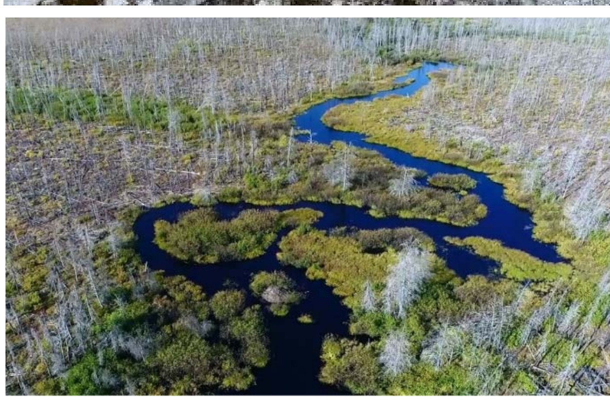
JAMES BAY LITHIUM MINE

ENVIRONMENTAL IMPACT ASSESSMENT

CHAPTER 4: PROJECT DESCRIPTION

JULY 2021 (VERSION 2)



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4 PROJECT DESCRIPTION

This chapter presents the various infrastructures and technologies proposed for the project. This description takes into account the optimizations that were made to the project described in the 2018 EIA.

4.1 MINERAL DEPOSIT

4.1.1 CHARACTERISTICS OF THE DEPOSIT

The pegmatites found on the property are from the Lower Eastmain Group of the Eastmain River greenstone belt. In 1975, a geological map of the property was prepared by the **Société de développement de la Baie-James (SDBJ).** It showed that biotite schist and gneisses, together with mafic metavolcanics, dacites, quartzites, meta-conglomerates, meta-gabbros, granites and pegmatites were located on site. In addition, most of the non-intrusive rocks are foliated, striking E-NE, and dipping subvertically. The granites and pegmatites have a more massive appearance. The pegmatites delineated to date are generally parallel to each other and are separated by barren host rock of sedimentary origin, metamorphosed to amphibolite facies (Figure 4-1). An induced polarization and magnetometer survey performed over the property in June 2008 revealed the presence of a diabase dyke.

A total of 18 pegmatite dykes have been found on the property to date, with the potential of additional dykes to be delineated by additional drilling, as based on numerous undefined borehole intersections of pegmatite during the GLCI 2017 drilling program. The mineralization consists essentially of spodumene. Spodumene is a relatively rare pyroxene that is composed of lithium (8.03% Li_2O), aluminium (27.40% Al) and silicon dioxide (64.58% SiO_2). It is found in lithium-rich granitic pegmatites, commonly associated with quartz, microcline, albite, muscovite, lepidolite, tourmaline and beryl. Spodumene is the principal source of lithium found on the project property.

The crystal orientation of the spodumene can be used to identify the orientation of the pegmatites; as the crystal laths are generally perpendicular to the dyke trend or long axis. The SDBJ suggested that the pegmatites intruded in radial fractures emanating from a centre located to the West. It is likely that the spodumene pegmatites are related to a granitic batholith located SW of the property. Spodumene occur as white to greenish prismatic and striated crystals varying from a few millimeters to over 1 meter in length. When it is altered, sericite forms on the surface of the spodumene. As it progresses, the colour changes to brown from the increasing iron oxides adhering to the surface. Spodumene can also alter to a Li-bearing mica in platy aggregates pseudomorphs after spodumene. Microprobe analysis revealed genuine spodumene with the chemical formula: (Li0.99Na0.01) $AlSi_2O_6$, with an iron content of 0.96% (total Fe_2O_3). The SDBJ also identified the major minerals associated with spodumene pegmatites in decreasing order of abundance as: perthitic feldspar, spodumene (25%), quartz, muscovite, apatite, beryl, iron oxides, ilmenite, serpentine, tourmaline and ferrisicklerite or lithiophilite (Li (Mn, Fe) PO_4). It was also revealed that the pale green muscovite contains 0.18% Li_2O.

The available data suggests that the pegmatites on the project property are of the rare-element “class”, the lithium, cesium, tantalum ‘family’ and the albite-spodumene ‘type’ according to the classification of Cerny (1991). Most lithium, cesium, tantalum pegmatites are known to have intruded metasedimentary rocks, typically low-pressure amphibolite to upper green schist facies (Cerny, 1991). Theses pegmatites represent the most highly differentiated and last to crystallizing components of certain granitic melts. Regional zonation of rare metals is generally observed in such pegmatites, resulting from a cogenetic intrusion. This zonation indicates an enrichment of various rare metals in pegmatite dykes as a function of their distance from the cogenetic intrusion.

Spodumene-bearing pegmatites of the project are likely the most differentiated dykes and the most distant from the cogenetic intrusion; the Kapiwak Pluton located to the south of the property (Moukhsil and coll., 2001).

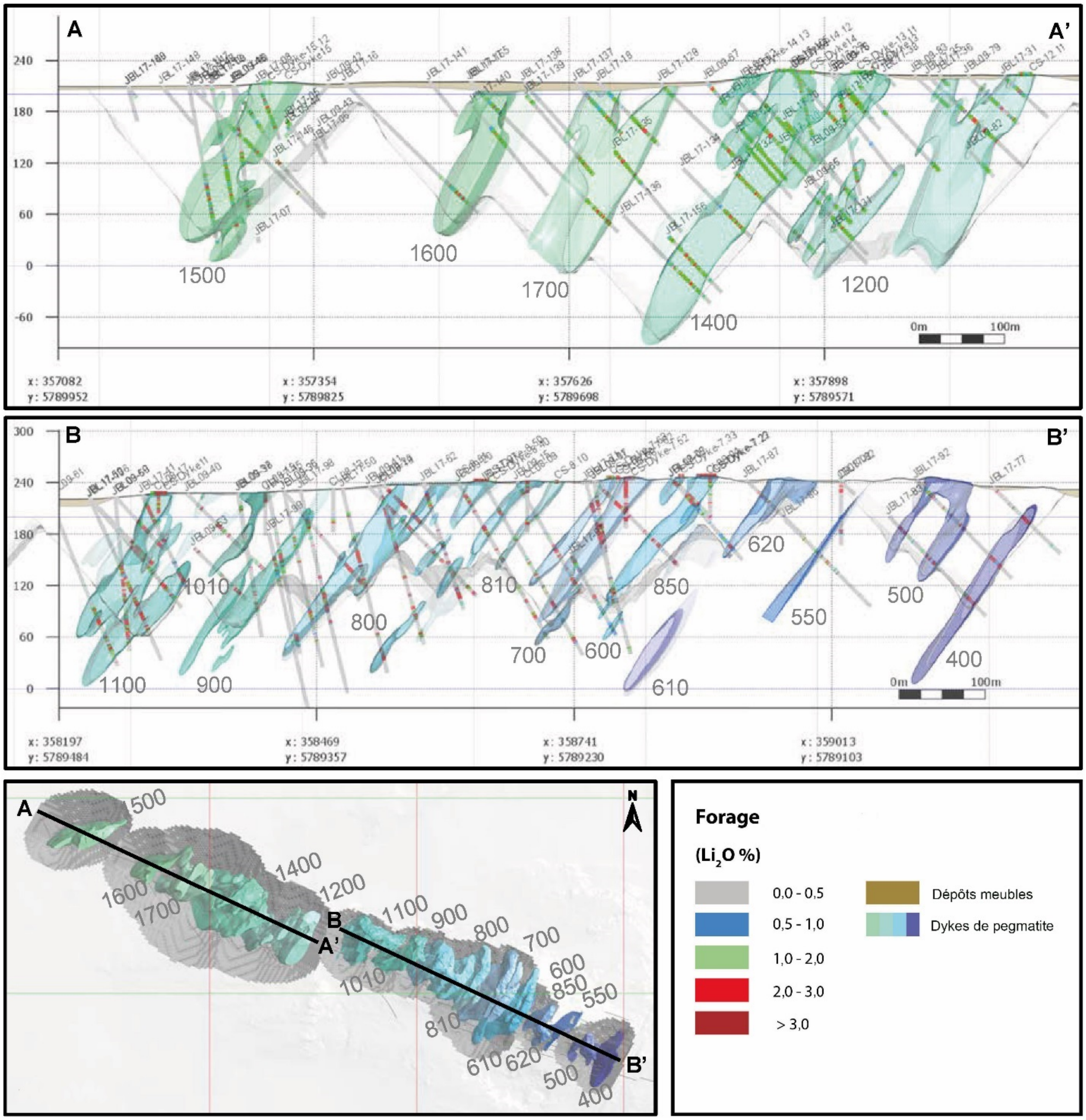


Figure 4-1 Model of pegmatite dykes

Source: SRK, 2018.

Individual pegmatites can form tabular dykes, sills, lenticular bodies, or irregular masses, and most lithium, cesium, tantalum pegmatites show some sort of structural control. Granitic pegmatites are generally more resistant and stands out from its environment, as is the case for the pegmatite in this project. It is easily recognizable due to its pale colour and unusually large crystal size (photo 4-1). The pegmatite dykes of the project are interpreted as being up to 60 m in width and over 200 m in length, generally striking south-southwest and dipping moderately to the west-northwest (215 degrees/60 degrees). Figure 4-2 illustrates a longitudinal view (looking at azimuth 30°) of the pegmatite deposit.

Photo 4-1 Spodumene crystal observed on project property

Source: ***G Mining Services, 2021.***

4.1.2 MINERAL RESOURCES

The mineral resource presented in this section is taken from the **Preliminary Economic Assessment report (G Mining Services, 2021)**. The mineral resource model **prepared by SRK** considers 102 core boreholes from 2008-2009, 53 channel samples from 2009-2010, and 157 core boreholes drilled in 2017.

A three-dimensional model of the main pegmatite dykes was created (Figures 4-1 and 4-2). SRK concluded that the three-dimensional model is consistent with the drilling data. The bodies were modelled from logged pegmatite intervals, not Li_2O grades, as implicitly derived intrusions or vein contact surfaces. The resulting geological model incorporates 18 pegmatite dykes. Block model quantities and grade estimates for the project were classified according to the CIM Definition Standards for Mineral Resources and Mineral Reserves (2014).

SRK considers that the Li_2O mineralization on the project property is amenable to open pit extraction. SRK considers that it is appropriate to report the mineral evaluation at a cut-off grade of 0.62% Li_2O. There is insufficient material below the conceptual open pit shell to support an underground evaluation. SRK (2018) evaluates the indicated resources of the project to 40,330,000 tonnes at a grade of 1.40 % Li_2O.

4.2 MINE SITE GENERAL ARRANGEMENT

The following section highlights the main project components. The mine site consists primarily of the open pit and the adjacent construction quarry, the **stockpiles** for the combined waste rock and tailings (hereinafter the waste rock stockpile), **the overburden and peat stockpile** as well as the industrial and administrative area (Map 4-1). Details of the various project components are found in the following sections of this chapter.

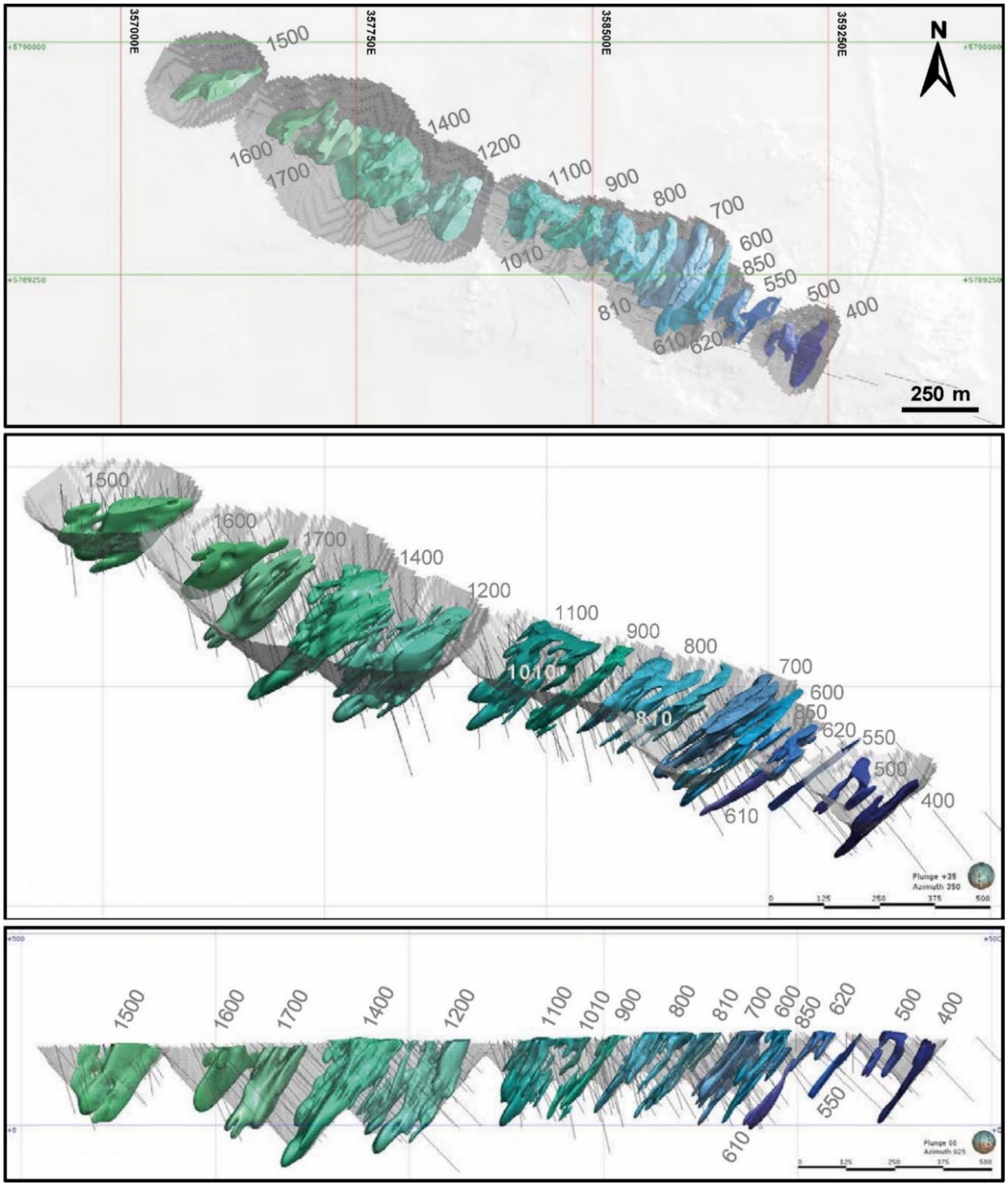


Figure 4-2 Representative cross-sections of pegmatite domains

Source: SRK, 2018.

The industrial and administrative sector includes the ROM pad, the industrial sector, the **mechanical workshop** and warehouses, the administrative buildings and housing.

An explosives storage facility is located at a safe distance from major infrastructure. Finally, there are **roads** for hauling and services.

With respect to water management infrastructure, **the project includes** two water ponds: the **main** one is located **at the northern boundary of the property,** north of the **overburden and peat storage facility, while** the second, **much smaller** one is located **northeast** of the **eastern waste rock and tailings** storage facility (WRTSF). **The water treatment plant (WTP) will be positioned to the east of the north water management pond, if required.** There is **a** clean water discharge **site, to remove water from the north water management pond, which is located in CE2**. For the construction phase, a concrete plant will also be erected **southwest of the plant site**. The site will be converted to a dry storage once construction is complete.

Table 4-1 summarizes the surfaces for each of the infrastructures mentioned in this section, for a total of **289.49** ha.

Table 4-1 Surface Areas of Project Infrastructure

Infrastructure	Area (ha)
Open pit	**51.09**
Waste rock and **tailings** storage facilities (including berms) **- West WRTSF (29.0 ha)** **- North WRTSF (54.4 ha)** **- Southwest WRTSF (31.0 ha)** **- East WRTSF (58.1 ha)**	**172.05**
Overbirden and peat storage facility (including berms)	**25.36**
Industrial and administrative area	**15.13**
Concrete batch plant (construction phase) / Dry storage area (operation phase)	**3.74**
Water treatment plant and pumping stations	**0.65**
Explosives magazine	**0.78**
Roads and ditches	**20.70**
Total	**289.49**

4.3 INDUSTRIAL AND ADMINISTRATIVE AREA GENERAL ARRANGEMENT

The industrial and administrative area includes the following:

- A three-phase crushing circuit (located beside the ROM pad), conveyors and a screening station;
- A crushed material stockpile (in a dome) and reclaim;
- A **dense media separation (DMS)** building (also referred to as the concentrator);
- A storage building for DMS products and chemicals for WTP;
- A tailing thickening reservoir;
- Two **raw** water tanks;

- A tailing loading and stacking station;
- A propane storage area;
- The final product stockpile (spodumene concentrate), in a dome and loadout;
- Various workshops and warehouses;
- A series of administration buildings and laboratory;
- A weighbridge (scale) and gate;
- A high-voltage switchyard;
- A diesel storage area;
- A site-wide fence;
- The worker's camp;
- The residual material building.

Map 4-2 shows the general arrangement of the mine site.

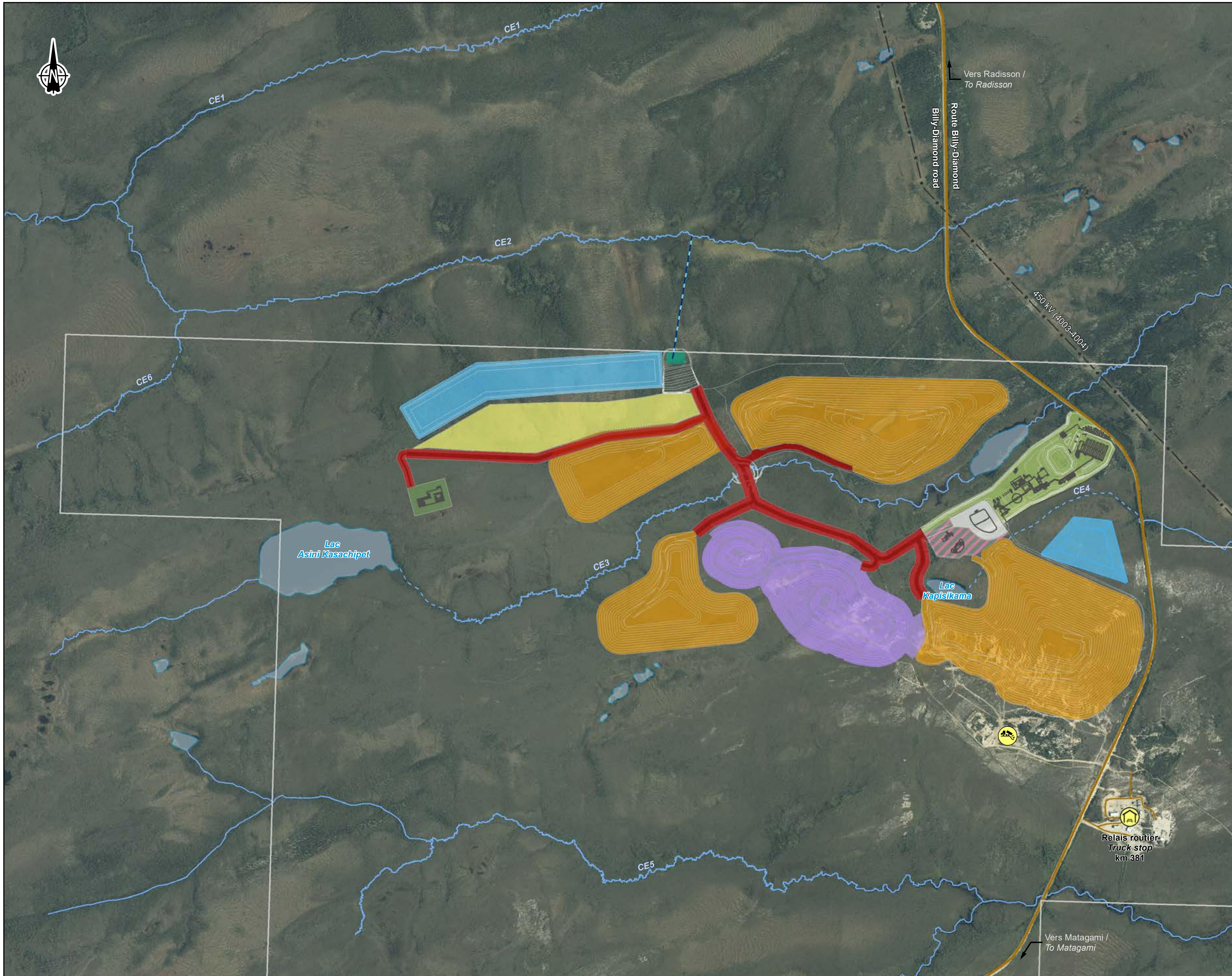
Most of the building foundations will be reinforced concrete. The concentrator building will consist of a steel structure covered by metal plating on the concrete slab and footings. The heavy equipment will be supported by a reinforced heavy-duty foundation.

The workshop and storage buildings will also be included in the DMS building. A two-storey building will be located near the DMS and will include the administrative area, the clinic and the laboratory.

All buildings will be insulated, heated and ventilated. They will include an access door for staff. In addition, the workshop and storage buildings will have a rolling steel door wide enough for a large forklift to pass through.

Some of the plant buildings, with the exception of cold storage facilities, are designed to have a heating-ventilation-air-conditioning (HVAC) system. The HVAC system will be more energy-intensive in the winter, as temperatures can drop to -45°C. Heat from the HVAC units will come from the propane heaters.

The site will be fenced and will include a gatehouse as well as strategically located closed circuit cameras.



Limite de propriété / *Property limit*

Composantes du projet / *Project Component*

- Route / *Road*
- Effluent minier / *Mine effluent*
- Usine de traitement de l'eau / *Water treatment plant*
- Secteur administratif et industriel / *Administrative and industrial sector*
- Fosse / *Pit*
- Halde à minerai / *ROM pad*
- Halde à stériles / *Waste rock stockpile*
- Halde à matières organiques et dépôts meubles / *Overburden and peat storage facility*
- Entrepôt à explosifs / *Explosives magazine*
- Aire d'entreposage / *Dry storage area*
- Usine à béton (temporaire) / *Concrete batch plant (temporary)*
- Bassin de rétention d'eau / *Water retention basin*

Infrastructures / *Infrastructure*

- Route principale / *Main road*
- Route d'accès / *Access road*
- Ligne de transport d'énergie / *Transmission line*
- Relais routier / *Truck stop*
- Lieu d'enfouissement technique isolé / *Isolated technical landfill*

Hydrographie / *Hydrography*

- CE3 Numéro de cours d'eau / *Stream number*
- Cours d'eau permanent / *Permanent stream*
- Cours d'eau à écoulement diffus ou intermittent / *Intermittent or diffused flow stream*
- Plan d'eau / *Waterbody*

GALAXY

Mine de lithium Baie-James / James Bay Lithium Mine

Carte / *Map* 4-1
Aménagement du site minier /
Mine Site General Arrangement

Sources :
Othoimage : Microsoft Bing (ESRI, 2017)
Gestim : MRNF Québec, 210315
Données du projet / Project data : Galaxy 2020

0 200 400 m
UTM, fuseau 18, NAD83

Juillet / *July* 2021

Dessin : A. Masson
Approbation : C. Martineau
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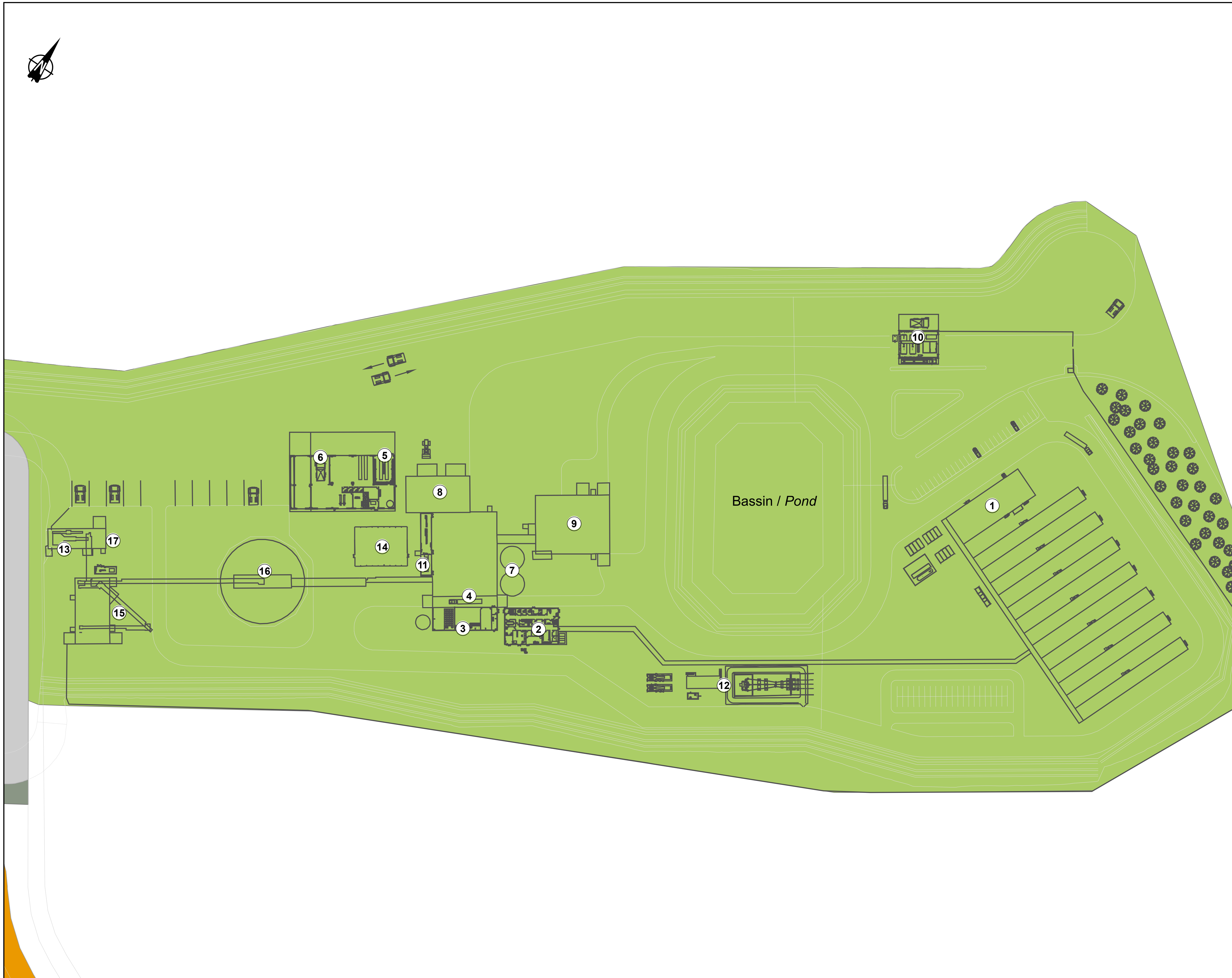

GALAXY

Mine de lithium Baie-James / James Bay Lithium Mine

Carte / *Map* 4-2
Aménagement du secteur industriel et administratif /
Industrial and Administrative Area General Arrangement

Juillet / *July* 2021

Dessin : A. Masson
Approbation : C. Martineau
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4.4 PREPARATORY WORK

Preparatory work consists of all the activities that precede the mining activities. **Site development and facility layout will be within one of the WRTSFs and other areas affected during the life of the mine to reduce the footprint (Map 4-3).** The following subsections describe the tasks included in each activity.

