**. The risk level is based on risks to persons, property and the environment.

9.3.12 RISK SUMMARY

The technological risks identified in the preceding sections are summarized in Table 9-10.

9.4 PRELIMINARY EMERGENCY RESPONSE PLAN

An emergency response plan is an essential tool to ensure a quick and effective response in an emergency. A preliminary plan has been developed. Presented in Appendix K, it contains:

- a list and description of events considered as high and very high risk;
- the roles and responsibilities of the stakeholders;
- the phone numbers of the main external stakeholders;
- the alert and mobilization procedures;
- the emergency response procedures;
- the evacuation procedures;
- the return to normal process.

The emergency plan will be known to internal stakeholders, updated annually, quickly accessible in an emergency and easy to consult.

Response measures will be in accordance with applicable regulations and industry best practices. When required, this plan will be revised and adapted to any new activity on the site.

9.5 CORPORATE POLICY

GLCI is firmly committed to limiting environmental impacts resulting from the development of mineral resources, while building a successful business that fully assumes its responsibilities in the communities where it operates.

This commitment is put into practice daily by integrating the social, economic and environmental dimensions to the company’s decision-making process and through the ongoing respect of the interests of other stakeholders in its activities.

In its environmental policy, GLCI plans to conduct its activities in a manner that respects the environment and all applicable regulations and to implement a management system that will ensure that the highest environmental standards possible are applied to its products, services and processes. In its health and safety policies, GLCI wants to take all possible and feasible measures to ensure the health and safety of its employees and other members of its personnel directly or indirectly involved in the project by eliminating all occupational injuries and diseases. GLCI guarantees that no business objectives will compromise safety.

Table 9-10 Summary of risk analysis results

Activity	Scenario	Probability of occurrence	Severity level	Risk level
Extraction pit	Pit flooding	Low	High	Moderate
	Falling rocks and landslides	Low	High	Moderate
Ore processing	Fire	Low	High	Moderate
	Exposure to ionizing radiation	Very low	High	Moderate
	Dust emission	Moderate	Low	Moderate
Storage and use of petroleum products	Spill of petroleum products	High	Moderate	High
	Fire/Explosion of petroleum products	Very low	Very high	Moderate
	Spill of oils and greases	Low	Low	Low
Propane storage and use	Fire	Very low	Very high	Moderate
	Propane vapour cloud formation	Very low	Very high	Moderate
Chemical storage and use	Chemical spill	Low	High	Moderate
Explosives storage and handling	Explosion of explosive material	Very low	Very high	Moderate
	Theft of explosive material	Very low	High	Moderate
Use of electric transformers	Dielectric oil spill	Low	Low	Low
	Fire/explosion	Low	High	Moderate
Mine water treatment	Non-compliant discharge into final effluent	Low	High	Moderate
Accumulation area	Stockpile collapse	Low	High	Moderate
	Failure of a retaining dike	Very low	Very high	Moderate
Road transport	Hazardous material spill	Low	High	Moderate
	Ore concentrate spill	Low	Low	Low
External hazards	Forest fire	High	Moderate	High
	Extreme weather	Very low	High	Moderate