4.4.1 TRANSPORT

Air travel will be the primary means of transportation for workers **who live outside the region**. GLCI will **likely** organize charter flights from **Montreal and the Abitibi region** to the Eastmain airport and provide bus service to and from the site. The **Eastmain** airport is located **130** km away from the project site.

Equipment and supplies will be trucked to the site. Equipment and supplies will be transported through Matagami **via the Billy-Diamond highway**. Minor improvements will be made **to km 382 of the Billy-Diamond highway to improve safety for users**. Turning lanes will be added in to and out of the site at the intersection of the Billy-Diamond highway and the site access road.

4.4.2 LOGISTICS

The worker' camp will be built to house the construction workforce as well as mining, processing, and administration personnel. Most of the buildings to be constructed will be a combination of "flat pack" components which will be assembled into 6 m x 2.6 m modules and containerized accommodation units.

Potable water for the construction camp will be initially trucked onto the site and stored in a potable water tank. Wells will be developed for the operations camp and will be used once they become operational. The same will apply to wastewater treatment. Water management is discussed in detail in Section 4.9.

All equipment and material will be stored on site in laydown areas prior to installation. Contractors conducting work in specific areas will be allocated space for temporary facilities. The location of these areas will be as close as practicable to the workplace and will contain the company-supplied site offices / temporary workshop areas and storage areas (equipment and material). Specific areas will be identified during award of each work package, considering the size and scope of the package and number of personnel. The number of areas established will be minimized to facilitate the provision of services and control traffic into the workplace. All laydown areas are included in the project footprint.

Once the workcamp is built, the contractors will position their trailers in the concrete batch plant area. Mechanical work on machinery will be initially done off-site, then in the MSA, once a leak prevention system is installed. **The mechanical work planned to be done off-site is actually light-duty, minor maintenance mechanical work to avoid having to return to Matagami (which is 381 km away) to do oil changes, tire changes or minor repairs to equipment used for basic site development. This work is scheduled to be performed at the SDBJ truck stop mechanical workshop. As soon as the site's mechanical workshop is set up, all mechanical work will be transferred there. The mechanical workshop is among the first buildings to be set up with the camp. The work added to the truck stop workshop is not significant; the truck stop has the availability to accommodate the few extra trucks and customers. If the SDBJ workshop is overloaded and the GLCI workshop is not ready, equipment requiring minor maintenance will be returned south to Matagami, Rouyn or Val-d'Or for servicing.**

Discussions are currently in progress with the SDBJ to use the km 381 truck stop as an accommodation site to facilitate the construction of the early facilities and initial wings of the worker' camp as well as construction offices and even housing contractors during the operation phase. However, no commitment has been made at this time. As such, if an agreement is not possible the accommodation camp on-site will house the expected 280 workers **during construction**.

4.4.3 QUARRY AND BORROW PITS

Due to the limited amount of construction materials available in the project area, GLCI wishes to use overburden and waste rock for road construction. Contrary to what was planned in the 2018 project, diabase will not be used as a building material. The waste rock will be mined and broken up, then weathered to leach out any metals that may seep for a few weeks. The broken waste rock seepage area will be contained and the water will be collected, monitored and treated if necessary, before being discharged to the environment. For the concrete aggregate, GLCI will purchase its material from a quarry already in operation at km 394.

A sand borrow pit located immediately south of the mine site, west of the truck stop landfill will also be used. However, another borrow pit will have to be opened to meet the sand and gravel requirements. The location of the latter is not known at this time. Potential borrow pits in the area of the mining project were explored in 2019 (Stantec, 2019). Depending on needs, the potential quantities to be mined will be analyzed to validate which site would be the most appropriate. The potential borrow pits pre-identified by Stantec (2019) are located on Map 4-4.

Sandpits are subject to restoration plans defined at the time of their application for authorization under the Environment Quality Act (EQA). Sand pits are generally under non-exclusive permits and their restoration method is included in the operating permit. Each sandpit or portion of a sandpit used will be closed in accordance with the requirements of the permits granted. As part of the sandpit permit applications, surface rights holders, including tallymen, will be involved.

In summary, restoration will be consistent with the objectives specified in Section 38 of the Regulation respecting pits and quarries (RCS), which are:

1. **elimination of unacceptable health risks and ensuring the safety of persons;**
2. **prevention of the release of contaminants that could harm the environment;**
3. **elimination of any long-term maintenance or follow-up;**
4. **restoration of the site to a condition compatible with its future use.**

Revegetation of the sites is the preferred option for restoring the sites to as close to their original condition as possible. As for the access roads, the conceptual restoration plan stipulates that their future will be the subject of consultations with local communities, including the tallyman. They could be vegetated in a natural way to maintain access to the territory for users.

Specific measures for site revegetation are as follows:

- **Select native plant species that are adapted and appropriate to the hardiness zone.**
- **Prevent the introduction of invasive alien species, eradicate them and monitor their presence annually.**
- **Add value to non-commercial wood by chipping them and using them to improve the soil.**

Vegetation-related measures will promote conditions for the recovery of wildlife habitat naturally. The restoration of the borrow pits is also intended to make the areas accessible to the communities again. Finally, at the end of the restoration work, the surface of the borrow pits will be free of any debris, waste, stumps, unusable equipment, machinery or other such clutter.

Limite de propriété / *Property limit*

Composantes du projet / *Project Component*

- Effluent minier / *Mine effluent*
- Route / *Road*
- Bâtiment ou usine / *Building or Plant*
- Secteur administratif et industriel / *Administrative and industrial sector*
- Fosse / *Pit*
- Halde à matière organique et dépôts meubles / *Overburden and peat storage facility*
- Halde temporaire de stockage du minerai / *Rom Pad*
- Agrandissement / *RomPad expansion*
- 1 Bassin de gestion des eaux / *Water management pond*
- 2 Bassin de gestion de la décharge Est / *East dump management pond*
- 3 Bassin / *Pond*
- 4 Bassin / *Rom Pad Pond*

Infrastructures / *Infrastructure*

- Route principale / *Main road*
- Route d'accès / *Access road*
- Ligne de transport d'énergie / *Transmission line*
- Relais routier / *Truck stop*

Hydrographie / *Hydrography*

- CE3 Numéro de cours d'eau / *Stream number*
- Cours d'eau permanent / *Permanent stream*
- Cours d'eau à écoulement diffus ou intermittent / *Intermittent or diffused flow stream*
- Plan d'eau / *Waterbody*

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

Carte / *Map* 4-3
Aménagement du site minier – Année -1 /
Mine Site General Arrangement – Year -1

Sources :
Orthoimage : Galaxy, août / august 2017
General Arrangement, 2020
Données du projet / Project data : Galaxy 2020

0 200 400 m
UTM, fuseau 18, NAD83

Juillet / *July* 2021

Dessin : A. Masson
Approbation : C. Martineau
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Composantes du projet / *Project Components*

- Route d'accès potentielle / *Potential access road*
- Route d'accès existante / *Existing access road*
- Source de matériaux d'emprunt / *Borrow sources*
- Carrière / *Quarry*
- Infrastructures minières / *Mining infrastructure*

Infrastructures / *Infrastructure*

- Route principale / *Principal road*
- Route d'accès / *Access road*
- Ligne de transport d'énergie / *Transmission line*

GALAXY

Mine de lithium Baie-James /James Bay Lithium Mine

Carte / *Map* 4-4
Localisation des bancs d'emprunts et des carrières / *Localisation of Borrow Pits and Quarries*

Sources :
Orthoimage : Galaxy, août / august 2017
Données du projet / Project data : Galaxy, 2020
Banc d'emprunt / Borrow pit, Stantec, 2019

0 350 700 m
UTM, fuseau 18, NAD83

Juillet / *July* 2021

Dessin : A. Masson
Approbation : C. Martineau
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4.4.4 LAYDOWN AND CONCRETE BATCH PLANT

The concrete plant site will be converted to a storage yard during the operation phase. During the construction phase, a mobile crusher and a vibrating conveyor will sort the rocks by size and separate them into different piles. Only the material from the quarry at km 394 will be used in the concrete plant. An aggregate storage area will be located near the plant, within the footprint of the surfaces affected by the mine development. The site will be used to prepare concrete to be poured into the foundations of buildings and tanks in the industrial and administrative sector. Administrative trailers and contractor equipment will also be located in this area.

The locations of the concrete plant and temporary crushing plant are shown on Map 4-1. They are located on a firm plateau southwest of the plant site. The equipment and concrete mixer washing area will be located at the process plant site, within the footprint of the plant pad stormwater management pond. The water that will come into contact with the concrete plant will be directed to a well for the separation of suspended solids and an acid will be added to balance the pH of the water before it is reused as industrial treated water required at the treatment plant.

The mobile concrete plant will be used during the construction phase only. It will operate until the industrial complex and mine infrastructure are built. The machinery required to operate the concrete plant could include truck mixers, a boom truck to handle bags of cement or a loader to feed the plant with sand and crushed stone, and a tank truck to supply the freshwater tank required for cement production.

Contaminated water could come from accidental spills. The collection and decontamination of soil in the event of any accidental spill of petroleum products will be carried out without delay and according to a procedure that will be implemented. In the event of an overflow or spill from the truck wash basin, the site would also be cleaned up immediately. The contaminated material would then be sent for management off-site at a licensed site. Otherwise, there will be no contaminated water discharged or effluent from this plant.

The concrete plant will require a supply of 300 L of water/m^3 of concrete produced. The water will be taken from Lake Kapisikama.

Truck mixers and concrete mixer scuppers will be cleaned with pressurized water in an area reserved for this purpose. No soap will be used. The concrete mixer will be brought forward near a water collection and settling pond, equipped with an oil-water separator. This pond will be approximately 10 m by 10 m. It will be constructed of granular backfill extracted from a quarry for which a permit application to MELCC and MERN will be filed. It will be waterproofed with a membrane made of geotextile and HDPE-40 or equivalent, covered with fine gravel. The water will be checked for TSS, oil and grease, pH before being discharged into the environment. Should the pH exceed 9.5 and TSS exceed 25 mg/L when checked, immediate action will be taken to retain and treat the water before discharging it to the environment or the site drainage system.

Dust collectors will be installed on the cement silos and a dust collection system will be set up at the transfer points.

Aggregate will be kept at the storage area identified on Map 4-1 during the construction phase. Aggregates will be stored in such a way that no particles are released into the environment. For example, they could be placed on a concrete slab or a waterproof membrane. Aggregates could also be covered with a waterproof membrane if they are stored outside (not inside the storage facility).

4.4.5 EARTHWORKS

Site earthworks are required **prior to** construction and mining **operations**, to build roads as well as foundations for various infrastructures. Table **4-2** summarizes the quantities for the main earthworks.

Table 4-2 Earthworks quantities

Activity	Unit	Value
Excavation **of organic material**	m^3	**636,200**
Excavation of granular material	**m3**	**1,100,000**
Final trimming, grading, profiling	m^3	**97,900**
Grading and profiling **of the land**	m^2	**213,000**
Rock excavation	**m3**	**675,000**
Production of aggregate for earthworks	**m3**	**127,070**
Drainage	m	44,030

Source: ***G Mining Services, 2021.***

4.4.5.1 CLEARING AND EXCAVATION

Clearing and grubbing will be done in areas to be excavated, subgrades to fill embankments, subgrades to concrete slabs and foundation structures and subgrades to roads. Typically, clearing will extend a minimum 3 m beyond the work area footprint. Trees, stumps and shrubs will be cut at approximately ground level. All wood and waste will be removed and disposed of in an approved manner. All stumps, roots, vegetation, other organic and topsoil matter below ground level will be moved to the **overburden and peat storage** facility. **The areas to be cleared include all vegetated areas within the project footprint, as well as an additional 50 m around them (35-m fire protection ring and an additional 15 m for machinery movement).** The resulting holes will be backfilled using suitable fill material, compacted to a maximum modified dry density equivalent to that of the surrounding soil. Under embankments, the backfill will also be compacted. Snow and ice cleared off the construction area will be piled outside of the construction area where it will not affect the construction or any constructed elements during thaw.

All soil that is of soft to medium stiffness, is saturated, disturbed or otherwise deemed unsuitable, will be excavated and moved to the **overburden and peat storage** facility. The unsuitable material will be replaced using suitable bulk or select fill material and compacted to a density equivalent to that of the acceptable surrounding soil.

Excavation will be carried out to ensure effective utilization of material for filling. Material classified as suitable for fill in accordance with construction specifications will be stockpiled separately and securely. Excavations that are steeper than the specified batter slopes for the material being excavated will be adequately supported by bracing and shoring to prevent slides, slips, or cave–ins. Bracing and shoring will comply with all requirements of the relevant statutory legislation and regulations for construction safety.

Surface water flows during the melting seasons will be directed away from the works by means of diversion berms, ditches or other acceptable means and all surface flows in the construction sector will be satisfactorily controlled. Adequate drains, sumps, sheet-piling, pumps and other approved means of dewatering will be used as necessary to remove all free water from excavation. Disposal of water removed from excavations is explained in Section 4.9.

4.4.5.2 BACKFILL

Embankment construction and backfill consists of all earthwork operations necessary to place fill materials using excavated or borrow material to the lines and levels shown on the drawings. The fill material will be free any deleterious materials including:

- Vegetation or timber or any other perishable matter;
- Demolition materials including masonry and concrete rubble;
- Organic or unstable soils;
- Expansive soils subject to high volume change.

Prior to placement of fill, the ground surface will be prepared as mentioned above. The stripped surface will be scarified to a depth of 300 mm where practical so the fill material binds into natural ground. The stripped and scarified surface will be proof-rolled and compacted. Material which cannot be compacted to the required standards will be reworked or replaced.

Embankment fill will be used for construction of all embankments which are not intended to support structures. The moisture content of each layer will be controlled to achieve the specific dry density. Moisture content will be adjusted by watering or by setting aside and turning material to dry. The fill will be compacted following engineering recommendations. Select fill will be used adjacent to foundations, footings, walls, etc., which are below grade, beneath all concrete floor slabs-on-grade and where otherwise shown on the drawings. For embankment fill, the moisture content of each layer will be controlled and compacted.

Following placement, compaction, and removal of excess fill, surfaces will receive a final shaping with a grader or excavator to produce a smooth surface and uniform cross-section. Should delays occur in spreading or compacting fill, the previously compacted layer will be scarified, rewatered if necessary, and recompacted. Should a preceding compacted layer become damaged (e.g. by excessive water ingress), the layer will be removed and replaced with suitable material.

4.4.5.3 BORROW PIT MATERIAL TESTING

Prior to being included in the earthworks, all construction materials from **the borrow pit,** including coarse and fine aggregate and granular materials, will be subject to dry sieve analysis and any other testing necessary to ensure compliance. Tests will be conducted upon establishment of **the borrow pit**.

4.4.5.4 DITCHES

Ditches consist of open channel ditches and seepage drains. Open ditches will be constructed at specified intersections. **No waterproofing or geomembrane material is provided. In addition, there will be directed drainage along the entire length of the ditches**. Changes in grade and line will be gradual. Over–excavation which may lead to channel erosion damage at intersections, pipe entries and the like will be minimized, and will be corrected. Rip–rap or other forms of channel protection will be incorporated where specified on drawings.

Seepage drains will be constructed to the specified cross-section using free-draining granular material with typical grain size in the range of 0.1 mm to 200 mm. Free-draining granular material will comprise an open-graded, hard, durable, angular gravelly rock material with particle sizes in the range of 30 mm to 300 mm. Drainage material will be placed on a grubbed and compacted surface. After placement, the drainage material will be covered with a geotextile separation layer.

4.4.5.5 RIP-RAP

Rip–rap will consist of a course of heavy stone, on bedding, laid to protect slopes or drains. Rip–rap will be hard, durable, angular rock having a specific gravity, when dry, of at least 2.5. Typically, rock size will be not less than 150 mm average dimension nor greater than 500 mm average dimension. Bedding, when required, will consist of sound uniform gravel, evenly graded from 5 mm to 50 mm.

Surfaces on which rip–rap is to be placed will be trimmed to a uniform slope. Rip-rap will be placed in a manner which ensures that the larger rocks are uniformly distributed throughout the protection work and the smaller rocks effectively fill the spaces between the large rocks without leaving any large voids. Laying will commence at the toe of the slope and progress upwards, with each stone being firmly embedded into the slope and against the adjoining stones. The rip–rap will be thoroughly **compacted** as the construction progresses, so that the finished surface is tight and uniform and conforms to the design slope.

4.4.6 POWER SUPPLY

Two emergency diesel generators will be required to provide emergency power to the workers' camp and buildings in the event of a loss of utility supply. These units will be installed early to provide the required power for the workers' camp housing. Small generators will be required on an occasional basis, but only temporarily during construction. Earthwork contractors will provide their own generators.

4.4.7 COMMUNICATION **SYSTEM**

A fibre link will be installed from the SBDJ km 381 truck stop to a site data room located adjacent to the communications tower. A two-way radio system will also be provided on a communications tower within the construction camp above the mine and plant site. This facility will be built during the initial phase of construction, to provide radio communications during construction and mine pre-stripping operations. The base unit will be solar powered, with sufficient battery backup to give up to five days operations. Hand-held satellite telephones will also be available for use as required and for emergencies.

4.4.8 FUEL SUPPLY

During the initial phase of construction, diesel will be sourced from the km 381 truck stop. At a later stage, contractors will provide their own fuel tanks to replenish their mobile equipment. In the final construction phase, the diesel farms will be operational and used.

4.4.9 SECURITY

One of the early activities will be to secure site **access** and establish security at the entrance to the site. This will allow site operations to proceed without interruption from the public and will ensure that tools and equipment are secured. GLCI will ensure that an ambulance and infirmary are available on site. Discussion are currently in progress with the SDBJ and the CRSSSBJ to share medical and ambulance services.

4.5 EXTRACTION

According to the present mine plan, approximately **37** Mt of material could be extracted at an average grade of **1.30** % Li_2O and the total waste rock excavation required will be approximately **130** million tonnes (Table 4-3). As presented in Section 4.1.1, the economic material consists of spodumene-bearing pegmatites. Spodumene is composed of lithium oxides (Li_2O), aluminum oxides (Al_2O_3), and silica (SiO_2). The waste rock is composed of metasediment (84.9 **wt** %), banded metasediment (14.0 **wt** %), mafic volcanic (0.9 **wt** %), feldspar porphyry (0.2 **wt** %), and noneconomical pegmatite (0.1 **wt** %). In addition, almost 6 Mt of overburden will be displaced.

Table 4-3 Composition and quantity of waste rock and overburden

Category	Volume (m³)	Tonnage (t)
Total waste rock	**59,047,447**	**129,904,382**
Overburden	**2,900,716**	**5,801,431**
Total	**48,931,856**	**133,260,352**

Source: G Mining Services, 2021

4.5.1 OPEN PIT CONFIGURATION

Pit slopes were designed using a geotechnical model composed of geological, structural, rock mass, and hydrogeological models. The rock mass model of the project is based on a geotechnical drillhole database, composed of 171 diamond drillholes. Fourteen boreholes were drilled specifically for the geotechnical design and were oriented and logged in detail during winter 2018. Stability analyses conducted included kinematic analyses and global slope stability analysis using a limit equilibrium approach. Based on a review of the geotechnical drillhole and rock property testing data, major lithologies were assumed to be geotechnical domains.

The primary focus of the pit slope design is to create a safe and economical design at the bench, inter-ramp, and overall slope scale (Figure 4-**3**). After reviewing and assessing all drillhole and rock property data, material properties were developed using industry-recognized rock mass failure criterion. Slope design sectors were identified and a geotechnical stability assessment was completed for:

— Bench scale using kinematic analysis including planar sliding, wedge sliding, flexural toppling, and direct toppling;

— Inter-ramp angle and height with rock mass classification values and empirical design graphs;

— Overall angle using 2D finite element numerical modelling on seventeen typical sections in various orientations and various parts of the proposed pits.

Based on industry standards, the acceptance criteria for bench stability is a Factor of Safety (FoS) of 1.1 in static conditions. Acceptance criteria for inter-ramp angle and overall angle were selected assuming that the failure consequences would be medium. Typically, a “high” consequence of failure is associated with sensitive infrastructure located near the pit crest (e.g. building, public road). Thus, the following factors were set for safety:

— Inter-ramp angle: 1.2 and 1.0, for static and dynamic failure, respectively;

— Overall angle: 1.3 and 1.05, for static and dynamic failure, respectively.

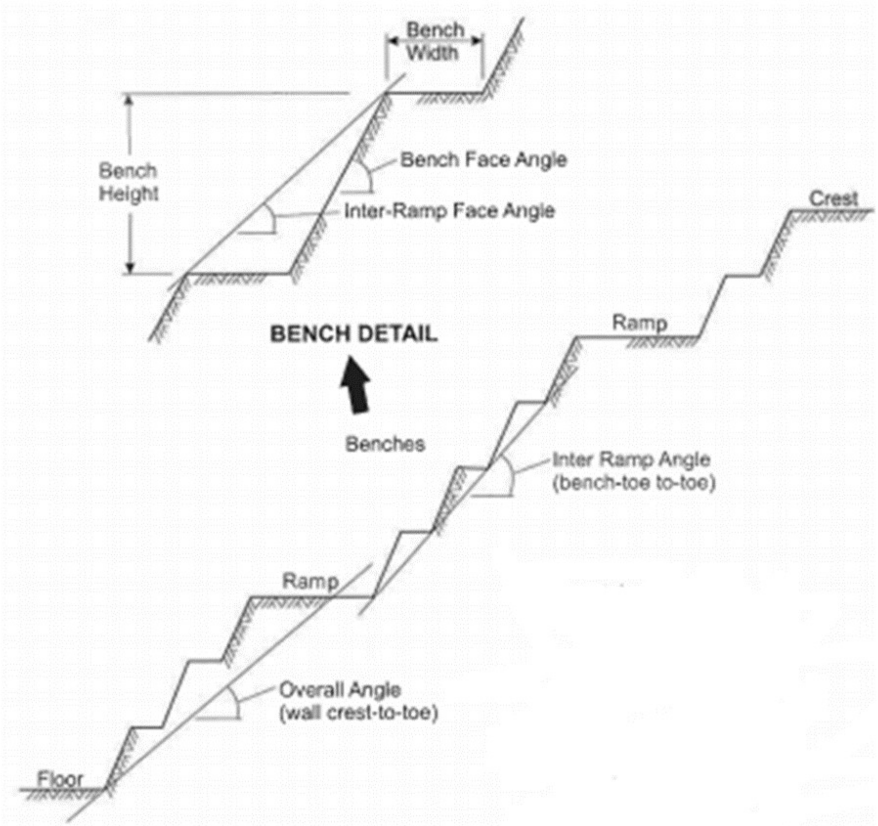


Figure 4-3 Schematic representation of pit geometry

Source: Read and Stacey, 2009.

The bench height was fixed to 10 m with a double bench mining approach, for a combined bench height of 20 m. The recommended bench, inter-ramp angle, overall angle design parameters for the project are presented in Table 4-**4**.

Table 4-4 Pit design criteria

Variable	Value
Bench height (m)	20
Catch bench width (m)	9
Bench face angle (◦)	75
Inter-ramp angle (◦)	54
Overall angle (◦)	48
Note: Maximum bench stack height: To uncouple slopes, incorporate a 20-m haul road or 20 m wide geotechnical bench below slopes greater than 120 m in height.	

Source: Petram, 2018.

The 20 m berms are designed with a 75-degree face angle with 9 m side catch berms. This results in an inter-ramp angle of 54 degrees and, with the addition of a 20 m wide haul road, an overall angle of 48 degrees. The stability analyses conducted by Petram (2018) for all these parameters demonstrated that the geometry respected all the acceptance criteria, both static and dynamic (when applicable). To manage risks associated with rock fall and adverse effects on mining costs and production, careful blasting practices will be adopted for the project. To uncouple slopes, the design till incorporates a 20 m haul road or 20 m wide geotechnical bench below slopes greater than 120 m in height.

A formal system will be developed in operations to maintain clean bench tops and face scaling immediately after blasting and during excavation to assist the management of rock fall hazards to personnel and equipment. The pit configuration will evolve from its initial configuration at Year 1 until the end of the LOM. Maps 4-5 **and 4-6** illustrate the evolution of the mine site for Years **2 and 13**.

4.5.2 MINING METHOD

Typical excavator and truck surface mining will be utilized to extract and transport material. A backhoe excavator was selected over a front-end **loader** as a backhoe provides higher mining selectivity based on the nature of the pegmatite dykes. Backhoe configured excavators were selected as they provide higher productivity and versatility than the front shovel counterpart. The excavator has the added advantage of mining from the bench above without requiring the construction of a ramp.

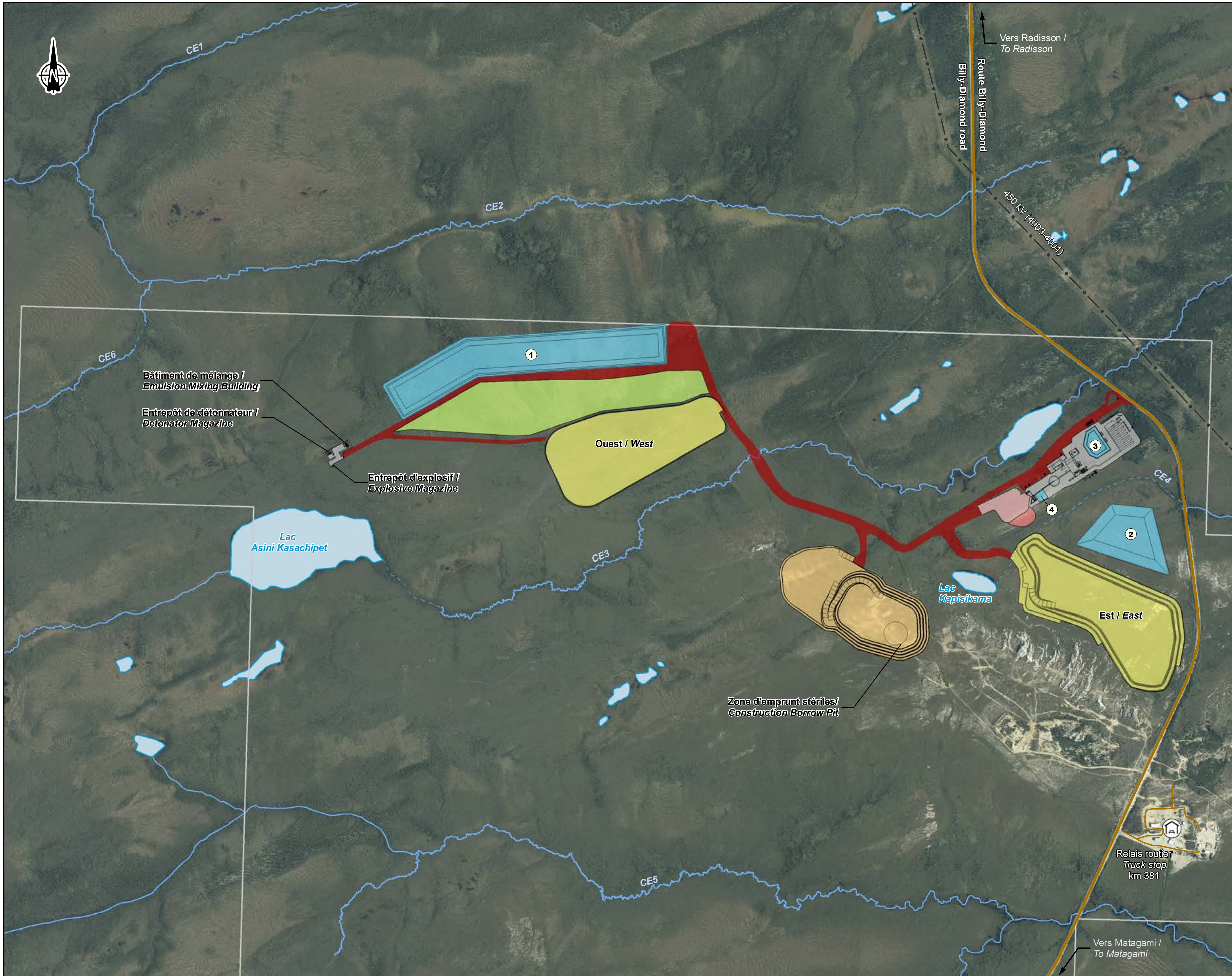
Mining for each bench will start on the hanging wall side of the mineral deposit and progress towards it. Once the material is extracted, remaining waste material on the footwall will be mined out in conjunction with developing an access road for accessing the next bench below. As mentioned in the previous section, the bench will be 10 m high. When vertical dilution is high, the 10 m blast is reduced to 5 m blast for further differentiation.

Material will be sequenced and scheduled utilizing phased pits. This will enable a smooth transition of lower waste stripping during the initial years with a gradual increase later in the mine lifeMaterial will be trucked to the ROM pad. Trucks will transport the ore to the ROM pad located **northeast of the pit**. The overburden and **surface deposits** will be transported by truck and placed in a **specific** stockpile, **as will the waste rock, which will be transported to four separate stockpiles**.

Individual pegmatite swarms (dykes) are narrow in nature and run in the north-east and south-west direction. Deposit will be mined along strike direction (NE, SW) to achieve selective extraction of pegmatite material.

Bulk explosives will be utilized for production blasting. Ammonium Nitrate/Fuel Oil (ANFO) and emulsion explosives will be utilized on a 50/50 volume ratio. During the wet months (May to October), bulk emulsion explosive will be utilized, with the drier months (November to April) utilizing ANFO.

Drill and blast configurations have considered the stand-off distances required to account for fly rock, air blasts, and ground vibrations for buildings and public roads. The mine plan complies with Québec's regulations with respect to maximum of explosives detonated within a fixed time frame and the distance **from** a public or tier infrastructure. Mine design has considered the impact of this restriction with the proximity of the km 381 truck stop. As a result, a small portion of the pit in the south consisting of 2% of the entire ultimate pit volume will require production blasts at 5-m high benches. Drilling will be done on site using diesel powered DTH machines capable of drilling between 89 to 152 mm holes. Blastholes will be drilled at a depth between 5.5 m and 11.5 m (10 m bench with 1.5 sub-drill depth) for all waste rock and for most of the economic material. A small portion of the economic material will have 5.5 m blastholes (5 m bench with 0.5 m sub-drill depth).



Limite de propriété / *Property limit*

Composantes du projet / *Project Component*

- Effluent minier / *Mine effluent*
- Route / *Road*
- Bâtiment ou usine / *Building or Plant*
- Secteur administratif et industriel / *Administrative and industrial sector*
- Fosse / *Pit*
- Halde à matière organique et dépôts meubles / *Overburden and peat storage facility*
- Halde à stériles et résidus minier / *Waste rock tailing storage facility*
- Halde temporaire de stockage du minerai / *Rom Pad*
- Agrandissement / *RomPad expansion*
- 1 Bassin de gestion des eaux / *Water management pond*
- 2 Bassin de gestion de la décharge Est / *East dump management pond*
- 3 Bassin / *Pond*
- 4 Bassin / *Rom Pad Pond*

Infrastructures / *Infrastructure*

- Route principale / *Main road*
- Route d'accès / *Access road*
- Ligne de transport d'énergie / *Transmission line*
- Relais routier / *Truck stop*

Hydrographie / *Hydrography*

- CE3 Numéro de cours d'eau / *Stream number*
- Cours d'eau permanent / *Permanent stream*
- Cours d'eau à écoulement diffus ou intermittent / *Intermittent or diffused flow stream*
- Plan d'eau / *Waterbody*

GALAXY

Mine de lithium Baie-James / James Bay Lithium Mine

Carte / *Map* 4-5
Aménagement du site minier – Année 2 /
Mine Site General Arrangement – Year 2

Sources :
Orthoimage : Galaxy, août / august 2017
General Arrangement, 2020
Données du projet / Project data : Galaxy 2020

0 200 400 m
UTM, fuseau 18, NAD83

Juillet / *July* 2021

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Approbation : C. Martineau
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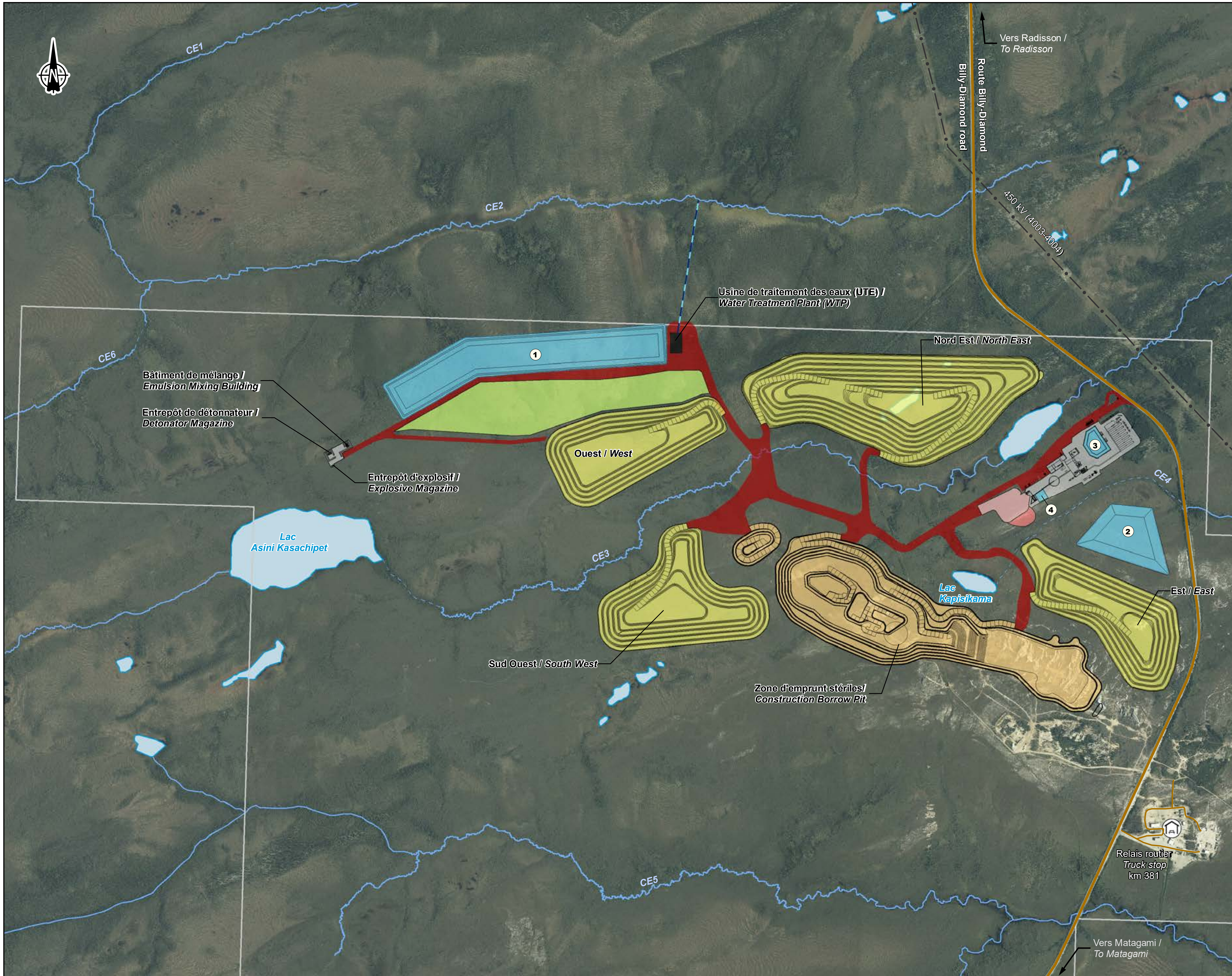

Limite de propriété / *Property limit*

Composantes du projet / *Project Component*

- Effluent minier / *Mine effluent*
- Route / *Road*
- Bâtiment ou usine / *Building or Plant*
- Secteur administratif et industriel / *Administrative and industrial sector*
- Fosse / *Pit*
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- Route d'accès / *Access road*
- Ligne de transport d'énergie / *Transmission line*
- Relais routier / *Truck stop*

Hydrographie / *Hydrography*

- CE3 Numéro de cours d'eau / *Stream number*
- Cours d'eau permanent / *Permanent stream*
- Cours d'eau à écoulement diffus ou intermittent / *Intermittent or diffused flow stream*
- Plan d'eau / *Waterbody*

GALAXY

Mine de lithium Baie-James / James Bay Lithium Mine

Carte / *Map* 4-6
Aménagement du site minier – Année 13 /
Mine Site General Arrangement – Year 13

Sources :
Orthoimage : Galaxy, août / august 2017
General Arrangement, 2020
Données du projet / Project data : Galaxy 2020

0 200 400 m

UTM, fuseau 18, NAD83

Juillet / *July* 2021

Dessin : A. Masson
Approbation : C. Martineau
201-12362-00_c4-6_wspT308_mine_design_yr13_210529.mxd

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Explosive products and blasting accessories will be provided by a third-party contractor. This third-party contractor will be responsible for the storage and blending of explosives on site, and delivery of these products to the drill hole. The contractor will also supply a magazine for blasting caps and accessories, and a separate magazine for boosters and packaged explosive products. Map 4-1 illustrates the proposed location of the explosives magazines.

Equipment fleet requirements are based a hydraulic excavator (backhoe) with a capacity of 7 m^3, loading a **100**-tonne rigid frame haul truck. The size selected for the excavator is the largest that still allows the mine to have two excavators, which are required for the multi-pit operations of the project. The **100**-tonne rigid frame haul truck was chosen for the 7 m^3 excavator because it can be loaded in **6.5** passes **and maintains 75% efficiency in loading cycles, which means that nearly 10 haul trucks can be loaded per hour**. The haul trucks are needed to transport tailings from the industrial sector **to the stockpiles**. A hopper bin will be utilized at the plant to load tailings onto trucks, as required. Given the lower tonnage of tailings and tighter confines of the hopper area, a 40-tonne articulated truck was selected for this task.

Total fuel consumption for the truck fleet over the life of the project is estimated to be 34.3 million litres.

Secondary equipment will **also** be used to directly support the equipment selected for mine production. The following activities will be carried out by secondary equipment:

- Clearing of spilled rock in mucking areas around excavators;
- Grading of in-pit bench areas for efficient work;
- Grading of stockpile platforms and clearing of rock for efficient truck unloading;
- Clearing of drill pads of any fly rock from previous blasts and mining operations to allow for productive drill patterns and for the safe loading of patterns by the blasting crew;
- Grading and clearing of in-pit ramps and surface haul roads with regards to spill rock and snow along with proper road maintenance, i.e. repairing ruts and allowing for the draining of any standing water.

There will also be auxiliary equipment such as pick-up trucks, passenger wagons (busses), dewatering pumps. **All light vehicles, such as vans and buses, will be electric.** Table 4-**5** summarizes the **primary and secondary equipment list (stationary, mobile, heavy-duty, light-duty)** for mining in Year **14**, when the fleet will reach its maximum capacity.

Table 4-5 List of mining equipment – Year 14

Equipment	Quantity
Primary equipment	
100-tonne rigid frame haul truck	9
Hydraulic Excavator (7 m³)	2
Wheel Loader (10.7 m³)	1
Production Drill (101-203 mm)	2
Tracked Dozer (436 HP)	2
Grader (4.26 m)	1
40-tonne Articulated Dump Truck (34 kL tank)	1
Wheel Dozer (496 HP)	1
Auxiliary Drill (114-203 mm)	1
Secondary equipment	
Articulated Dump Truck (45 t)	2
Excavator (49 t)	1
Hydraulic Hammer for the 49 t excavator	1
Emulsion Truck	1
Stemming Loader	1
Utility Wheel Loader	2
28-tonne Crane	1
Telehandler	1
Forklift, 4-tonne lifting capacity	1
Mechanic Service Truck	1
Fuel/Lube Truck	1
Lowboy & Tractor	1
Pickups, crew cab	10
Pit Bus for 15 people	1
Electric Welding Machine	2
Mobile Welding Machine	2
Lighting Tower	4
Genset 6 kW	2
Genset 60 kW	1
Diesel Dewatering Pump (25 cm)	2
Trash Pump (8 cm)	4
Diesel Powered Air Heaters	2

*Source: **G Mining Services, 2021**.*

4.5.3 EXTRACTION SCHEDULE

The pegmatite extraction will follow the concentrator's yearly capacity: **2,000,000 tonnes per year until the year before last**. The last year will complete the production. Table 4-**6** summarizes the extraction schedule.

Table 4-6 Extraction Schedule

Material	X 1000 m³ Ore	Waste Rock	Overburden	X 1000 tonnes Ore	Waste Rock	Overburden	Ore Grade % Li_2O	Stripping ratio (W:O)
A-1	68	664	240	184	1,838	479	0.05	9.99
A1	743	1,814	484	2,007	5,025	968	1.34	2.51
A2	741	2,183	0	2,000	6,046	0	1.39	2.99
A3	749	1,858	415	2,022	5,148	830	1.36	2.50
A4	762	1,908	329	2,057	5,286	657	1.37	2.64
A5	741	2,161	7	2,000	5,986	14	1.33	2.43
A6	913	1,908	126	2,464	5,284	252	1.08	2.64
A7	741	1,932	324	2,000	5,353	647	1.31	2.68
A8	741	2,816	525	2,000	7,800	1,049	1.30	3.90
A9	741	3,049	96	2,000	8,445	191	1.30	4.22
A10	730	3,259	1	1,971	9,027	2	1.26	4.56
A11	741	3,196	74	2,000	8,852	148	1.25	4.43
A12	589	3,397	0	1,591	9,409	0	1.22	5.91
A13	657	3,330	0	1,775	9,225	0	1.12	5.20
A14	715	3,274	0	1,930	9,070	0	1.15	4.70
A15	741	2,438	123	2,000	6,754	246	1.31	3.38
A16	741	2,514	160	2,000	6,964	319	1.27	3.48
A17	741	2,166	0	2,000	6,000	0	1.36	3.00
A18	741	2,560	0	2,000	7,092	0	1.35	3.54
Last year	334	470	0	902	1,301	0	1.37	1.44

Source: ***G Mining Services, 2021***.

The overburden and waste rock extraction schedule follows the mining plan developed. The volume of waste rock excavated averages **2,345,000 m³** per year, with a maximum of **3,397,000 m³** at Year **12** and a minimum of **470,000 m³ last year**. The volume of overburden excavated varies between **1,000 to 525,000 m**³ per year. **The extraction schedule does not include mining of overburden for several production years (years 2, 12, 13, 14, 17, 18 and 19).**

The material extraction calculations assume a specific gravity of 2.7 (mean result of the pycnometry assays performed on 30 pegmatite samples) while waste tonnage is calculated using a specific gravity of 2.77 (mean value of the pycnometry assays done on 62 waste rock samples), all lithologies combined. Overburden tonnage is calculated using a specific gravity of 2.0. The specific gravities presented are for in situ material (before excavation).

The grade of the feed material ranges from **0.05-1.39%** Li_2O, for an average of **1.28%** Li_2O.

Waste rock tonnage averages **6,495,000** tonnes per year with a maximum of **9,409,000** tonnes at Year **12** and a minimum of **1,301,000 tonnes last year**. The LOM's average stripping ratio **ranges from 1.44-9.99**. The overburden and topsoil tonnage averages **290,000** tonnes per year.

Table 4-**7** presents the explosives yearly consumption schedule with a distinction between the consumption from May to October (inclusively) and November to April.

Table 4-7 Explosives consumption

	Explosives Consumption (tonnes)		
Year	May-Oct.	Nov.-Apr.	Total
Y1	1,014	401	1,415
A2	1,289	1,276	2,565
A3	1,218	1,206	2,424
A4	1,586	1,568	3,154
A5	1,766	1,745	3,512
A6	2,229	2,201	4,430
A7	2,229	2,201	4,431
A8	2,251	2,223	4,474
A9	2,422	2,391	4,813
A10	2,430	2,399	4,829
A11	2,387	2,356	4,743
A12	1,715	1,695	3,411
A13	1,250	1,237	2,488
A14	968	960	1,928
A15	808	802	1,610
Last year	1,062	1,050	2,112
Rest of LOM	n.d.	n.d.	n.d.
Notes: The detailed mine extraction schedule is provided for the first 15 years only.			

Source: WSP 2018a.

4.5.4 ROCK TRANSPORTATION

Ore and waste rock will be transported on several haul roads shown on Map 4-1. The haul roads will be 25 m wide and will be on a foundation acceptable for heavy machinery to support the proposed 100 tonne haul trucks. The trucks will exit the pit via one of three ramps: JB1, JB2 or JB3.

The ore will be transported to the crusher located 960 m from JB1 and JB2 and 1200 m from JB3. The ore will be placed in the crusher and sorted, and then sent to the crushed ore pile (in a dome) located in the processing plant area. The waste rock will be transported to one of the waste rock stockpiles. The waste rock will be unloaded according to a predetermined disposal plan and a bulldozer will flatten the incoming material (Section 4.8).

As the haul road crosses the CE3 Creek, a haul bridge will need to be constructed. The bridge will comply with the standards set out in the *Regulation respecting the sustainable development of forests in the domain of the State.* It should be noted that CE3 Creek is not navigable.

4.6 ORE PROCESSING

4.6.1 PROCESS DESCRIPTION

Processing is categorized as a DMS process. The concentrator is designed to process 2 million tonnes per year of spodumene ore, with a nominal concentrate production of spodumene **ranging from 317,107-378,036** tonnes **according to the year** (41 t/h). The process design criteria are summarized in Table 4-8. The design criteria were based on industry standards, professional experience, as well as calculations and data provided by GLCI. The simplified process flow diagram is presented on Figure 4-**4**, while Figure 4-**5** presents a more detailed process flow diagram.

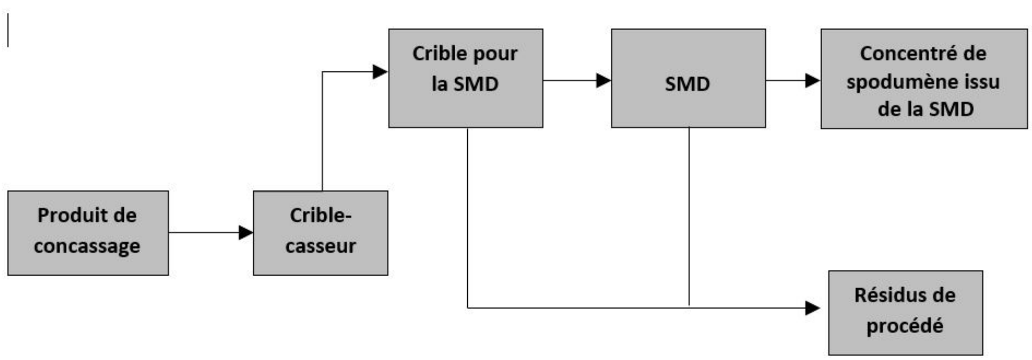


Figure 4-4 Simplified process flow diagram

The material is transported from the open pit mine to the ROM pad that has a **minimum** capacity of **20,000** tonnes (loose). It is then fed to the crushing circuit via a front-end loader. The material is then crushed in a three-stage crusher circuit comprising a primary jaw crusher, a secondary cone and tertiary cone crusher closed with a screen to produce the targeted product size.

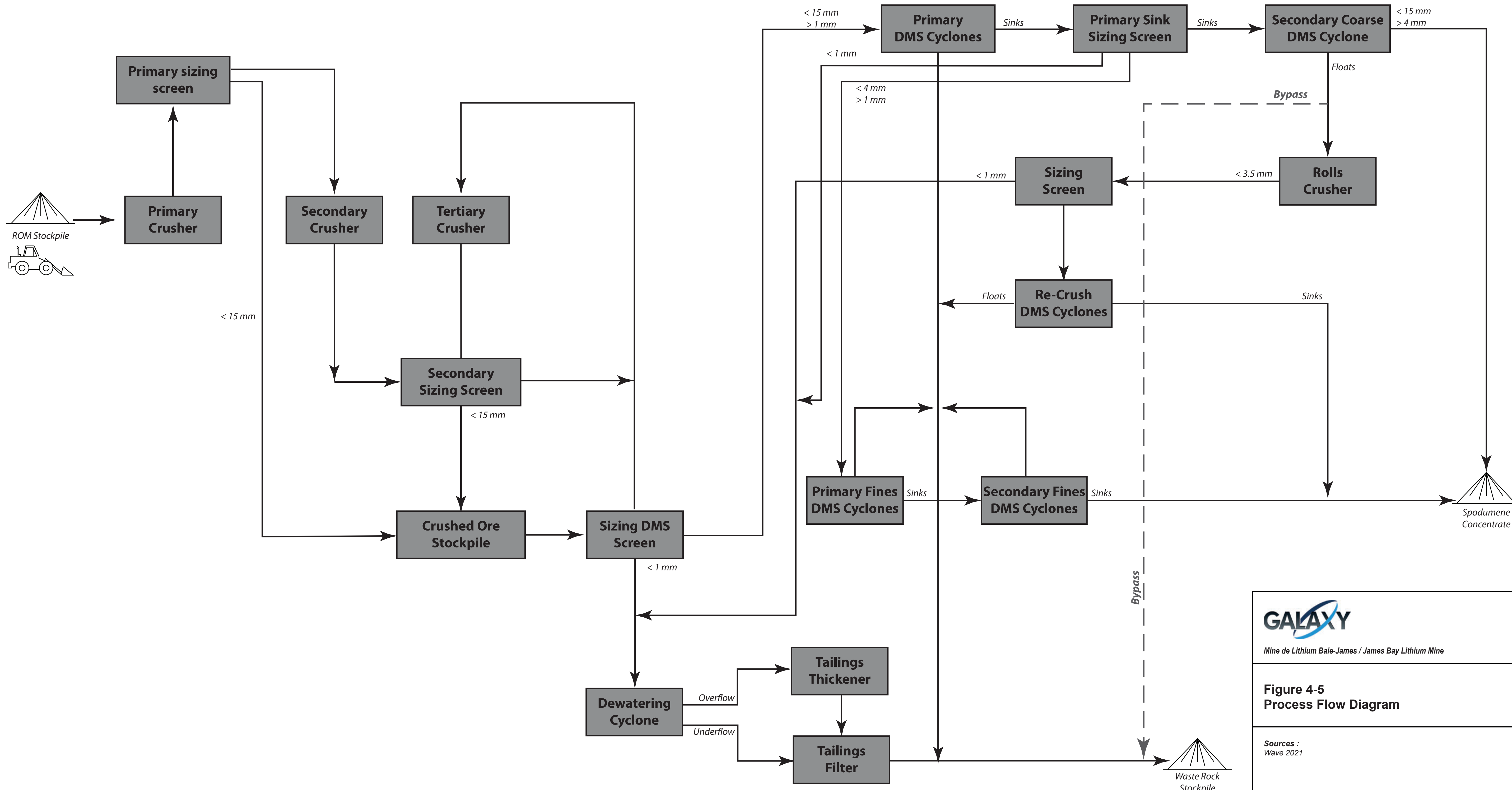
The ROM feed average humidity is estimated at 5 % while the average humidity of the tailings is estimated at 11.4 %. The following sections describe key circuits of the process is more details.

Table 4-8 Process design criteria

Parameter	Unit	Design Value
Operating Schedule		
Nominal throughput	t/annum	2,000,000
Operating days per year	d	365
Operating shifts per day	no.	2
Hours per shift	h	12
Crushing Operating Schedule		
Crushing circuit overall utilisation	%	**68.5**
Crushing circuit utilised hours	h	**6,000**
Required average crushing rate (dry)	dry t/h	**333**
Required average crushing rate (wet)	wet t/h	**344**
Design surge factor	%	20
Design crushing rate	wet t/h	**412**
DMS Circuit Operating Schedule		
DMS circuit utilisation	%	85
Effective daily processing hours	h	20.4
Required average DMS	dry t/h	**269**
Feed material Characteristics		
Feed grade[a]	% Li_2O	**1.30-1.46**
Product Characteristics		
Recovery	%	**66.5**
Concentrate grade	% Li_2O	6
Nominal lithium production	Li_2O t/a	**18,850**
Lithium concentrate production @ 6.0% Li_2O	t/a	**310,500**
ROM Feed Characteristics		
Specific gravity[b]	t/m³	2.73
Bulk density crushed feed material	t/m³	1.7
ROM Sizing		
F_{100}[c]	mm	**700**
F_{80}[c]	mm	**360**

a Feed grade: The initial design was based on the Mineral Resource average grade before the completion of the mine design which lead to the estimation of an average grade of 1.43 %Li_2O. The difference is deemed acceptable by the process engineer.
b Specific gravity: the proposed design used an earlier study as data source. The difference with the update specific gravity (2.7) is deemed acceptable by the process engineer.
c F100 and F80 are dimensions of which 100% or 80% of the material is smaller than a given size.

Source: ***G Mining Services, 2021.***



GALAXY

Mine de Lithium Baie-James / James Bay Lithium Mine

Figure 4-5
Process Flow Diagram

Sources :
Wave 2021

July 2021

Dessin : A. Masson
Approbation : C. Martineau
201-12362-00_f4-5_wsp311_process_flow_210512.ai

wsp

4.6.1.1 DENSE MEDIA SEPRATION FEED PREPARATION

The preparatory stages for DMS are designed to classify the ore into distinct size fractions. **The ore is first passed through a primary crusher and then onto a primary sizing sieve. This primary classifier screen is a double deck, inclined, vibrating screen with an upper mesh size of 30 mm and a lower mesh size of 15 mm. Ore smaller than 15 mm is sent directly to the crushed ore reserve. The coarse ore from this screen is directed into a secondary crusher and then fed to a screen identical to the primary screen, with an upper mesh size of 20 mm and a lower mesh size of 15 mm. The undersized ore is then sent to the crushed ore reserve. The oversized ore from the secondary screen is passed through a tertiary crusher and returned to the secondary sizing screen. The ore is thus recycled in the crushing circuit until it is under 15 mm in grain size. The crushed ore is then transferred by a feed conveyor to the DMS area.**

4.6.1.2 DENSE MEDIA SEPARATION

The DMS receives all the feed (>1 mm, <15mm) from the sizing screen. Following the initial preparation steps, the crushed feed material is mixed with ferrosilicon (FeSi) and is pumped to the DMS cyclones. The FeSi slurry acts as a densifying medium which enables the gravity separation of spodumene from minerals with a lower specific gravity. The spodumene typically has a higher specific gravity than the gangue minerals and consequently the spodumene sinks while the gangue material floats.

The DMS cyclone underflow is dewatered and pumped to the magnetic drum for FeSi recovery and water removal. The water removed is re-used in the DMS. This **final** product is the spodumene concentrate that will be prepared for transport.

The DMS cyclone overflow streams go to a wet belt magnetic separator where the ferromagnetic material is separated using a ferromagnetic extraction matrix. Following this separation, the product is dewatered and FeSi recovered. This product corresponds to the tailings. Tailings are sent to the transfer conveyor for processing and thickening.

4.6.1.3 LOADOUT

Tailings are discharged onto the tailings transfer conveyor from the **DMS** streams, sizing screens and the tailings thickening. The material is conveyed via the tailings discharge conveyor to the tailings loadout hopper. Mine haul trucks are cycled to cart the tailings and bring the tailings to the waste rock **stockpiles**.

Dewatered spodumene concentrate travels on the conveyor to the dome where it is loaded onto trucks for shipment to Matagami, where it will be loaded onto trains. **The concentrate will then** be transported to another plant **where it will undergo** a second treatment. **At the appropriate time, GLCI will conduct an economic market opportunity analysis for processing in Quebec in accordance with Section 101 of the Mining Act. However, for the purposes of this study, the activities under consideration stop with shipping the concentrate to Matagami.**

4.6.2 SEPARATION MEDIA

Ferrosilicon (FeSi) is an inert media in the DMS process. It is added in the DMS process at a rate of 0.2 t/hours. FeSi comes in bulk one tonne bags. It will be transported to the site and stored in the DMS storage warehouse. In addition to FeSi, sodium nitrite and lime **are used** to prevent corrosion. Sodium nitrite and lime will be shipped in 20 kg bags and as for the FeSi stored in the DMS storage warehouse. As for quantities needed, approximately 0.5 kg of sodium nitrite and 2 kg of lime are needed per tonne of FeSi.

4.6.3 *WASTE FILTRATION*

The tailings will be filtered before being transported to the waste rock stockpiles. There are two possible sizes of residue: 15/+4 mm (44.5% of volume) and -4/ <1 mm (55.5%).

Both size classes will be dewatered through a sieve to obtain a moisture content of less than 10 % w/w. Each of the residue streams is discharged onto its dedicated conveyor where an automatic sampler takes a sample which is analyzed for moisture content.

4.7 GEOCHEMICAL CHARACTERIZATION

The purpose of the geotechnical tests was to determine the main characteristics of the materials that will be extracted by mining to design the project according to best industry practices. To provide spatial representativeness of rock samples were selected throughout, also ensuring proper spatial representation for tailings testing. The results are presented in greater detail in the *Étude spécialisée sur la géochimie* (WSP, 2018*b*).

After consulting available drilling reports and based on the recommendations of the project's geologists, four main lithologies were targeted for the geochemical characterization of waste rock, i.e., one pegmatite waste rock unit (I1G), gneiss (M1) and banded gneiss units (M2) and one unit of mafic volcanic rock (V3), which included the basalt unit (V3B). For its part, the economic material is associated with spodumene, which occurs in large crystals in pegmatite intrusions (also part of unit I1G).

Thus, a certain number of samples from the lithologies were analyzed to assess the geochemical behaviour of the five lithological units. The tailings samples characterized in this study were recovered from a bulk sample, on which metallurgical tests representative of those that will be used during operations were performed.

Thus, 10 samples of unit V3B (basalt), 20 of unit M2 (banded gneiss), 21 of unit I1G (pegmatite) and 30 of unit M1 (gneiss) were selected to ensure uniform spatial coverage of waste rock that will potentially be extracted during mining. The samples were not selected to reflect the tonnage of waste rock that will be extracted; rather, the selection was based on the frequency (percentage) the lithological units were crossed during drilling. As well, 28 samples of unit I1G, considered economic material and 12 samples of tailings were selected.

For comparison purposes, some of the tests performed materials were also performed on soil samples collected for an additional project study (WSP, 2018*c*) to assess their geochemical behaviour and impact on the environment when stored. The results of these analyses were also compared to the criteria for mining sites.

4.7.1 *WASTE ROCK*

Various static tests were performed on the selected samples to assess their geochemical behaviour. All 81 waste rock samples were analyzed for available metal content. The leaching test was performed on all the samples (80) for which the available metal content exceeded criteria "A" in the Guide d'intervention - Protection des sols et réhabilitation des terrains contaminés (Beaulieu, 2016) to determine the mobility of inorganic analytes.

The results of these analyses show that all the waste rock is considered "low risk" under the D019. In addition, the waste rock from the lithological units is leachable to varying degrees under this same directive. The details of the results for each unit tested following the TCLP are presented in Table 4-**9**.

Less aggressive leaching testing than the TCLP, i.e., SPLP and CTEU-9, was also performed on the waste rock. The test results indicated leaching of certain metals, mostly arsenic, silver, barium, copper, manganese, nickel, lead and zinc. More extensive leaching was obtained in the CTEU-9 test due to the very fine particle size (100 mesh) of the materials tested. This can result in an increase of the materials' specific surface and in a higher solubility of some metals.

The D019 criterion for arsenic was exceeded in this test for units I1G (4%) and V3B (80%). Although this is not the test recommended by D019 for the characterization of mine waste rock, these exceedances should still be considered because the site conditions are more suited to water leaching than acid leaching. However, this particle size is far from that of the waste rock that will be stockpiled on site. The leachability of the waste rock is not insignificant and should be considered in waste rock management.

The results of the static test to predict acid generation potential (MABA) showed a total sulphur concentration of less than 0.3% for all the waste rock samples of units I1G and V3B analyzed; these are therefore classified as non-potentially acid generating (non-PAG) under D019.

Table 4-9 Test results for waste rock

Unit	Metals >A	TCLP>GWS	SPLP>GWS	CTEU-9>D019	CTEU-9>RES	PAG (D019)
I1G	96%	Mn (95%)	Hg (25%)		Cu, Pb, Zn (100%)	0 %
		Cu, Zn (55%)	Zn (10%)		Mn (90 %)	
		Cd, Pb (5%)	Ag, Ba (5%)		As (25%)	
					Cd (10%)	
M1	100 %	Ba (77%)	Cu (17%)	As (4 %)	Cu (100 %)	30 %
		Zn (63 %)	Zn (13 %)		Ba, Pb, Zn (88%)	
		Ni, Pb (47%)	Ag (8%)		Ag (79 %)	
		Cd (30 %)	Ni (4%)		Cd, Ni (75%)	
		Mn (10 %)			As (71 %)	
		As, Cu (3%)				
M2	100 %	Ba (77%)			Ag, Ba, Cd, Cu, Pb, Zn (100%)	50 %
		Pb (65%)			As (88 %)	
		Zn (55 %)			Ni (75 %)	
		Ni (30 %)			Mn (13 %)	
		Cd (15 %)				
		Mn (5 %)				
V3B	100 %	As, Ba, Ni (100%)	As (100 %)	As (80 %)	As (100 %)	0 %
		Mn (30 %)			Ba, Cu, Ni (80%)	
					Fluorides (20%)	

However, 30% of the samples of unit M1 and 50% of the samples of unit M2 are potentially acid generating (PAG) under D019. Comparing the results to the criteria of the URSTM and MEND, 70% are uncertain, 20% are considered PAG and 10% non-PAG for unit M1, while 40% of the samples of unit M2 are uncertain, 55% are considered PAG and 5% non-PAG. Therefore, the waste rock of unit M1 and M2 would be considered PAG.

Moreover, following the gamma spectrometry test (radionuclides), none of the eight units of waste rock analyzed are considered hazardous materials under the RHM.

4.7.2 PEGMATITE

In all, 28 samples were analyzed for their available metal content and 27 had available metal concentrations that exceeded criteria “A” in the Guide d’intervention (Beaulieu, 2016). The TCLP test was therefore performed on these 27 samples.

When compared to the criteria in Table 1 of Appendix II of D019, the results of these analyses show that 96% of the samples analyzed would be considered “low risk” materials.

However, under D019, the material is considered leachable. As such, 83% of the samples would leach manganese, 50% zinc and 46% copper. Lastly, between 13% and 42% of the samples analyzed could leach arsenic and/or barium and/or cadmium and/or nickel and/or lead. Less aggressive leaching tests than the TCLP, i.e., SPLP and CTEU-9, were also performed on 18 and 4 of the samples respectively. The results of the SPLP test also showed leaching of some metals, specifically arsenic, silver, copper, mercury, nickel and zinc. The results are summarized in Table 4-**10**.

Just like the waste rock, greater elemental mobility was also observed in the CTEU-9 test, resulting in a greater number of results that exceeded the RES criteria in the Guide d’intervention, specifically, in all the copper, manganese, lead and zinc samples and some exceedances in the silver, arsenic and barium samples. The material is therefore considered leachable according to the various leaching tests performed during the study.

Table 4-10 Test results for pegmatite samples

Metals>A	TCLP>GWS	SPLP>GWS	CTEU-9>D019	CTEU-9>RES	PAG (D019)
96%	Mn (83 %)	Cu, Zn (18 %)		Cu, Pb, Zn (100%)	21 %
	Zn (50 %)	Ag, As, Hg, Ni (6%)		Mn (75 %)	
	Cu (46 %)			Ag, As (25%)	
	Pb (30 %)				
	Ni (21 %)				
	As (17 %)				
	Cd (13 %)				

The results of the MABA static test to predict acid generation potential showed that 79% of the samples are considered non-PAG and 21% are considered PAG under D019.

However, comparing the MABA test results with the requirements in the MEND *Prediction Manual for Drainage Chemistry from Sulphidic Geologic Materials* (Price, 2009), 64% of the samples would be considered non-PAG and 36% would be uncertain, while none would be considered PAG.

As such, under applicable regulation, most of the material would be considered non-PAG. Still, according to the MEND criteria, the PAG of 36% of the samples would be uncertain.

4.7.3 TAILINGS

All 12 tailings samples analyzed for total metal content exceeded at least one of criteria “A” in the Guide d’intervention. A leaching test was therefore performed on the 12 samples to determine the mobility of inorganic analytes. The results showed that none of the criteria in Table 1 of Appendix II of D019 were exceeded; the risk of the analyzed tailings is therefore classified as “low.” These results are summarized in Table 4-**11**.

Table 4-11 Test results for tailings samples

Metals>A	TCLP>GWS	SPLP>GWS	CTEU-9>RES	PAG (D019)
100 %	Cu, Mn (100%)		Ag, Cu, Hg (100%)	0 %
	Cd (33 %)			
	Hg (8 %)			

However, all the samples analyzed showed exceedances of the RES criteria in the Guide d’intervention – Protection des sols et réhabilitation des terrains contaminés (Beaulieu, 2016) for copper and manganese. Moreover, 33% of the samples exceeded the criteria for cadmium while one sample also exceeded the RES criterion for mercury.

In all, five tailings samples were tested using the Synthetic Precipitation Leach Procedure (SPLP). These samples were selected because their exceedance values for the RES criterion were higher or because they exceeded the RES criterion for at least two TCLP parameters. The results of this leaching test showed no exceedance of the criteria in Table 1 of Appendix II in D019, which corroborates the results of the regulatory TCLP test that the level of risk associated with tailings is low.

The water leaching test (CTEU-9) was performed on the same five samples. Its results showed no exceedance of the criteria in Table 1, Appendix II in D019; however, all the samples exceeded the RES criteria in the Guide d’intervention for silver, copper and mercury.

The samples of 12 tailings on which the MABA static tests were performed **showed** total S concentrations of less than 0.3% and are therefore all classified as non-PAG under D019. Also, an analysis of the difference between the gross neutralization potential (GNP) and maximum potential acidity (MAP), as well as the GNP/MAP **ratio**, confirmed that all the samples analyzed are also non-PAG according to URSTM and MEND criteria.

Therefore, according to applicable regulations, the tailings that will be generated on the site would be considered non-PAG but leachable for cadmium, copper, manganese, mercury and zinc. These results **were** considered when designing the tailings storage infrastructure.

4.7.4 UNCONSOLIDATED DEPOSITS

A total of 15 samples from the sand unit and 6 samples from the clay unit were analyzed for their total metal content. The results of the chemical analyses for the sand unit samples showed concentrations higher than the background concentrations established for the Superior Province (criteria “A”) for two parameters: arsenic (13% of samples) and hexavelent chromium (46% of samples).

The results of the chemical analyses for the clay unit also showed concentrations higher than criteria “A” for cadmium (83% of samples) and chromium (33% of samples).

The leaching test was performed on six samples from the sand unit and two samples from the clay unit to determine the mobility of inorganic analytes. For the two clay samples analyzed, the RES criteria in the Guide d’intervention were exceeded for copper, lead and zinc. One of the two samples also exceeded the criteria for manganese. None of the sand unit samples exceeded the criteria.

The two clay samples were also subjected to the Synthetic Precipitation Leach Procedure (SPLP). The two samples exceeded the RES criterion in the Guide d'intervention for barium, copper, lead and zinc.

These results show that the sand unit in the project area is not leachable and that only the clay unit causes metal leaching. The fine particle size of the clay compared to that of the sand may explain the greater metal mobility.

4.7.5 RESULTS OF COLUMN KINETIC TESTS ON WASTE ROCK AND TAILINGS

Column kinetic tests were performed on mine waste rock and tailings samples (WSP, 2019). A flush was performed weekly until week 4 and then every two weeks for a total period of 50 weeks. Two of the columns contained a waste rock sample, one kept saturated at all times and the other kept unsaturated between one flush and the next, while the third column contained a tailings sample and was kept unsaturated between one flush and the next.

The kinetic tests on the waste rock were carried out on a set of samples totalling approximately 26 kg. This sample was composed of 25 different core samples from as many different boreholes and taken representatively in the envelope considered uneconomic (waste rock). The samples were not selected based on their NC/MPA ratio but rather on the spatial distribution of the ore samples. The WSP report dated June 2019 describes how the samples were selected and lists the selected samples. As mentioned in this study report, the samples were selected using the 3D model of the deposit to obtain a good spatial representation of the waste rock. We believe that water quality was not underestimated in this study since the waste rock tested is representative of the bedrock.

The results of these tests are summarized below.

ACID GENERATING POTENTIAL

The results observed in the kinetic tests on the three columns resulted in the following observations regarding the acid generation potential:

- The pH of the leachate for all three columns remained between 7 and 8 for the first 20 weeks of the test and then stabilized between 6.25 and 7.01 until the end of the test.
- SO4 concentrations remained between 5 and 10 mg/L for the majority of the test for both waste rock columns, while concentrations for the tailings column remained below 1 mg/L.
- The acidity measured in the leachate from all three columns remained near the detection limit throughout the test.
- Only one increase was measured at week 8 for the unsaturated waste rock (12 mg/L) and saturated waste rock (110 mg/L).
- Electrical conductivity was maximum at the beginning of the test and then reached a plateau around week 14 for the three columns, at about 15 µS/cm for the tailings column, 28 µS/cm for the unsaturated waste rock column and 35 µS/cm for the saturated waste rock column.
- The oxidation reduction potential varied throughout the test for all three columns but remained between 500 mV and 75 mV.

Therefore, based on the results obtained from these column kinetic tests, it appears that the acid generation potential of both the saturated and unsaturated waste rock and tailings is insignificant since the pH of all three columns was maintained between 6.25 and 8 throughout the test and the acidity in the leach water remained below the DL throughout most of the test, with similar results in all three columns.

The measured conductivity is also lower for tailings than for waste rock.

Concentrations of SO_4 in solution also remained stable throughout the test. It also appears that the SO_4 concentrations in the tailings leachate are lower than in the waste rock leachate.

The oxidation/neutralization curves were evaluated for these column kinetic tests. The initial concentrations of neutralizing materials are clearly sufficient to neutralize all the SO4 that could potentially be generated by these materials. Tailings and waste rock are therefore considered non-acid generating.

LEACHING POTENTIAL

COLUMN 1 – UNSATURATED TAILINGS

- Silver concentrations were above the GWS criterion for the first six weeks of testing. They remained below the DL from week 8 onwards (note that the DL [0.00005 mg/L] was greater than GWS [0.00003 mg/L] criterion). A value equal to the DL, and therefore greater than the GWS criterion, was also obtained at week 46. Since this value is a point value and just above the DL, it is not considered to have a significant impact on water quality. It could also be a false positive from the laboratory.
- The D019 monthly average final effluent discharge concentration was exceeded in the initial analysis.
- The copper GWS criterion was exceeded at weeks 0 to 18, 22 and 28. After week 28, concentrations remained below the GWS criterion.
- Iron exceeded the D019 final effluent discharge maximum acceptable concentration in weeks 0 and 2 and exceeded the monthly average acceptable final effluent discharge concentration in weeks 1, 3, 4 and 6. Concentrations then gradually decreased, reaching a threshold near the DL around week 14.
- Manganese exceeded the GWS criterion only between weeks 0 to 4. Concentrations reached a threshold near the DL as of week 14.
- Mercury exceeded the GWS criterion primarily between weeks 0 and 14. As of week 16, concentrations remained below the DL (note that the DL [0.00001 mg/L] was greater than GWS criterion [0.0000013 mg/L]).
- Lead exceeded the GWS criterion in the first 6 weeks of testing. Concentrations stabilized near the DL as of week 10.
- Zinc exceeded the GWS criterion during the first 14 weeks of testing. Concentrations stabilized near the DL as of week 16.
- The arsenic, barium and nickel tests did not exceed the GWS criterion.
- The copper, nickel, lead and zinc tests did not exceed the D019 (average and maximum) final effluent discharge acceptable concentrations.

COLUMN 2 – SATURATED WASTE ROCK MIX

- Only the initial and week 1 analyses results were higher than the DL. Concentrations subsequently remained below the DL (note that the DL [0.00005 mg/L] was greater than the GWS criterion [0.00003 mg/L]).
- Arsenic exceeded the D019 final effluent discharge maximum acceptable concentration at week 3 and the monthly average acceptable concentration at weeks 2, 4, and 6. The GWS criterion was also exceeded in weeks 3 and 4. Concentrations subsequently dropped to a threshold around week 24.
- Barium exceeded the GWS criterion in the initial analysis. However, concentrations stabilize near the DL as of week 2.
- Copper exceeded the GWS criterion in both the initial and week 1 analyses. However, concentrations stabilize below the GWS criterion as of week 2.

- Iron exceeded the D019 final effluent discharge maximum acceptable concentration in the initial analysis and the monthly average concentration in week 1; however, concentrations stabilized near the DL starting in week 2.
- Mercury exceeded the GWS criterion primarily between weeks 0 and 14. As of week 16, concentrations remained below the DL (note that the DL [0.00001 mg/L] was greater than GWS criterion [0.0000013 mg/L]).
- Zinc exceeded the GWS criterion only in the initial analysis. Concentrations then remained near or below the DL.
- The manganese, nickel and lead tests did not exceed the GWS criterion.
- The copper, nickel, lead and zinc tests did not exceed the D019 (average and maximum) final effluent discharge acceptable concentrations.

COLUMN 3 – UNSATURATED WASTE ROCK MIX

- Silver concentrations were above the GWS criterion for the first 12 weeks of testing. They remained below the DL from week 14 onwards (note that the DL [0.00005 mg/L] was greater than GWS [0.00003 mg/L] criterion).
- Arsenic exceeded the D019 monthly average acceptable final effluent discharge concentration in weeks 4 and 6; concentrations remained below the D019 requirements thereafter.
- Barium exceeded the GWS criterion at weeks 0, 2, 4, 5 and 10. However, concentrations stabilize near the DL as of week 14.
- Copper exceeded the GWS criterion between weeks 0 to 12. However, concentrations stabilize below the GWS criterion as of week 14.
- Iron exceeded the D019 final effluent discharge maximum acceptable concentration between weeks 0 and 12. Concentrations dropped to reach a threshold near the DL at week 14.
- Manganese exceeded the GWS criterion only at weeks 2 and 4. Concentrations reached a threshold near the DL as of week 14.
- Concentrations remained below the DL throughout the test, with the exception of the initial analysis (note that the DL [0.00001 mg/L] was greater than the GWS criterion [0.0000013 mg/L]).
- Lead exceeded the GWS criterion at weeks 2, 4 and 6. Concentrations stabilized near the DL as of week 10.
- Zinc exceeded the GWS criterion during the first 12 weeks of testing. Concentrations stabilized near the DL as of week 14.
- The arsenic and nickel tests did not exceed the GWS criterion.
- The copper, nickel, lead and zinc tests did not exceed the D019 (average and maximum) final effluent discharge acceptable concentrations.

Based on these results, although some metals were released in concentrations exceeding the GWS criterion and/or the D019 final effluent discharge requirements, in most cases the release was limited to the first weeks of testing.

Therefore, in the case of the tailings column, the GWS criterion and/or D019 final effluent discharge requirements were not exceeded after week 14, except copper, for which the exceedances ceased after week 28. For the unsaturated waste rock mix column, the GWS criterion and/or D019 final effluent discharge requirements were not exceeded after week 12. For the saturated waste rock mix column, excluding mercury, the GWS criterion and/or D019 final effluent discharge requirement exceedances were limited to the first weeks of testing, up to week 4.

Therefore, at the end of the test, unsaturated and saturated waste rock and tailings appear to exhibit similar behaviour over the test time scale. These results assume that the waste rock and tailings are potentially leachable in the short term, but that metal release is significantly limited and meets the applicable criteria and requirements (D019 and GWS) after an average of 12 weeks. These materials can therefore be considered low risk according to D019 at the end of this period.

Table 4-12 presents a summary of the results.

Table 4-12 Summary of GWS criteria and D019 final effluent requirement exceedances during column testing

Column	Parameter	D019[1, 2] exceedance	GWS exceedance	Stabilization	D019 exceedance at end of test	RES exceedance at end of test
Column 1- Unsaturated tailings	Silver	-	Weeks 0 to 6, week 46 (0.00005 mg/L)	Week 8	-	No (DL > GWS)
	Arsenic	Week 0 (avg.)	-	-	No	-
	Copper	-	Weeks 0 to 18, 22 and 28	Week 32	-	No
	Iron	Weeks 0 and 2 (max.) Weeks 1, 3, 4 and 6 (avg.)	-	Week 14	No	-
	Manganese	-	Weeks 0 to 4	Week 10	-	No
	Mercury	-	Weeks 0 to 14	Week 16	-	No (DL > GWS)
	Lead	-	Weeks 0 to 6	Week 10	-	No
	Zinc	-	Weeks 0 to 14	Week 16	-	No
Column 2 – Saturated waste rock mix	Silver	-	Week 1	Week 2	-	No (DL > GWS)
	Arsenic	Week 3 (max.) Weeks 2, 4 and 6 (avg.)	Weeks 3 and 4	Week 24	No	No
	Barium	-	Week 0	Week 2	-	No
	Copper	-	Weeks 0 and 1	Week 2	-	No
	Iron	Week 0 (max.) Week 1 (avg.)	-	Week 2	No	-
	Mercury	-	Weeks 0 to 14	Week 16	-	No (DL > GWS)
	Zinc	-	Week 0	Week 2	-	No
Column 3 – Unsaturated waste rock mix	Silver	-	Weeks 0 to 12	Week 14	-	No (DL > GWS)
	Arsenic	Weeks 4 and 6 (avg.)	-	-	No	-
	Barium	-	Weeks 0, 2, 4, 5 and 10	Week 14	-	No
	Copper	-	Weeks 0 to 12	Week 14	-	No
	Iron	Weeks 0 to 12 (max.)	-	Week 14	No	-
	Manganese	-	Weeks 2 and 4	Week 14	-	No
	Mercury	-	Week 0	Week 1	-	No (DL > GWS)
	Lead	-	Weeks 2, 4 and 6	Week 10	-	No
	Zinc	-	Weeks 0 to 12	Week 14	-	No

4.7.6 RESULTS OF COLUMN KINETIC TESTS ON ORE AND DIABASE

Column kinetic tests were conducted on an ore sample and a diabase sample (WSP, 2020), as the latter was being considered for use as backfill material on the site (which is no longer the case for the current project). A flush was performed every two weeks for a total period of 25 weeks. The two columns were kept unsaturated between flushes.

Kinetic tests on the ore were carried out on a sample set totalling 24.886 kg. This sample was composed of 19 different core samples from 12 different boreholes, taken representatively from the mineralized envelope. The samples were not selected based on their NC/MPA ratio but rather on the spatial distribution of the ore samples. The WSP report from March 2020 describes how the samples were selected and lists the selected samples.

The kinetic tests on the diabase were carried out on a sample set totalling 26.612 kg. This sample was made up of 10 core samples from the same borehole. In fact, the number of boreholes intersecting the diabase was limited, and given the mass required to carry out the tests, the choice of samples was limited. The samples were not selected on the basis of their NC/MPA ratio but rather on sample availability. The WSP report from March 2020 describes how the samples were selected and lists the selected samples.

The results of these tests are summarized below (Table 4-13).

ACID GENERATING POTENTIAL

Two test columns were monitored during the kinetic tests, an ore column and a diabase column, both of which were kept unsaturated during the test. The results observed during the kinetic test resulted in the following observations:

- The pH of the leachate from both columns remained near-neutral throughout the test, although slightly alkaline for the diabase column.
- SO_4 concentrations remained between 1 and 14 mg/L during the test for both columns.
- The acidity measured in the leachate from both columns remained below the detection limit throughout the test.
- Electrical conductivity was maximum at the start of the test for both columns and then stabilized around 20 µS/cm for the ore column and 30 µS/cm for the diabase column; these values are consistent with the reduction in dissolved metal concentrations in the leachate throughout the tests.
- The oxidation reduction potential varied throughout the test for both columns but remained between 500 mV and 70 mV.

Therefore, based on the results obtained from these column kinetic tests, it appears that the acid generation potential of both the ore and diabase is insignificant since the pH of both columns was maintained near neutral throughout the test and the acidity in the leach water remained below the DL throughout most of the test as well. Concentrations of SO_4 in solution also remained stable throughout the test.

Table 4-13 GWS criteria and D019 final effluent requirement exceedances during column testing

Column	Parameter	D019[1, 2] exceedance	GWS exceedance	Stabilization	D019 exceedance at end of test	RES exceedance at end of test
Column 1- Unsaturated tailings	Silver	-	Weeks 0 to 6, week 46 (0.00005 mg/L)	Week 8	-	No (DL > GWS)
	Arsenic	Week 0 (avg.)	-	-	No	-
	Copper	-	Weeks 0 to 18, 22 and 28	Week 32	-	No
	Iron	Weeks 0 and 2 (max.) Weeks 1, 3, 4 and 6 (avg.)	-	Week 14	No	-
	Manganese	-	Weeks 0 to 4	Week 10	-	No
	Mercury	-	Weeks 0 to 14	Week 16	-	No (DL > GWS)
	Lead	-	Weeks 0 to 6	Week 10	-	No
	Zinc	-	Weeks 0 to 14	Week 16	-	No
Column 2 – Saturated waste rock mix	Silver	-	Week 1	Week 2	-	No (DL > GWS)
	Arsenic	Week 3 (max.) Weeks 2, 4 and 6 (avg.)	Weeks 3 and 4	Week 24	No	No
	Barium	-	Week 0	Week 2	-	No
	Copper	-	Weeks 0 and 1	Week 2	-	No
	Iron	Week 0 (max.) Week 1 (avg.)	-	Week 2	No	-
	Mercury	-	Weeks 0 to 14	Week 16	-	No (DL > GWS)
	Zinc	-	Week 0	Week 2	-	No
Column 3 – Unsaturated waste rock mix	Silver	-	Weeks 0 to 12	Week 14	-	No (DL > GWS)
	Arsenic	Weeks 4 and 6 (avg.)	-	-	No	-
	Barium	-	Weeks 0, 2, 4, 5 and 10	Week 14	-	No
	Copper	-	Weeks 0 to 12	Week 14	-	No
	Iron	Weeks 0 to 12 (max.)	-	Week 14	No	-
	Manganese	-	Weeks 2 and 4	Week 14	-	No
	Mercury	-	Week 0	Week 1	-	No (DL > GWS)
	Lead	-	Weeks 2, 4 and 6	Week 10	-	No
	Zinc	-	Weeks 0 to 12	Week 14	-	No

Furthermore, oxidation / neutralization curves were conducted to evaluate the long-term acid generation potential of the two columns. This assessment was made by placing the cumulative magnesium, manganese and calcium (neutralizing minerals) loads on the y-axis, based on the cumulative sulphate loads on the x-axis. Furthermore, the initial total composition of neutralizing minerals as a function of the initial sulphate composition was placed on the graph. If the initial composition is above the oxidation / neutralization curve, it is assumed that the material will deplete its sulphur content before depleting its neutralizing mineral content. This is what is observed for the ore and diabase during testing. Ore and diabase are therefore considered non-acid generating.

LEACHING POTENTIAL

COLUMN 1 – ORE

Silver concentrations remained below the DL from week 13 onwards (note that the DL [0.00005 mg / L] was great than the GWS [0.00003 mg / L] criterion). Values above the DL were measured weeks 0, 6, 9 and 12.

- Mercury concentrations exceeded the DL at weeks 0, 2, 9 and 25 of the test (note that the DL [0.00001 mg / L] was greater than the GWS criterion [0.0000013 mg / L]). Concentrations remained below the DL for all the other test weeks.
- The D019 final effluent discharge maximum acceptable concentration was exceeded at week 0 for the SS.
- Copper, lead and zinc concentrations remained below the RES criteria as of week 1 or 2 of testing.
- No exceedance of the GWS criteria was obtained during the test for all other metals analyzed.
- No exceedances of (average and maximum) D019 final effluent discharge acceptable concentrations were obtained during the test.

COLUMN 2 – DIABASE

- The results of weeks 0, 1, 6, 9 and 11 were greater than the DL. Concentrations subsequently remained below the DL (note that the DL [0.00005 mg / L] was greater than the GWS criterion [0.00003 mg / L]).
- Copper concentrations exceeded the GWS criteria at weeks 0, 1, 3, 6, 7 and 16 but remained below the criteria as of week 17.
- Mercury concentrations exceeded the DL at weeks 0, 2, 3, 22 and 23 of the test (note that the DL [0.00001 mg / L] was greater than the GWS criterion [0.0000013 mg / L]). Concentrations remained below the DL for all the other test weeks.
- Iron concentrations exceeded the D019 final effluent discharge maximum acceptable concentration at weeks 0 and 1 but remained below the latter as of week 2.
- The D019 final effluent maximum acceptable discharge concentration was exceeded between weeks 0 and 8 for the SS.
- Barium, cadmium, lead and zinc concentrations remained below the GWS RES criteria as of week 4 of testing or earlier.
- No exceedance of the GWS criteria was obtained during the test for all other metals analyzed.
- No other exceedances of (average and maximum) D019 final effluent discharge acceptable concentrations were obtained during the test.

Based on these results, although some metals were released in concentrations exceeding the GWS criterion and/or the D019 final effluent discharge requirements, in most cases the release was limited to the first few of testing, which is normal for this type of test. Therefore, for the ore column, no exceedance was observed after week 12 of the test, except for mercury (week 25). For the diabase column, exceedances of the applicable criteria stop after week 11, except for mercury (weeks 22 and 23) and a one-time result at week 16 for copper.

Therefore, mercury concentrations above the GWS criteria (at the DL) were obtained at one point even at the end of the test for both columns. Since there does not appear to be a clear downward trend in mercury behaviour, the ore and diabase would be considered mercury leachable even after 25 weeks. These results assume that the ore and diabase are also potentially leachable, in the short term only, for some metals ([ore: silver, copper, lead, zinc], [diabase: silver, barium, cadmium, copper, iron, lead, zinc]). However, the release of metals is limited.

Table 4-14 presents a summary of the results.

Table 4-14 GWS criteria and D019 final effluent requirement exceedances during column testing

Column	Parameter	D019[1, 2] exceedance	GWS exceedance
Column 1 - Ore	Silver	-	Weeks 0, 6, 8, 9, 12
	Copper	-	Weeks 0 and 1
	Mercury	-	Weeks 0, 2, 3, 9, 25
	Lead	-	Week 0
	Zinc	-	Week 0
Column 2 – Diabase	Silver	-	Weeks 0, 1, 6, 7, 8, 9, 11
	Barium	-	Week 0
	Cadmium	-	Week 0
	Copper	-	Weeks 0, 1, 3, 6, 7, 16
	Iron	Weeks 0 and 1	-
	Mercury	-	Weeks 0, 2, 3, 22, 23
	Lead	-	Weeks 0, 1, 3
	Zinc	-	Weeks 0, 1, 3
	Suspended solids	Weeks 0 to 8	-

4.7.7 TANTALUM PENTOXIDE

In response to the July 2020 CCE request, information on tantalum levels is presented here for information purposes. No additional geochemical characterization of the ore is available. Tantalum is not expected to be mined as part of this project due to the low levels observed.

Tests were conducted to evaluate the possibility of integrating a Ta_2O_5 circuit to produce a marketable tantalum by-product. A total of 96 samples were analyzed for Li_2O and Ta_2O_5. Nine of these samples had Ta_2O_5 levels equal to or greater than 100 ppm, with a maximum of 343 ppm. Three of these samples had Li_2O levels above 0.3%. In all samples analyzed, tantalum is generally found in higher concentrations when lithium levels are lower (Figure 4-6).

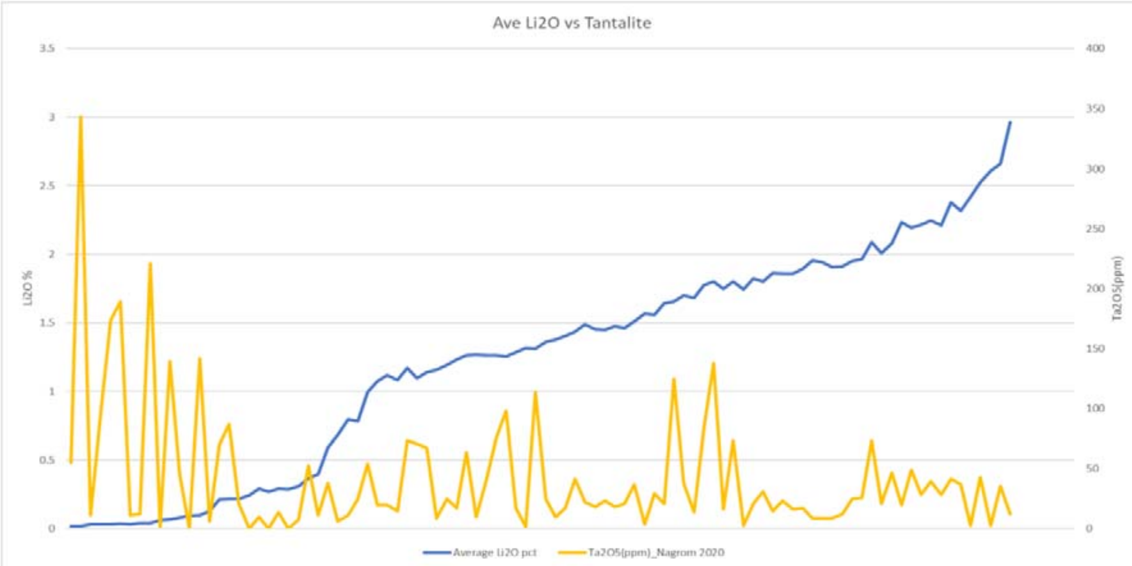


Figure 4-6 Comparison of Li_2O and Ta_2O_5 levels

Source: Galaxy, 2021

Higher concentrations of tantalum were observed mainly at the periphery of pegmatites and/or in small pegmatite dikes (1-2 meters thick). There may be a tantalum distribution pattern. The highest Ta2O5 levels (> 200 ppm) from the assays were observed in distal zones of pegmatite mineralization that were not modelled.

Based on these preliminary geological sample assays, the data indicate that less than 10% of the samples have Ta2O5 concentrations comparable with the Mt. Cattlin deposit (120-335 ppm in 2019 and 110-350 ppm in 2020). There is insufficient data at this time to recommend that metallurgical testing be undertaken.

4.8 STOCKPILES

The waste rock **stockpile** as well **the unconsolidated deposits and organic matter stockpile** are **shown** on Map 4-1.

The stockpile design is supported by stability tests that include geotechnical studies. These stability tests were performed by Golder Associates Ltd (2021) and can be found in Appendix A. The geotechnical studies include 78 boreholes, 15 piezocones, 79 exploratory trenches, in-situ shear strength measurements of cohesive soils (e.g., clay), laboratory tests (e.g., moisture content, grain size tests, hydrometric tests, plasticity (Atterberg) limits).

Stability tests (limit equilibrium) were carried out for static or pseudo-static conditions, the latter taking into account the seismic hazard in the project area (the project is located in a region with low seismic activity). The seismic hazard value was determined using the *2015 National Building Code of Canada* Seismic Hazard Calculator (NRCan, 2016). The minimum safety factor required is based on the parameters provided in D019.

The peak horizontal ground acceleration (PGA) at the site is 0.038 g in “firm soils” with a probability of occurrence of 0.02 in 50 years according to D019. The horizontal seismic coefficient k retained for the pseudo-static stability analyzes is considered equal to 50% of the PGA. A value of 0.019 g was selected for the analysis. Key design criteria of the stockpiles are presented in Table 4-**15**.

A tailings and waste rock disposal strategy was developed based on the **mining engineer**’s estimates. This disposal strategy includes the unconsolidated deposits and organic matter. Figures 4-7 through 4-9 illustrate various cross-sections of the stockpiles and **berms**. **No sealing measures are currently planned under the stockpiles. All materials used for the construction of the stockpiles at the site will come from the pit.**

The next subsections present additional details on the **overburden and peat storage facility, the WRTSFs**, and the ROM pad. It should be noted that in the following sections, the term “upstream” of a dike or berm represents the side that faces the inside of the retain matter (material, water, etc.). “Downstream” of a dike or berm represents the side facing away from the storage infrastructure.

Table 4-15 Stockpiles key design criteria

Parameter	Unit	Design Value
Material acid drainage potential		
Waste Rock	Yes / no	**No**
Tailings	Yes / no	**No**
Unconsolidated deposits (inorganic)	Yes / no	No
Organic matter	Yes / no	N/A
Material water content		
Waste Rock	% w/w	**3**
Tailings	% w/w	**12**
Unconsolidated deposits (inorganic)	% w/w	15
Organic matter	% w/w	75
Global slope		
Waste Rock **and Tailings**	H:1V	2.5 H:1V
Unconsolidated deposits **and organic matter**	H:1V	**5** H:1V
Specific dry density (loose)		
Waste Rock	t/m³	**2.2**
Tailings	t/m³	1.70
Unconsolidated deposits (inorganic)	t/m³	**2.0**
Organic matter	t/m³	1.22
ROM (pegmatite)	t/m³	**1.74-1.76**
Storage capacities		
Waste rock tonnage	Mt	**129.9**
Filtered Tailings tonnage	Mt	**31.4**
Waste rock volume (loose)	Mm³	**59**
Filtered Tailings volume (loose)	Mm³	**18.5**
Unconsolidated deposits and **organic matter** (loose)	Mm³	**3.4**
Seismic hazard		
PGA: Peak horizontal ground acceleration in “firm soils” with a probability of occurrence of 0.02 in 50 years	G	0.038
K: Horizontal seismic coefficient retained for pseudo static stability analysis	G	0.019

Source: **G Mining Services, 2021.**

4.8.1 OVERBURDEN

According to the available data, the unconsolidated material is composed of a mixed granular deposit with a small fraction of cohesive soil. Because of the heterogeneous properties of the unconsolidated deposits, it was recommended to incorporate a protection layer on the slope surface of the stockpile. This layer will be made of selected granular material, will be a more homogeneous material, and will have better frictional property to ensure the slope stability. This protection layer will be compacted to provide the required shear resistance.

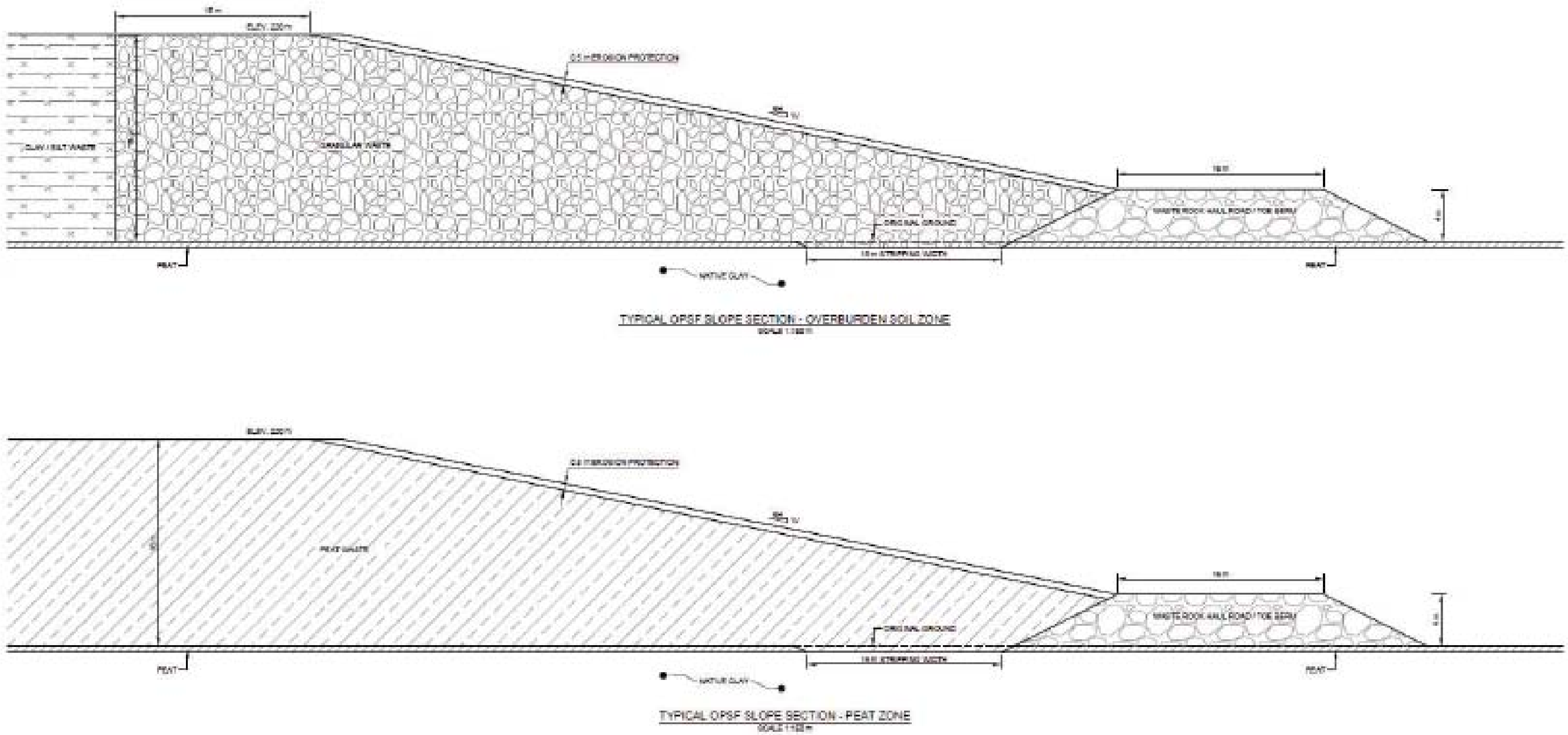


Figure 4-7 Cross-sections of the unconsolidated deposits and organic matter stockpile

Source: Golder Associates Ltd in G Mining Services, 2021

The proposed unconsolidated deposits **and organic matter** stockpile will be a fill with a maximum height (depending on the ground elevation) of approximately **16** m (Figure 4-**7**). The maximum elevation of the proposed stockpile is **220** m. The stockpile will be assembled over the years and its general geometry will be:

— **Perimeter ring width: 15 m**;
— Maximum bench offset: 5 m;
— Maximum bench height: 20 m;
— Local bench slope – 2.25 H: 1V.

Organic material was found in most of the borehole locations and consists of fibrous peat. This material is known to be saturated with water (Mesri and Ajlouni, 2007). Therefore, it is important to consider water management in the stockpile design to allow for easy drainage of this liquid. To this end, a perimeter stone dike (0-1,000 mm) will be built around the stockpile. In addition, access roads, spaced approximately 100 m apart, will be constructed to optimize bulldozer grading. The roads will be used by the trucks to travel safely on the stockpile while unloading the organic matter. A bulldozer can then be used to spread and compact the material. A gentle slope of 6H: 1V is recommended in the vicinity of the stockpile. Figure 4-8 illustrates the **unconsolidated deposits and** organic matter stockpile geometry. The volumes **that will be placed in the stockpile** are summarized in Table 4-**16** for Reference Years -1, 1, 3, 5, 10, and rest of LOM.

Table 4-16 Cumulative volumes in the overdurben and peat storage facility

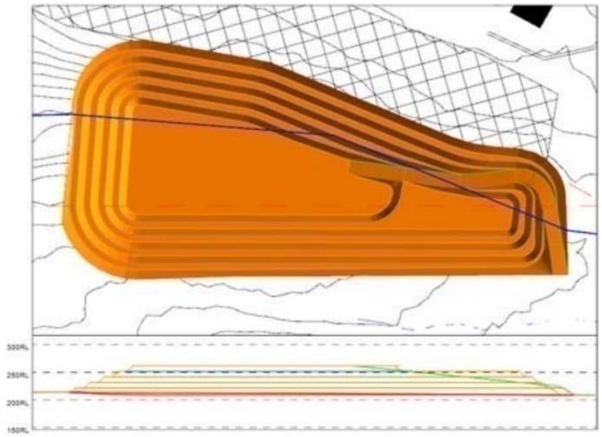
Reference Years	Unconsolidated Deposit (Mm³)
Year -1	**0.24**
Year 1	**0.72**
Year 3	**1.14**
Year 5	**1.47**
Year 10	**2.54**
Rest of LOM	**2.90**

Source: G Mining Services, 2021

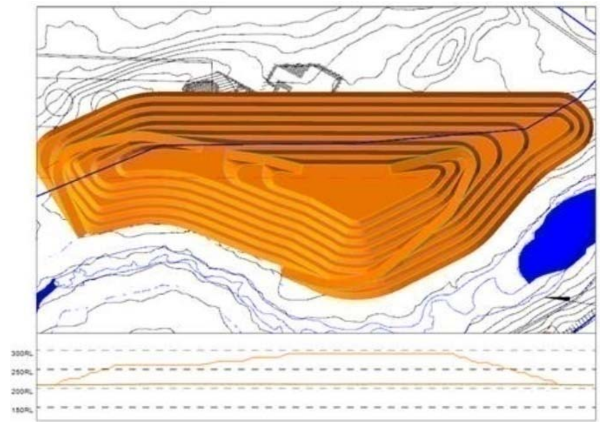
4.8.2 WASTE ROCK AND TAILINGS

The waste rock and the tailings will be placed in **four stockpiles referred** to in this study as the waste rock **stockpiles (Figure 4-8). Also, some of the waste rock will be placed in the northwestern part of the pit when it is mined-out.**

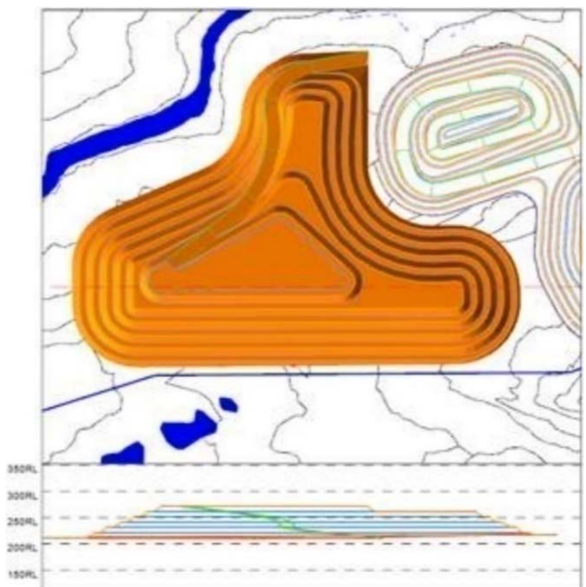
The combined waste rock and filtered tailings will be placed at four different stockpiles named "West", "Northeast", "Southwest" and "East" as identified on Map 4-1. The waste rock piles have been designed to accommodate a total of 31.4 Mt (approximately 18.5 Mm³) of solid filtered tailings and 129.9 Mt (approximately 59.0 Mm³) of waste rock. The east waste rock stockpile will extend to the southeast end of the pit (after all available reserves have been mined) in order to put waste rock there.



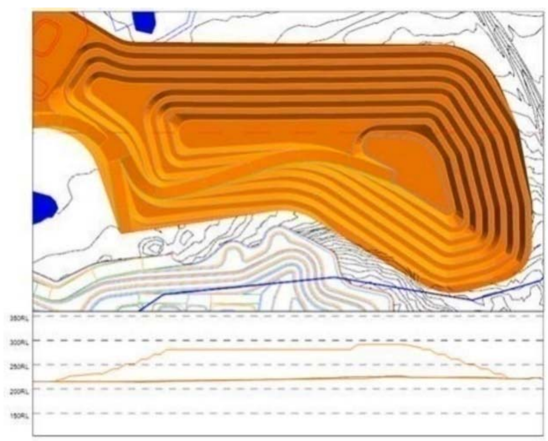
West WRTSF



Northeast WRTSF



Southwest WRTSF (JB1)



East WRTSF

Figure 4-8 WRTSFs Configuration

The WRTSFs were designed taking into consideration the site properties, the design criteria of D019 (MELCC, 2012), as well as the Guidelines for preparing mine closure plans in Quebec (MERN, 2017). The design assumes that the foundation soils have a sufficiently low permeability to meet the maximum infiltration rates allowed by D019. The soils at the proposed sites are described as a non-cohesive granular sand and silt deposit. Infiltration rates measured under the waste rock stockpiles are significantly less than 3.3 L/m2/day (WSP, 2021a).

The location of the WRTSFs was determined to minimize hauling distances from the pit. All stockpiles will be a minimum of 60 metres from the high water mark of streams and lakes, with the exception of the east waste rock stockpile which crosses a segment of an intermittent stream draining Kapisikama Lake. It was already planned that this lake would be drained during the pit operations. The properties of the four WRTSFs are presented in Table 4-17 below.

Table 4-17 Summary of WRTSFs

WRTSFs	Ultimate Footprint Area (ha)	Ultimate Crest Elevation (m)	Maximum Final Height (m)	Slope
West	29.0	260	53	2.5
Northeast	54.4	290	83	2.5
Southwest (JB1)	31.0	270	62	2.5
East	58.1	280	68	2.5

According to the mining plan, the diameter of the blocks will be 900 mm at maximum, with an **average** F50 of **200** mm.

Table 4-18 summarizes the minimum values for slope stability safety factors for waste rock stockpiles recommended in the applicable Canadian Dam Association (CDA) guidelines and D019. For mine closure, surface restoration of the waste rock stockpiles will be required. The Guidelines for preparing mine closure plans in Quebec (MERN, 2017) recommend minimum values for safety factors consistent with those presented in Table 4-18 below.

Table 4-18 Minimum values of the recommended safety factors for the stability of waste rock piles

Conditions	Safety factor
Short term	1.3
Long term	1.5
Pseudo-static	1.1
After an earthquake (if applicable)	1.3

Deposition Plan

The waste rock and tailings will be placed on a solid foundation. **There is no clay under the stockpiles, with the exception of the southwest stockpile where there is a layer of about 1.5 m.** The topsoil and peat will be cleared **around the perimeter. These materials will either be stored in the overburden and peat storage facility or temporarily stored nearby for use as material in the progressive restoration of the WRTSF.**

Runoff water that has come into contact with the materials stored in the stockpiles will be collected by the ditches around the perimeter of the waste rock stockpiles and redirected to the main collection basin in order to avoid the suspension of sediments in the surrounding waterways. The quality of the water drained by the waste rock/tailings mixture will be monitored throughout the operation, as this water is the main effluent.

The co-disposal method consists of constructing a mixed stockpile by mixing the two types of material at the same site. This method was not chosen based on the geochemical characteristics of the materials to be stored, although the geochemical characteristics of the materials were considered. Stacking will be done under unsaturated conditions. Tailings cells will be constructed within the stockpiles and encapsulated by the waste rock, with a transition layer between the two to prevent particle migration. The detailed design of the interior layout for the placement of waste rock and tailings will be completed later (detailed engineering).

Co-disposal offers the following advantages:

— **improved physical slope stability of the stockpile in the waste rock embankment zones;**
— **accelerated consolidation and improved shear strength of the tailings;**
— **reduced risk of embankment failure and loss of tailings containment;**
— **reduced dust generation and erosion of tailings;**
— **improved opportunities for progressive closure.**

The slope will consist of 8.75 m benches for an average resulting slope of 2.3H:1V and berms of at least 5 m. At the top, the slope will be gentle to avoid ponding and prevent water erosion. The stockpiles will reach an elevation of between 260 and 290 m, i.e., between 53 and 83 m above the surrounding natural environment. The volumes **that will be placed in the four waste rock and tailings stockpiles** are presented in Table 4-**19**.

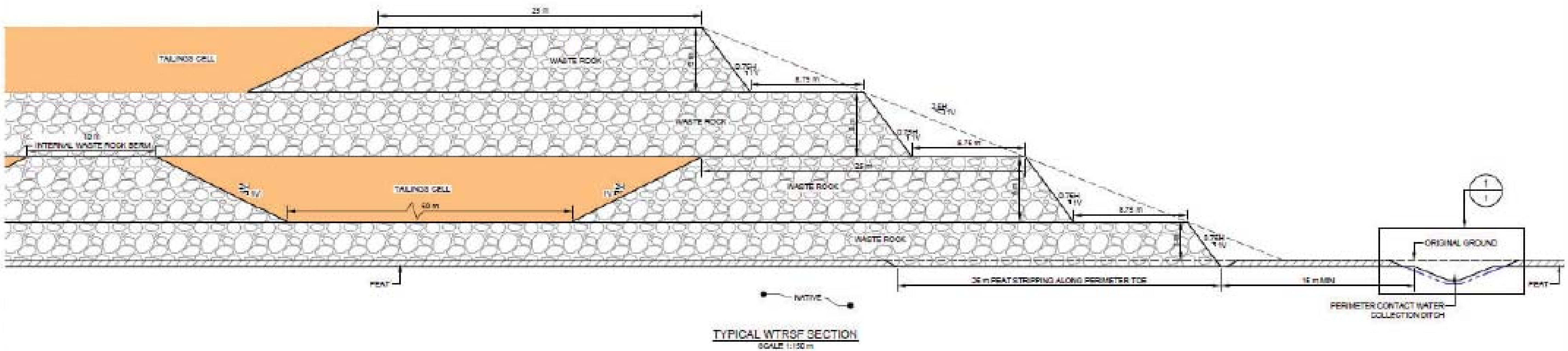


Figure 4-9 Tailings stockpiles - Cross section

Source: Golder Associates Ltd in G Mining Services, 2021

Table 4-19 Volumes of material placed in the WRTSFs

Reference Year	Waste Rock (m³)	Tailings (m³)	Total (m³)	Waste rock stockpile receiving materials
Year 1	2,284,233	1,000,000	3,284,233	East
Year 2	2,748,020	1,000,000	3,748,020	East
Year 3	2,339,979	1,000,000	3,339,979	East
Year 4	2,402,750	1,000,000	3,402,750	East
Year 5	2,720,712	1,000,000	3,720,712	West
Year 6	2,401,705	1,000,000	3,401,705	West
Year 7	2,433,218	1,000,000	3,433,218	West
Year 8	3,545,455	1,000,000	4,545,455	West
Year 9	3,838,761	1,000,000	4,838,761	West
Year 10	4,103,404	1,000,000	5,103,404	West
Year 11	4,023,522	1,000,000	5,023,522	Southwest (JB1)
Year 12	4,276,935	1,000,000	5,276,935	Southwest (JB1)
Year 13	4,193,224	1,000,000	5,193,224	Southwest (JB1)
Rest of LOM	16,900,214	5,450,860	22,351,074	Northeast
Total	58,212,134	18,450,860	76,662,994	-

Source: G Mining Services, 2021.

Fine Tailings Reclamation Project

The current project design allows for the coarse and fine portions of the tailings to be disposed of together in the WRTSFs. This approach is the cheapest option, but it means losing the ability to process fine tailings in the future, should the opportunity arise. A cost-benefit analysis was conducted by Galaxy to look at the possibility of separating fine tailings from coarser tailings and waste rock so that the processing of fine tailings remains possible in the future to recover Li2O content.

Figures 4-10 to 4-13 show a preliminary version of the sections of the stockpiles that contain fine tailings cells. For the first 5 years of operation, the fine tailings would be concentrated in the northeast stockpile for possible reuse at the plant. Thereafter, the disposal would be flexible and adjusted annually. There would be no disposal constraints from a geotechnical standpoint. However, fine tailings would not be placed in the pit.

Northeast WRTSF

Color	Name	Material Model	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)	Minimum Strength (kPa)	Tau/Sigma Ratio	B-bar	Add Weight
	Bedrock	Bedrock (Impenetrable)						0	No
	Clay SHANSEP	SHANSEP	18.5			20	0.22	0.1	No
	Coarse Tailings (Drained)	Mohr-Coulomb	18.7	0	30			0	Yes
	Fine Tailings (Drained)	Mohr-Coulomb	17.6	0	28			0	Yes
	Fine Tailings (Liquefied)	SHANSEP	17.6			0	0.5	0	Yes
	Native Granular (Till)	Mohr-Coulomb	19.5	0	32			0	No
	Peat (SHANSEP)	SHANSEP	14			10	0.3	0.1	No
	Waste Rock	Mohr-Coulomb	22	0	38			0	Yes

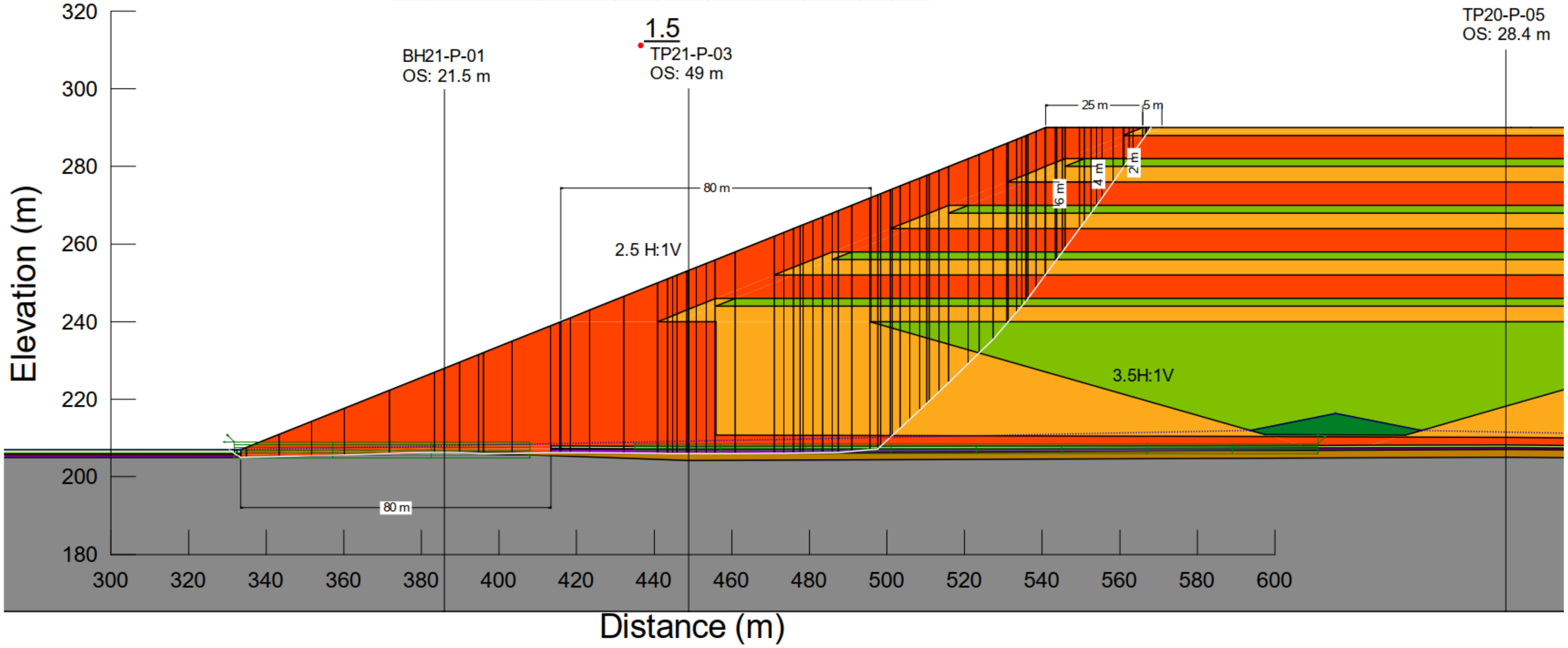


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Figure 4-10 Cross-section of the Northeast WRTSF

Northwest WRTSF

Color	Name	Material Model	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)	Minimum Strength (kPa)	Tau/Sigma Ratio	B-bar	Add Weight
	Bedrock	Bedrock (Impenetrable)						0	No
	Clay SHANSEP	SHANSEP	18.5			0	0.22	0.2	No
	Coarse Tailings (Drained)	Mohr-Coulomb	18.7	0	30			0	Yes
	Fine Tailings (Drained)	Mohr-Coulomb	17.6	0	28			0	Yes
	Native Granular (Till)	Mohr-Coulomb	19.5	0	32			0	No
	Peat (SHANSEP)	SHANSEP	14			10	0.3	0.2	No
	Waste Rock	Mohr-Coulomb	22	0	38			0	Yes

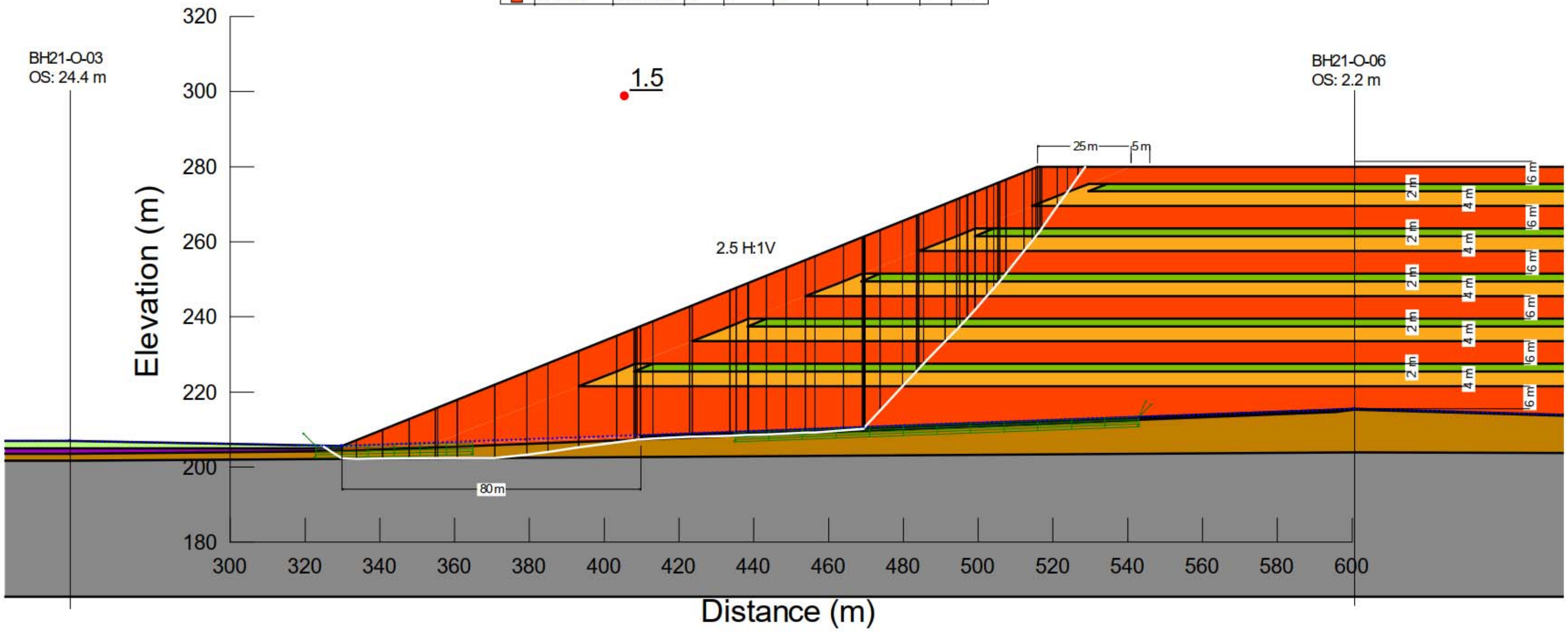

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Figure 4-11 Cross-section of the Northwest WRTSF

Southwest WRTSF

Color	Name	Material Model	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)	Minimum Strength (kPa)	Tau/Sigma Ratio	Piezometric Line	B-bar	Add Weight
	Bedrock	Bedrock (Impenetrable)						1	0	No
	Clay SHANSEP	SHANSEP	18.5			0	0.22	1	0.2	No
	Coarse Tailings (Drained)	Mohr-Coulomb	18.7	0	30			1	0	Yes
	Fine Tailings (Drained)	Mohr-Coulomb	17.6	0	28			1	0	Yes
	Native Granular (Till)	Mohr-Coulomb	19.5	0	32			1	0	No
	Peat (SHANSEP)	SHANSEP	14			10	0.3	1	0.2	No
	Waste Rock	Mohr-Coulomb	22	0	38			1	0	Yes

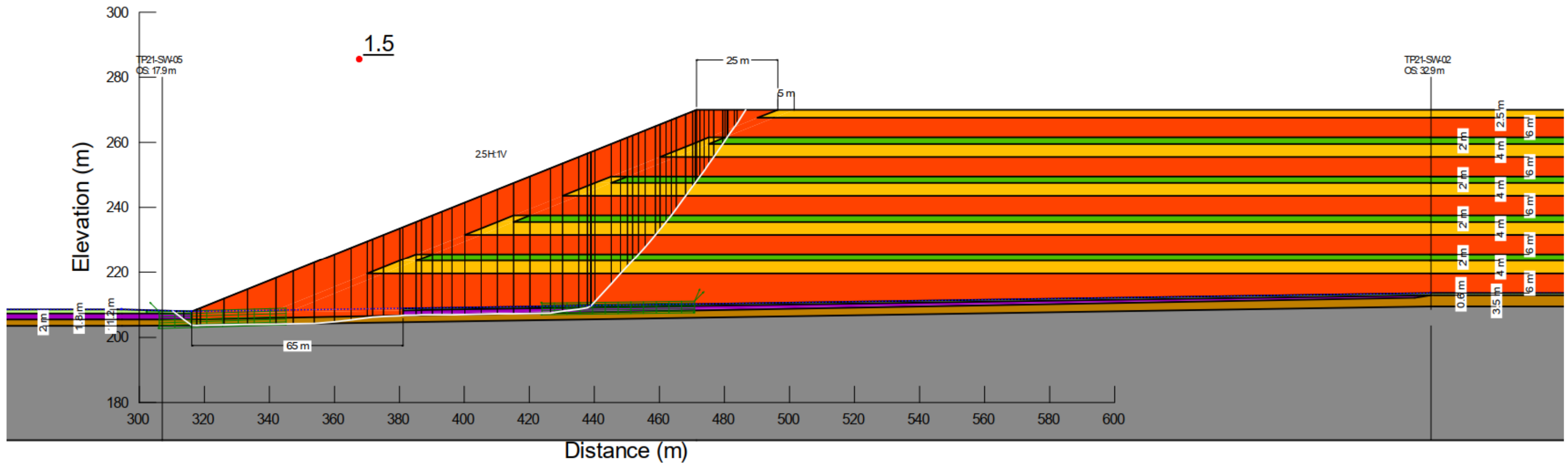

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Figure 4-12 Cross-section of the Southwest WRTSF

Southeast WRTSF

Color	Name	Material Model	Unit Weight (kN/m³)	Minimum Strength (kPa)	Tau/Sigma Ratio	Effective Cohesion (kPa)	Effective Friction Angle (°)	Piezometric Line	B-bar	Add Weight
	Bedrock	Bedrock (Impenetrable)						1	0	No
	Coarse Tailings (Drained)	Mohr-Coulomb	18.7			0	30	1	0	Yes
	Fine Tailings (Drained)	Mohr-Coulomb	17.6			0	28	1	0	Yes
	Native Granular (Till)	Mohr-Coulomb	19.5			0	32	1	0	No
	Peat (SHANSEP)	SHANSEP	14	10	0.3			1	0.1	No
	Waste Rock	Mohr-Coulomb	22			0	38	1	0	Yes

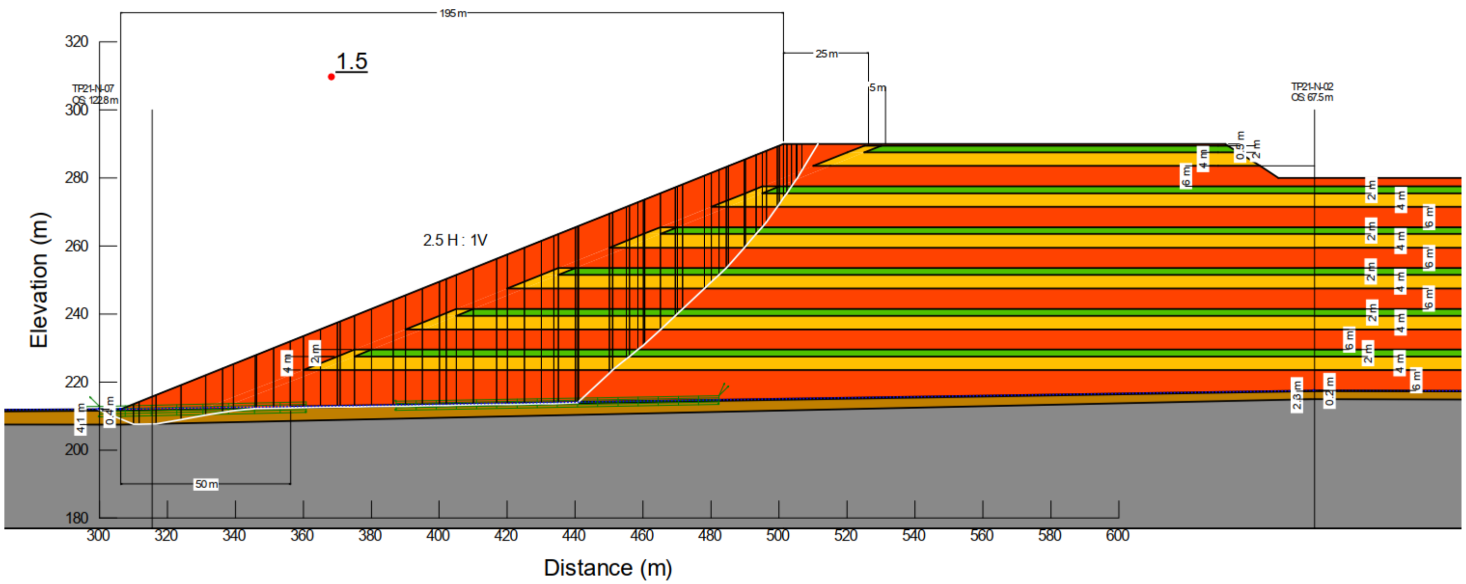

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Figure 4-13 Cross-section of the Southeast WRTSF

Development and operation of waste rock and tailings strorage facilities

A summary of the development and operation of the WRTSFs and water management ponds is presented here:

- **Pre-production (year -1): Under the proposed development plan, the East Water Management Pond and Phase 1 of the North Water Management Pond will need to be constructed in the production period (i.e., year -1). All waste rock mined during the pre-production period will be used to construct the base drainage layer and perimeter containment berms for the East Waste Rock and Tailings Stockpile. The overburden from the pit stripping and site development will be placed in the Overburden and Peat Storage Facility while the runoff will be collected in the North Water Management Pond (Phase 1).**
- **Start-up (years 1 to 4): During years 1 to 4 of mine operation, waste rock placement will occur in both the East WRTSF and the West WRTSF. Tailings will be placed inside the waste rock cells of the East WRTSF only during the first four years of mine operation. During this period, the waste rock to be placed in the West WRTSF will be used to construct the base drainage layer and perimeter containment berms. Contact water from the East Stockpile (containing both waste rock and tailings) will be collected in the East Water Management Pond and pumped to WRTSF (during the disposal of filtered tailings) and will begin in the Northeast WRTSF (to construct the base drainage layer). There may be a final waste rock disposal in the East WRTSF to cover all exposed tailings and achieve the required external waste rock embankment slopes. Phase 2 of the North Water Management Pond will need to be constructed by Year 5 to collect runoff from the Overburden and Peat Storage Facility, the West WRTSF (containing both waste rock and tailings), and the Northeast WRTSF (containing only waste rock during this period). The East Water Management Pond will continue to collect contact water from the East WRTSF.**
- **Years 11 to 13: In years 11 to 13 of mine operation, the tailings will be placed in waste rock cells in the southwest WRTSF (JB1). During this period, waste rock will continue to be placed in the West WRTSF (to cover all exposed tailings and achieve the required external waste rock embankment slopes) and in the Northeast WRTSF (to construct the base drainage layer and perimeter containment berms prior to tailings disposal). Runoff from the Southwest WRTSF (JB1) will be drained to the open pit where it will be pumped to the North Water Management Pond. Phase 2 of the North Water Management Pond will continue to collect runoff from the West and Northeast WRTSFs. The East Water Management Pond will continue to collect contact water from the East WRTSF.**
- **Years 14 to 18.5: During the final years of mine operation, the tailings will be placed in waste rock cells in the Northeast WRTSF. Waste rock disposal during this period will be primarily in the mined-out open pit (i.e., in the eastern extension of the waste rock and tailings stockpile). There will also be waste rock disposal throughout the WRTSFs to cover all exposed tailings and achieve the required external waste rock embankment slopes. Runoff from the Overburden and Peat Storage Facility, the West and Northeast WRTSFs will flow into the North Water Management Pond (Phase 2). The East Water Management Pond will continue to collect contact water from the East WRTSF. Runoff from the Southwest WRTSF (JB1) will continue to flow to the open pit and be pumped to the North Water Management Pond.**
- **Once the planned footprint of each WRTSF has been fully developed (i.e., when the waste rock base drainage layer has been completed), the waste rock will then be used to construct internal disposal cells in all of the stockpiles where the tailings will then be placed to reach the maximum elevations presented in Table 4-17. The development and elevation of waste rock and tailings piles will be done with care to avoid failure of the underlying clay soil foundation, as needed.**

Dikes

The foundations of the planned stockpiles have a natural slope orientation to avoid the construction of berms to contain or direct runoff. A collection ditch is planned in the stockpiles in order to direct the water to the water catchment basins.

4.8.3 ORE

As presented in section 4.6, the blasted material is first stored on the ROM pad. This stockpile has a **minimum** capacity of **20,000** tonnes (loose). The pad is designed to allow the trucks to access, circulate, and place the blasted material on a temporary stockpile. The ROM pad is adjacent to the industrial and administrative area (Map 4-2); the designed geometry of the pad is shown on Figure 4-**14**.

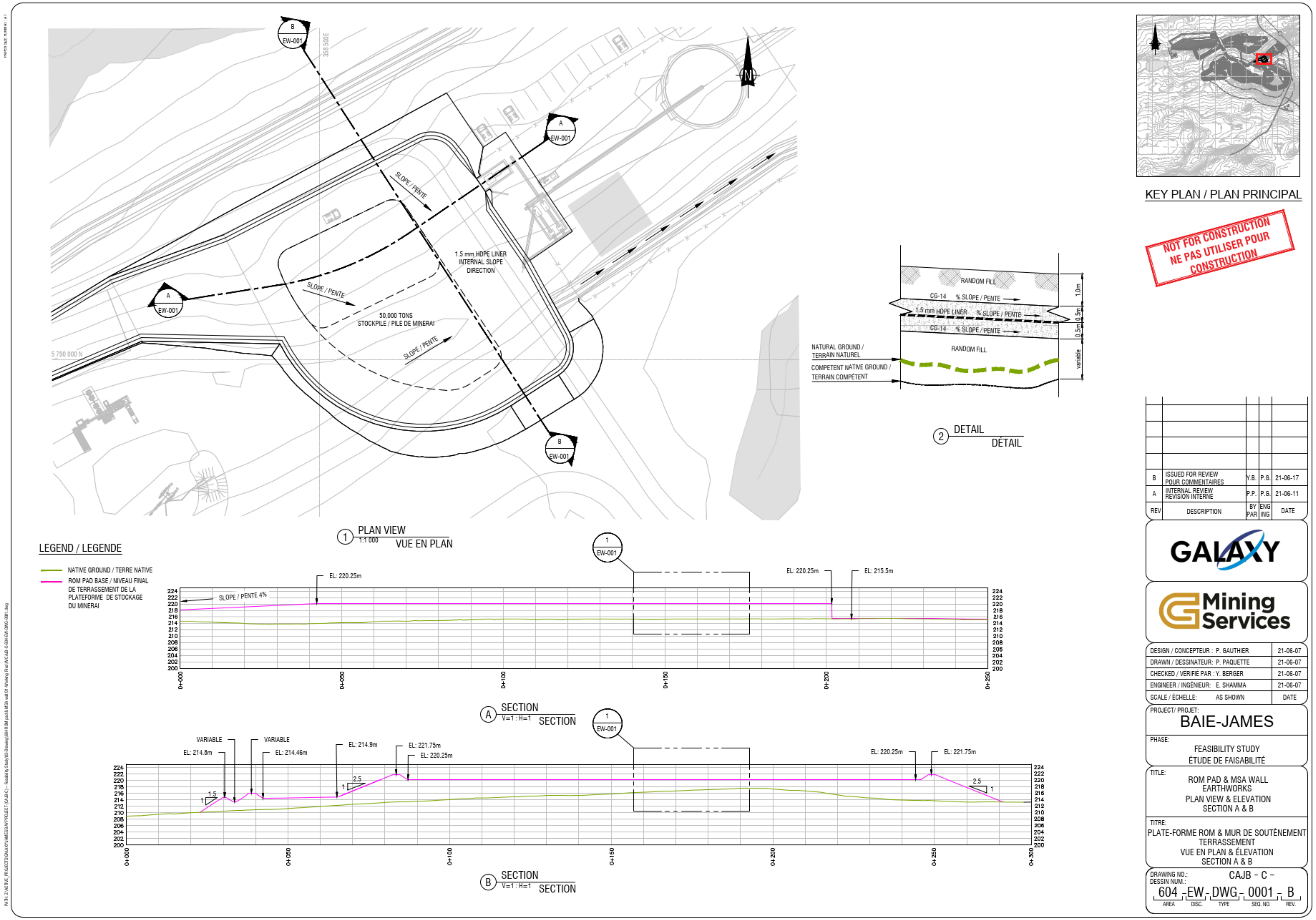


Figure 4-14 Design and cross-sections of the ROM pad

Source: G Mining Services, 2021.

The ore is classified as leachable for various parameters (As, Mn, Cu, Zn, etc.) as defined in D019, and groundwater and surface water protection measures are planned for on-site ore storage. However, ore storage will be sporadic and short-lived, and the ore will then be sent to the processing plant. The ore pile and the industrial water pond (the one located between the camp and the concentrator) will be waterproofed with an HDPE geomembrane. The water draining from the pile will be directed to the industrial water pond and the water from this pond will be redirected to the concentrator.

Construction Material Selection

In order to carry out the activities, i.e., loading the main crusher using a front-end loader, it was proposed that the stockpile crest be at an elevation of approximately 215 m; this is approximately 8 m above the existing ground. In view of the planned volume of the stockpile, an area of approximately 120 m by 140 m is required. In accordance with safety regulations, a perimeter berm with a height greater than the radius of the largest machine wheel is required at the crest. The proposed berm will be 1.5 m high. Stone (0-600 mm) of suitable material will be used to build the stockpile with the required elevation.

Preparation of the foundation soil will include excavation and grading of the site to create a usable and low-maintenance ground surface that does not flood or erode. In order to prevent erosion of the outer slopes, a 200 mm thick layer of plant cover will be laid. For the road surface, a 150 mm thick layer of crushed rock (maximum 80 mm) will be placed on a 650 mm thick base layer of rock (0-450 mm).

Drainage

Site grading will be consistent with the following:

— design a surface water management system for the platform;

— provide an adequate surface slope for the platform to minimize stormwater runoff on the platform.

The ROM pad design includes an impermeable layer. The ROM pad will be graded at a 2% downslope to a gravity ditch and a pumping station (if required in detailed engineering) designed to allow water that has been in contact with the stockpile to be discharged to the sedimentation pond in the industrial and administrative sector. A perimeter ditch will be constructed at the low points of the natural terrain. Where required, a berm will be constructed to direct runoff water to the gravity ditches. The height of the berm will comply with the requirements for water containment structures in D019 as well as the *Safety Code for the construction industry* (Government of Quebec, 2018).

4.9 WATER MANAGEMENT

Water management infrastructure, water balance, and specifics of the main project phases (construction, operations, and rehabilitation) are described in the following sections. The project will include **a single clean water discharge site at the CE2 watercourse**.

4.9.1 DESIGN PARAMETERS

For mining projects in northern Québec, the issues and risks associated with low water reserves can be entirely avoided with well-defined operational procedures and controls. The following elements will be implemented:

- The commissioning of the mine is planned to follow a spring melt event (late May to early June). Even with a low snow-pack year, the spring melt event will generate enough runoff to meet the needs of commissioning without requiring supplementation from natural sources. The risk of delays due to inadequate water reserves can be further alleviated by completing the construction **of the waste rock stockpile water retention basin dike** during the previous summer. This would allow for the accumulation of a few months of rain water prior to winter.

- **The design of the north water retention basin provides for a minimum emergency water supply (liquid and accessible) equivalent to the amount needed to meet the ore processing plant demand of 30 m³/hr for approximately 50 days.**
- An additional quantity of water must be kept in the **north** water **retention** basin before prior to the onset of winter. This volume is needed to account for losses due to an **estimated** surficial ice formation **thickness of 2 m** and to a prolonged period (typically from November to **April**) where **liquid** precipitations cease. **The quantity of water to be reserved at the end of November varies with mine site development and is estimated to be 500,000 m³ for operating years 1 through 3 and 1,000,000 m³ for operating years 4 through 19.**

The preliminary design result indicates that the annual water balance for the project is positive even in dry years, and site runoff and pit dewatering water can supply the water demand from the ore processing plant. We expect effluent to discharge to the environment in all operating years. In a subsequent **design** phase, general operational and **regulatory** criteria **will be** considered **depending on the type of water management infrastructure to be constructed, for:**

- The design flood management;
- The freeboard;
- The water quality standards;
- The water treatment capacity.

Design Flood Management

As specified in the D019, water retention basins associated with tailings and/or **mining** waste rock **management** facilities must be designed to manage the design flood in a 30-day period. This is defined as the contact water volume generated by a 30-day spring melt event with a 100-year return period, combined with the contact water volume generated by a 24-hour rain event with a 1,000-year return period. Also specified in D019, all water management infrastructure without the permanent ability to retain significant water reserves must be designed to safely manage a storm event with a 100-year return period. **Again under D019, retention basin emergency overflow must be designed to discharge a probable maximum flood (PMF).**

The sedimentation basin of the overburden stockpiles is not associated with an area used for the permanent storage of mining waste as defined by D019. No volumetric flood storage requirements are thus imposed. The basin can therefore be regarded as a type of water treatment facility. As such, it must be dimensioned so its effluent will meet water quality requirements.

Freeboard

A freeboard of 1.0 m is recommended by D019 when there are no sensitive receptors downstream of the dike (ecological reserves, water sources, etc.). The freeboard of this project is 1.5 m to account for possible variations with regards to climate change. **No additional calculations were performed to determine the freeboard height.**

Effluent Water Quality Standards

The D019 and the MDMER mining effluent regulations apply to both effluent discharge **locations (CE2 watercourse)**.

Water Treatment Capacity

The WTP must be capable of dewatering surplus volumes of water generated by a wet year such that the water level in the basin can be brought down to an established pre-winter target. For this criterion, a wet year is defined as a year with a total precipitation accumulation with a 10-year return period, combined with the supposition that the basin that will receive the water will be at its capacity at the beginning of spring.

4.9.2 INFRASTRUCTURE

Surface water management strategy

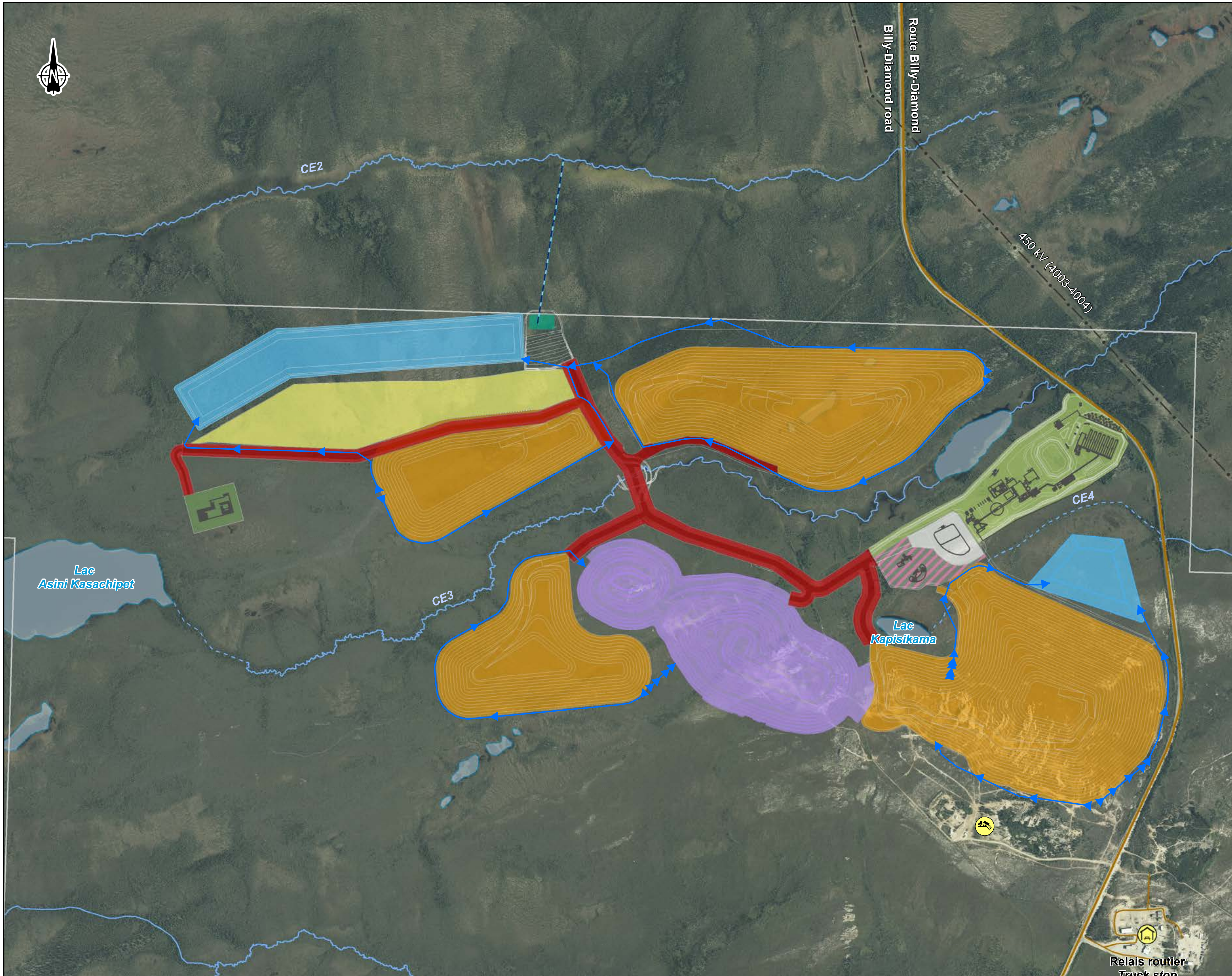
The proposed surface water management strategy for the site has been developed in conjunction with the design of the tailings, waste rock and overburden accumulation areas and in consideration of the proposed preliminary site development. All runoff from precipitation that falls on areas affected by mining is considered "contact water". Contact water will be collected and stored before treatment (if required) and discharged to the environment (Map 4-7).

The project's surface water management strategy includes the following:

- **Diverting natural runoff around areas affected by mining to limit mixing of natural runoff with contact water.**
- **Limiting the mixing of natural runoff with contact water (i.e., reducing the volume of contact water requiring management).**
- **Limiting the risk of contact water discharge to the environment.**
- **Collecting all runoff and seepage water from tailings, waste rock and overburden accumulation areas. Contact water from these areas will be collected in collection ditches and directed to the water retention basins or the open pit. Water collected in the east water retention basin and the open pit will be pumped to the north water retention basin, which is the main water management pond for the site.**
- **Prioritize reuse (i.e., recovery) of contact water.**
- **Have a single final effluent point (CE2 watercourse).**

Based on the results of the preliminary engineering study, the north and east retention basins will have a maximum water storage capacity of 1,360,000 m^3 and 180,000 m^3 respectively, which provides sufficient capacity to contain the design flood recommended by Directive 019 without discharge to the environment during spring melt and to meet process water needs throughout the year.

Sludge will accumulate in the water management ponds throughout the project. We have not yet assessed the expected sludge quantities. This is an operational constraint that should be managed in compliance with applicable laws and regulations. A specialized contractor will remove the accumulated sludge from the ponds if required. This sludge will then be analyzed and managed accordingly.



Limite de propriété / *Property limit*

Composantes du projet / *Project Component*

- Route / *Road*
- Effluent minier / *Mine effluent*
- Usine de traitement de l'eau / *Water treatment plant*
- Secteur administratif et industriel / *Administrative and industrial sector*
- Fosse / *Pit*
- Halde à minerai / *ROM pad*
- Halde à stériles / *Waste rock stockpile*
- Halde à matières organiques et dépôts meubles / *Overburden and peat storage facility*
- Entrepôt à explosifs / *Explosives magazine*
- Aire d'entreposage / *Dry storage area*
- Usine à béton (temporaire) / *Concrete batch plant (temporary)*
- Bassin de rétention d'eau / *Water retention basin*
- Sens d'écoulement des eaux / *Direction of water flow*

Infrastructures / *Infrastructure*

- Route principale / *Main road*
- Route d'accès / *Access road*
- Ligne de transport d'énergie / *Transmission line*
- Relais routier / *Truck stop*
- Lieu d'enfouissement technique isolé / *Isolated technical landfill*

Hydrographie / *Hydrography*

- CE3 Numéro de cours d'eau / *Stream number*
- Cours d'eau permanent / *Permanent stream*
- Cours d'eau à écoulement diffus ou intermittent / *Intermittent or diffused flow stream*
- Plan d'eau / *Waterbody*

GALAXY

Mine de lithium Baie-James / James Bay Lithium Mine

Carte / *Map 4-7*
Gestion des eaux en phase d'exploitation /
Water management during the operation phase

Sources :
Othoimage : Microsoft Bing (ESRI, 2017)
Gestim : MRNF Québec, 210315
Données du projet / Project data : Galaxy 2020

0 150 300 m
UTM, fuseau 18, NAD83

Juillet / *July* 2021

Dessin : A. Masson
Approbation : C. Martineau
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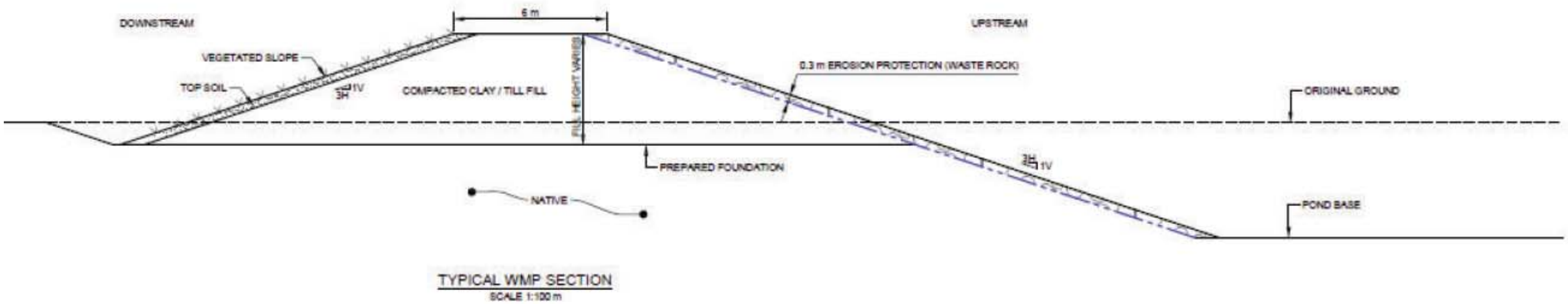


Figure 4-15 Dike cross-section

Source: Golder Associates Ltd dans G Mining Services, 2021.

Water treatment plant

The WTP is designed to treat water from the water retention basin (if measurements show noncompliance).

Based on the water quality modelling results (WSP, 2021b) presented in Appendix B, year 9 of operation may show arsenic concentrations over D019. The effluent will be carefully monitored to ensure that discharged water complies with environmental standards (Chapter 10). When arsenic (or other metal) concentrations approach the maximum environmental standards, the WTP will be constructed and ready to treat the effluent before discharge to the environment to ensure that discharge standards are not exceeded. A WTP construction permit application will be made at the appropriate time before the construction of this treatment unit.

As per D019's definition, waste rocks and tailings are considered as low risk. Therefore, according to this directive, a water treatment plant is not necessary. However, some parameters do not meet the environmental discharge objectives (EDOs). The effluent will be subjected to testing before being discharged to the environment and discharge will be stopped in case of noncompliance with D019 criteria. Absorbents will be available in case of SS or HC contamination. If pH, iron or any other metal exceeds the criterion, batches could be treated directly in the basin.

Considering the low leaching results which are close to the EDO boundary values, it is impossible to determine if it is necessary, and technically possible, to reach the EDO lower boundary values at the moment. We believe that we need to wait for the analysis results following a full year of production before establishing the treatment chain. The project costs integrate space and financial reserve, but we will work out the plant design details only when we know the parameters and intensity of treatment required.

Concerning the disposal of the treated sludge, when disposal is required, it will be analyzed and will either be directed to the tailings and waste rock facility or considered as contaminated soils or residual hazardous materials after discussion with MELCC representatives. The quantity is difficult to estimate, but it will certainly not be comparable to that generated by systems that treat acidic water. There may not even be any treatment sludge.

Mining ***effluent***

The CE2 watercourse **effluent will include**:

- construction of an overflow or channel to allow for flow measurement (e.g., Parshall flume);
- pH, temperature and water outflow monitoring instruments;
- energy dissipation measures to reduce water velocity and minimize sediment disturbance.

These elements will be installed upstream of the watercourse discharge point and will be designed at a later date (during the detailed engineering study).

Sanitary effluent

After treatment, the sanitary effluent will be discharged to CE4 (see Section 4.10.2).

Drinking water well

During the construction phase, tank trucks will supply potable water during the construction of the water wells and water treatment infrastructure. We estimate the drinking water requirement at 63 m³ per day for the maximum number of 280 workers. The water will be stored in a 400 to 500 m³ insulated and heated water tank.

The operation phase will require two to three wells to meet the potable water needs of 41 m³ per day for 150 workers. The potable water supply will include a treatment plant and pipe insulation or heating to the camp and treatment site. **The wells will be located near the workers' camp.**

Based on the area's hydrogeological characteristics, the bedrock aquifer has been identified as being usable. According to the studies carried out, the permeability of the rock varies depending on its nature and its degree of fracturing.

A water search will enable us to target sectors favourable to exploiting potable water and, subsequently, build open wells in the rock. The diameter is to be determined, but will most likely vary between 6 and 8 inches at a depth between 30 and 100 m. A submersible pump installed in the well will be used to draw water for the camp. The number of wells to be constructed will depend on the aquifer capacity at the location of the drill holes. Two wells are currently proposed.

4.9.3 WATER BALANCE

A monthly water balance study was conducted as part of the preliminary engineering study for the project's operation phase, taking into consideration the major project water flows presented in Figure 4-15. The water balance study considers the 19 years of project operation to estimate effluent volumes to the CE2 watercourse and to define a water management strategy for the north water retention basin, ensuring water supply to the ore processing plant. The main water balance study results are as follows:

- The annual runoff volume generated by the site exceeds the process water demand, even under dry weather conditions. There is, therefore, a surplus of water that must be managed at the north water retention basin and discharged as effluent to the CE2 watercourse.
- The proposed operating strategy for the north retention basin keeps the water level below the emergency overflow level, even in wet weather years. This strategy will be reassessed or confirmed in a later phase of the project, taking into consideration the water pumping and treatment system design.

Water will not be drawn from the watercourses. The north water retention basin and the ore storage area raw water basins will supply water for the concentrator, fire protection and dust control (250 m^3/day).

Table 4-20 provides an estimate of the annual final effluent volumes to the CE2 watercourse.

Table 4-20 Final effluent volume to CE2

Year of operation	Effluent (m^3) according to the climate scenarios			
	Average historical conditions	Dry year 1:25	Humid year 1:25	Average conditions considering the potential effects of climate change
1	702,400	556,900	849,300	761,900
2	650,500	495,600	807,500	713,400
3	909,100	716,300	1,103,600	985,300
4	1,054,600	705,900	1,406,600	1,202,400
5	1,439,700	1,090,000	1,792,800	1,587,900
6	1,541,500	1,171,100	1,915,500	1,697,100
7	1,721,500	1,311,200	2,135,600	1,891,200
8	1,978,000	1,535,300	2,424,900	2,159,200
9	1,900,800	1,455,400	2,350,500	2,083,000
10	1,891,700	1,447,300	2,342,200	2,074,200
11	1,904,700	1,456,800	2,356,800	2,087,700
12	1,911,500	1,463,700	2,365,100	2,094,900
13	1,785,400	1,366,700	2,209,700	1,958,500
14	1,786,300	1,366,800	2,211,400	1,959,700
15	1,791,300	1,367,200	2,219,500	1,966,000
16	1,811,200	1,385,100	2,241,300	1,986,500
17	1,770,800	1,344,100	2,203,300	1,946,800
18	1,649,300	1,255,000	2,049,000	1,813,800
19	1,464,500	1,070,200	1,864,200	1,629,000

Source: Golder Associated Ltd., 2021.

Table 4-21 presents the average final water effluent discharge volumes on a monthly basis for years 3 and 9 of operation and for the different climate scenarios considered.

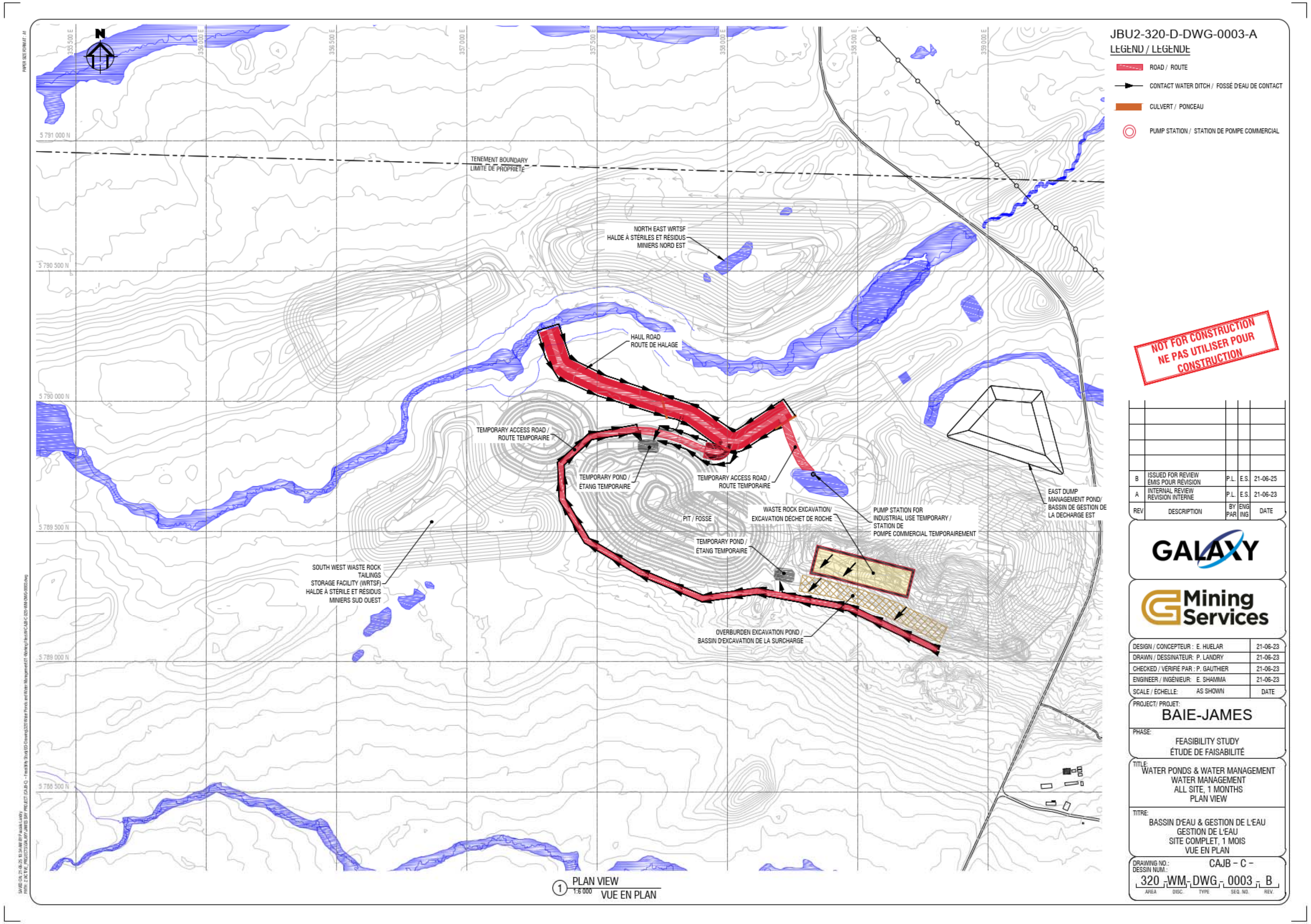
Table 4-21 Final water effluent volume to CE2 per month for years 3 and 9

Month	Effluent (m³) according to the climate scenarios							
	Average historical conditions		Dry year 1:25		Humid year 1:25		Average conditions considering the potential effects of climate change	
	Year 3	Year 9	Year 3	Year 9	Year 3	Year 9	Year 3	Year 9
1	79,570	152,790	76,830	148,060	82,340	157,560	82,650	158,920
2	76,140	147,110	74,210	143,710	78,100	150,540	78,560	152,150
3	77,540	148,800	75,280	145,010	79,820	152,630	79,160	152,650
4	80,670	155,250	77,670	149,940	83,700	160,610	82,740	159,470
5	0	0	0	0	0	0	0	0
6	0	0	0	0	15,040	94,620	0	0
7	84,000	217,850	0	11,700	155,360	331,330	109,540	284,130
8	95,520	218,420	73,220	167,190	116,430	270,140	101,990	236,120
9	140,300	308,530	109,060	236,100	171,840	381,640	153,310	338,700
10	143,260	317,280	111,320	242,800	175,500	392,470	156,540	348,270
11	45,510	69,560	36,560	53,340	54,500	85,930	50,100	78,790
12	86,540	165,240	82,160	157,580	90,960	172,970	90,960	173,780

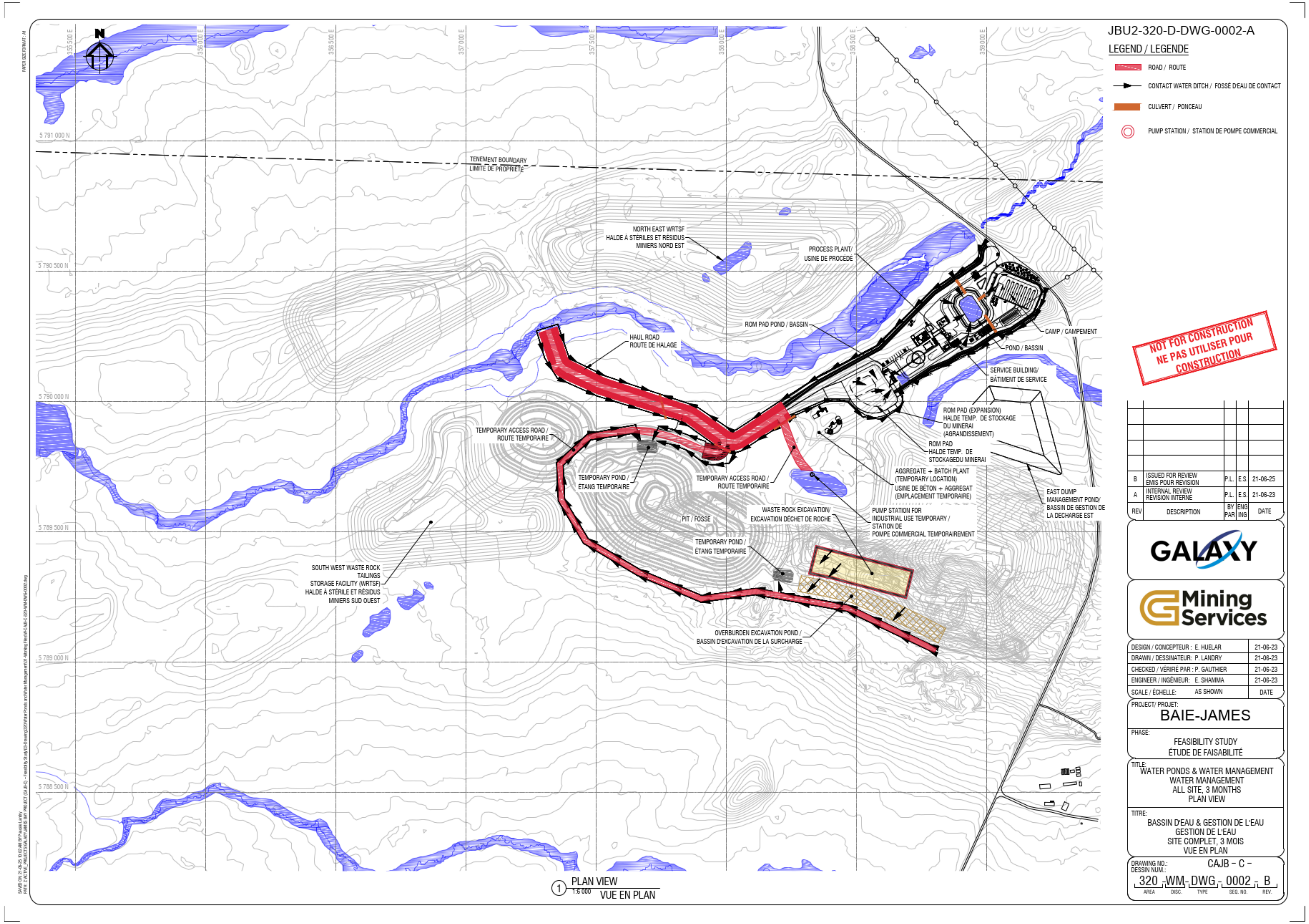
Source: Golder Associated Ltd., 2021.

4.9.4 DURING THE CONSTRUCTION PHASE

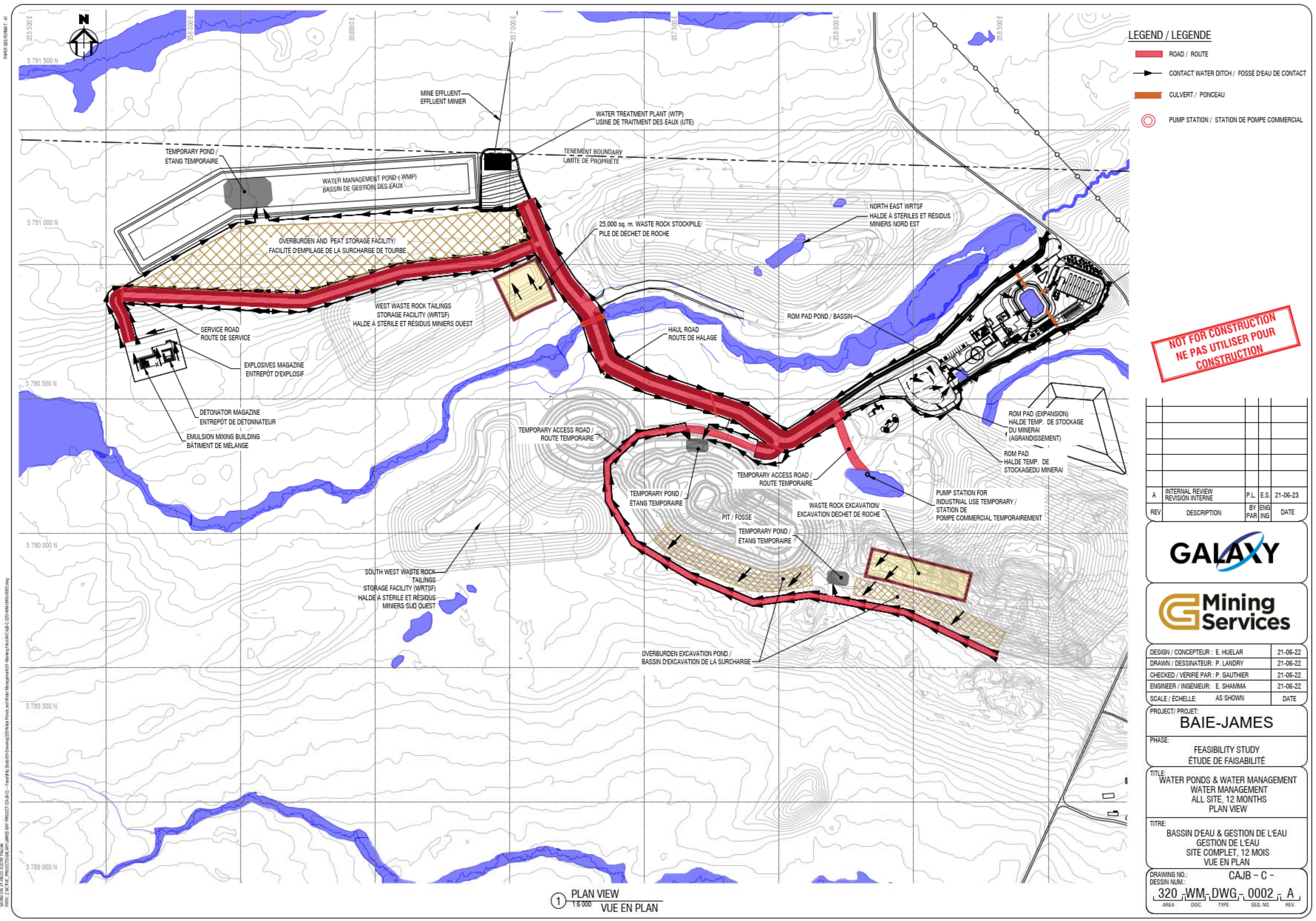
Maps 4-8 to 4-10 show the water management infrastructure planned for the construction phase. The progress of site construction and associated water management infrastructure is presented for months 1, 3 and 12 of the construction phase.



Map 4-8 **Water management infrastructure during the construction phase (1st month)**



Map 4-9 Water management infrastructure during the construction phase (3rd month)



Map 4-10 Water management infrastructure during the construction phase (12th month)

During construction, water will be managed by the same clean water network as during operation. The collected water will be channelled to the main water management pond. Water will be treated mechanically at the outlet of the collection ditch network. Indeed, the sedimentation of suspended solids (SS) will occur in the basin designed for this purpose. Then, sediment barriers combined with absorbent socks will be installed at the basin's outlet to avoid the discharge of SS or possible petroleum products. This equipment will, therefore, help treat the water at the outlet of the basin before discharge to CE2.

The project plans no watercourse diversion or dewatering activities during infrastructure construction. The project has designed the facilities and the overall mine site footprint to avoid existing watercourses to minimize the impact on the aquatic environment. A single culvert spanning CE03 and reaching the waste rock stockpiles to the north, the organic and overburden stockpile, the north water management pond and the explosives magazine is planned. The design of the culvert will comply with NOR 05[1] and outside the periods defined by the FAU 01[2] measure, as described in Chapter 7.

The only water body that will be dewatered is Lake Kapisikama. Construction activities will, however, not cause the dewatering of this water body. The lowering of the water table during the operation phase of the mine will cause dewatering. The development of a compensation plan will address the loss of habitat caused by this dewatering. As required by Section 101 of the Mining Act, the full rehabilitation and restoration plan will be prepared at a later stage and will include the fate of this water body site.

Runoff water and spill control measures will be implemented throughout the construction phase to prevent the introduction of suspended solids (SS) into watercourses (sediment barriers, erosion control mats) as well as contamination of watercourses in the event of an accidental hydrocarbon spill during construction (use of absorbent and recovery materials). Chapter 7 presents these measures. There will be no effluent during the construction phase. All water will be collected in large capacity retention basins. Furthermore, the basin outlets will be equipped with a sediment curtain and a hydrocarbon absorbent sock installed as a preventive measure to contain any accidental spill.

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1 NOR 05: Install culverts or crossing structures designed to maintain the free flow of water (and the free passage of fish). The construction of bridges or the installation of culverts shall not reduce the width of the watercourse by more than 20%, as measured from the natural high-water mark. The base of the lower culvert shall be driven below the natural bed of the watercourse at a depth of not less than 15 cm or 10% of the height of the structure and its ends shall extend beyond the base of the embankment by not more than 30 cm and be adequately stabilized.
Reference: Regulation respecting the sustainable development of forests in the domain of the State.

2 FAU 01: Perform work in water outside the different breeding periods of the species present, from September 15 to December 1, inclusively.

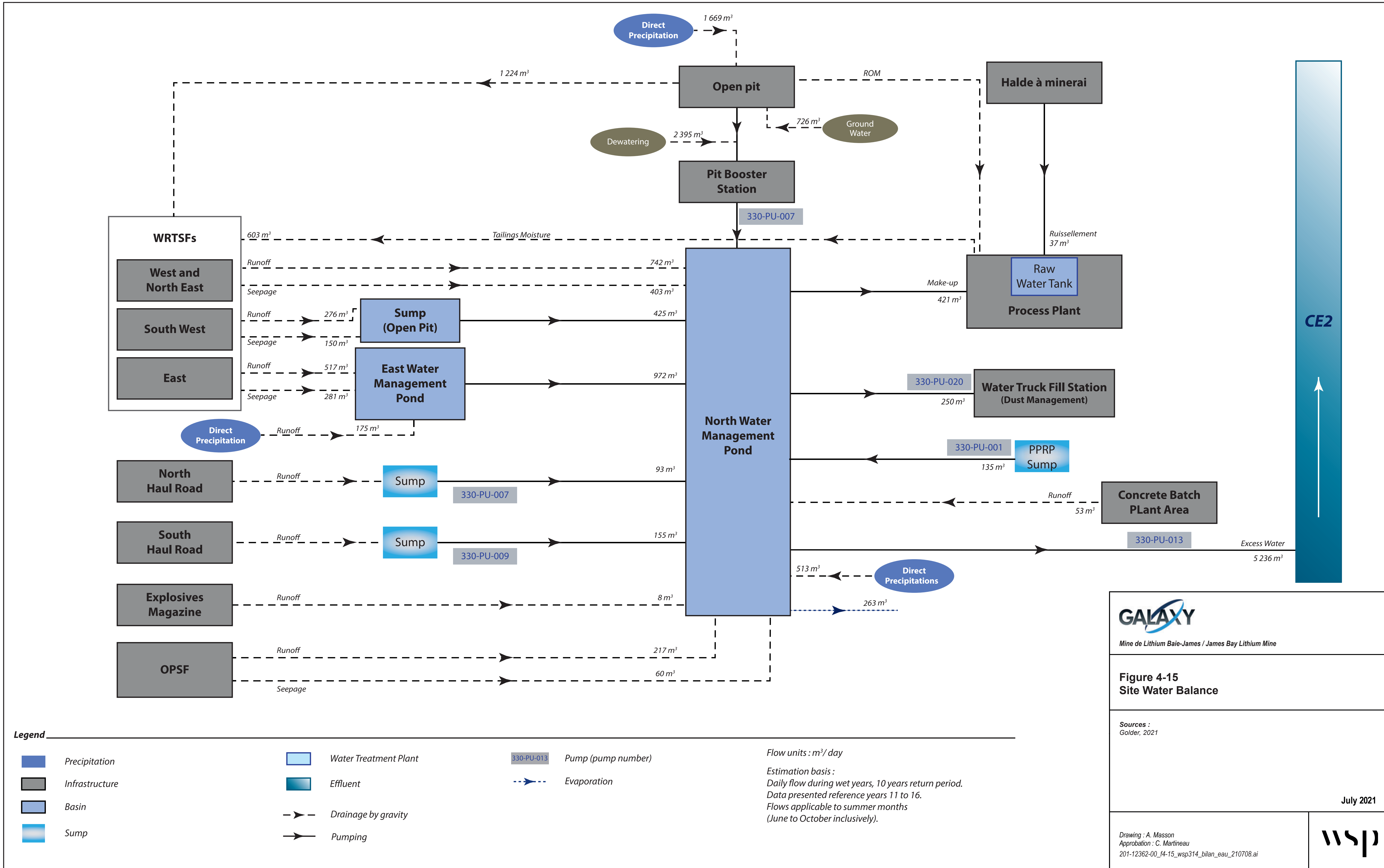

Figure 4-15
Site Water Balance

Sources :
Golder, 2021

July 2021

Drawing : A. Masson
Approbation : C. Martineau
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The pit overflow will be constructed with a low permeability core covered in compacted granular material and riprap. The invert of the overflow will be protected with riprap of larger dimension to accommodate higher velocity flow. The preliminary design of this infrastructure will be completed in the closure plan that will be submitted to MERN at a later phase of the permitting process. A preliminary ground water flow model has indicated that the pit would fill with water in between 120 to **180** years **(WSP, 2021a)**.

4.10 EMISSIONS, DISCHARGES AND WASTE MANAGEMENT

4.10.1 AIR EMISSIONS

Air emissions types and locations throughout the mining site as summarized in Table 4-**22**, while those of the industrial and administrative sector are presented in Table 4-**23**. The noise components of air emissions are associated with drilling, blasting and hauling activities. Noises sources specific to the industrial area are also presented in Table 4-**22**. A dust management plan for the handling of waste rock and tailings was prepared for the project **by Stantec (2021). Appendix C presents the modelling report and the dust management plan.** Water will be used as a dust suppressant. Several variables have been considered in the design of the spray system, e.g. dust particle size, spray drop size, etc. The following criteria and assumptions were accounted for in the dust management plan:

- Equipment that require dust management;
- Dust suppression will be conducted using a 20 m^3 water spray truck;
- To minimize water consumption, the droplet size of the spray system along with pressure will be accounted for;
- Dust reduction factor of 75%;
- Source of water: treated **domestic** water from WTP;
- Road length: 1-) from mine to ROM pad, 2-) from process plant to waste rock stockpile and 3-) from mine to waste rock stockpile;
- Period: from May to September.

The water volume requirements will vary with the various project phases. However, during operation, water requirements will total 500 m^3 per day.

The project's GHG emissions have also been estimated. Table 4-**24** presents the total direct emissions as estimated. Appendix C details the GHG calculation methods.

The quantity of GHG emissions caused by all direct activities during the construction, operation and rehabilitation phases is **615,200** tCO_2eq. During the life of the project, the average annual emissions will be **32,379** tCO_2eq. **During the operation phase, the average annual emissions will be 32,273 tCO_2eq. Indirect project emissions have been estimated at 12,137 tCO_2eq.**

Table 4-22 Mining air emissions – Types and locations

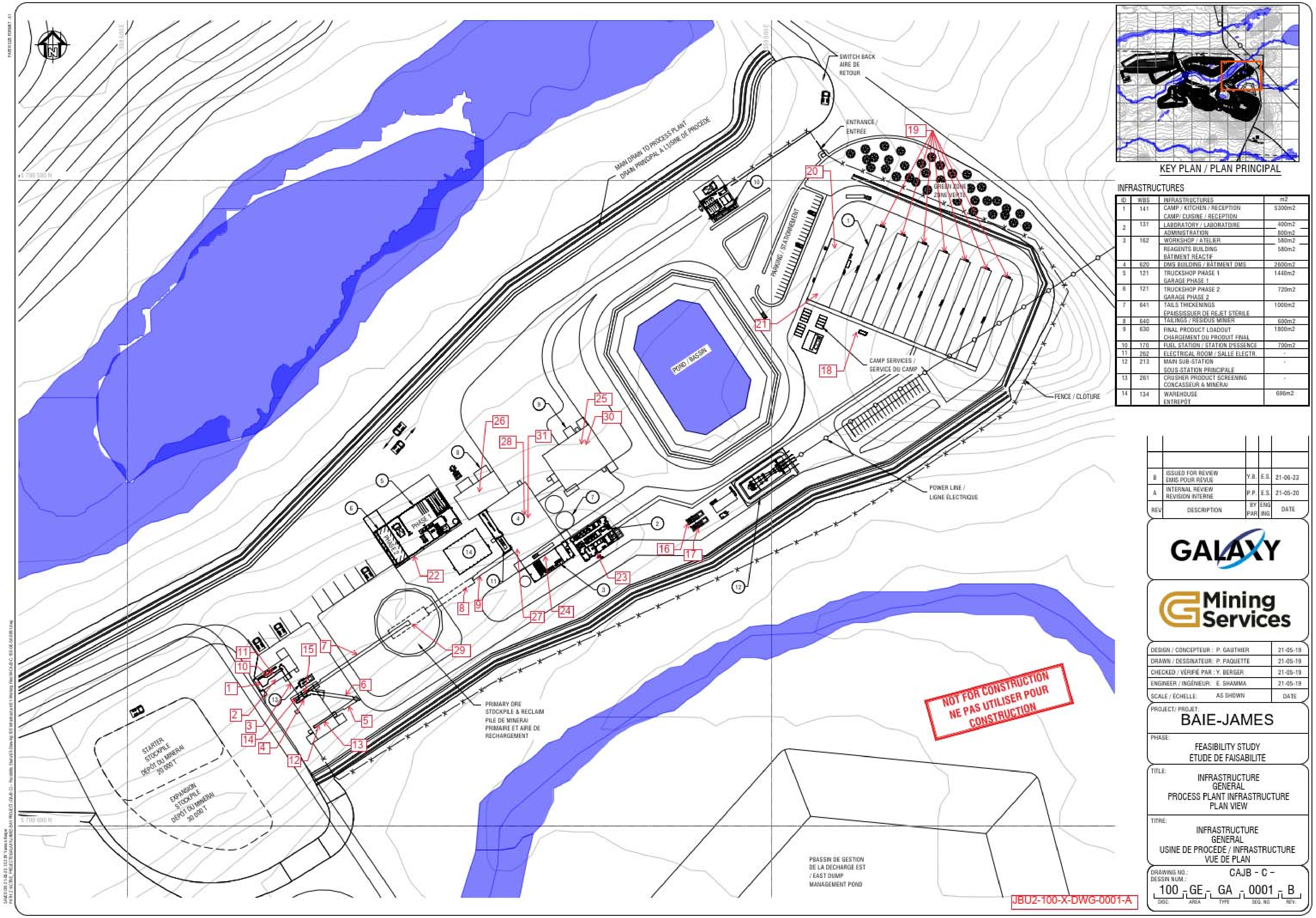
Emission Type	Location	Project Phase
Blast gases	Pit	Operation
	Quarry	Construction / Operation
	Borrow pit	Construction
Dust	Pit	Operation
	Construction quarry	Construction / Operation
	Access roads	Construction / Operation / Rehabilitation
	Haul roads	Construction / Operation / Rehabilitation
	ROM pad	Construction / Operation / Rehabilitation
	Industrial area	Construction / Operation / Rehabilitation
	Waste rock and tailings **storage facilities**	Construction / Operation / Rehabilitation
	Overburden and peat storage facility	Construction / Operation / Rehabilitation
	Concrete batch plant / Dry storage area	Construction / Operation
Exhaust gas – Fixed equipment	Industrial area	Construction / Operation / Rehabilitation
	Workers' camp	Construction / Operation / Rehabilitation
Exhaust gas – Mobile equipment	Pit	Operation
	Construction quarry	Construction / Operation
	Access roads	Construction / Operation / Rehabilitation
	Haul roads	Construction / Operation / Rehabilitation
	ROM pad	Construction / Operation / Rehabilitation
	Waste rock and tailings **storage facilities**	Construction / Operation / Rehabilitation
	Overburden and peat storage facility	Construction / Operation / Rehabilitation
	Concrete batch plant / Dry storage area	Construction / Operation
Ventilation	Industrial area	Construction / Operation / Rehabilitation
	Workers' camp	Construction / Operation / Rehabilitation

*Source: **G Mining Services, 2021**.*

Table 4-23 Air emissions in industrial and administrative area – Types and locations

Emission Type	Area	ID [a]	Source	Project Phase
Dust	Crushing and screening	1	**ROM pad**	Operation
		2	Primary crushing building dust collector	Operation
		3	**Primary screen** feed conveyor	Operation
		4	**Secondary and tertiary crushing building dust collector**	**Operation**
		5	Secondary **and tertiary** crusher conveyor	Operation
		6	**Secondary screen feed** conveyor	Operation
		7	Crushed feed material conveyor	Operation
	Crushed feed material dome	**8**	**Recovery tunnel** dust collector	Operation
		9	DMS feed conveyor	Operation
	Tailings and product handling	**25**	**Product storage and loading**	**Operation**
		26	**Tailings storage and loading**	**Operation**
Noise	Crushing and screening	**10**	Vibrating grizzly	Operation
		11	Primary crusher	Operation
		12	Secondary crusher	Operation
		13	Tertiary crusher	Operation
		14	Primary sizing screen	Operation
		15	Secondary sizing screen	Operation
	DMS	**27**	Sizing screen	Operation
	Recrusher	**28**	Crusher	Operation
	Crushed ROM pad	**29**	ROM pad	Operation
	Tailings and product handling	**30**	Product handling and loading	Operation
		31	Tailings handling and loading	Operation
Noise / Exhaust gas	Main substation	**16**	Diesel generator no. 1	Operation
		17	Diesel generator no. 2	Operation
	Workers' camp	**18**	**Temporary** diesel generator	**Construction**
		19	**Camp and water tank heating**	**Construction / Operation**
		20	**Kitchen – ventilation exhaust**	**Construction / Operation**
		21	**Administrative buildings kitchen and make-up ventilation unit**	**Construction / Operation**
	Workshops	**22**	**Truck workshop – ventilation exhaust**	**Operation**
Ventilation	**Administration building**	**23**	**Laboratory – ventilation exhaust**	Operation
	DMS building	24	DMS building heating	Operation

a ID: Refer to Map 4-11 for locations of sources of emissions.



Map 4-11 Air emission sources

Table 4-24 Annual and period GHG emissions

Phase / Year	CO_2 Emissions (tonnes)								
	Direct emissions					Indirect emissions			Total
	Explosives	Road transport (on-site)	Off-road mobile equipment	Stationary combustion	Total direct	Electricity	Off-site transport	Total indirect	Total direct + indirect
Construction (year -1)	152.5	963.1	2,464	10,768	14,348	73.0	4,164	4,237	18,585
Year 1	488.0	3,076	9,669	16,153	29,386	73.0	12,388	12,461	41,847
Year 2	490.8	3,576	9,829	16,153	30,048	73.0	12,388	12,461	42,509
Year 3	488.0	3,945	9,840	16,153	30,426	73.0	12,388	12,461	42,886
Year 4	488.0	4,208	9,839	16,153	30,688	73.0	12,388	12,461	43,149
Year 5	488.0	3,638	9,789	16,153	30,068	73.0	12,388	12,461	42,528
Year 6	488.0	3,385	9,594	16,153	29,620	73.0	12,388	12,461	42,081
Year 7	488.0	3,565	9,590	16,153	29,795	73.0	12,388	12,461	42,256
Year 8	661.8	5,081	11,695	16,153	33,591	73.0	12,388	12,461	46,052
Year 9	648.8	5,367	10,812	16,153	32,980	73.0	12,388	12,461	45,441
Year 10	671.0	5,817	11,424	16,153	34,065	73.0	12,388	12,461	46,526
Year 11	671.0	5,424	11,061	16,153	33,309	73.0	12,388	12,461	45,770
Year 12	671.0	5,657	11,392	16,153	33,873	73.0	12,388	12,461	46,334
Year 13	671.0	6,374	11,675	16,153	34,873	73.0	12,388	12,461	47,334
Year 14	671.0	6,947	11,726	16,153	35,497	73.0	12,388	12,461	47,958
Year 15	549.0	6,738	10,278	16,153	33,718	73.0	12,388	12,461	46,179
Year 16	566.2	7,216	10,474	16,153	34,409	73.0	12,388	12,461	46,870
Year 17	488.0	5,563	9,663	16,153	31,866	73.0	12,388	12,461	44,327
Year 18	554.6	5,848	10,146	16,153	32,702	73.0	12,388	12,461	45,163
Rehabilitation (Year 19)	134.3	1,329	2,321	16,153	19,937	73.0	1,995	2,068	22,005

Energy transition

Efforts are made to reduce GHG emissions, as well as the projected evolution of the power supply for the project. The current mine life cycle is greater than the useful life of a heavy truck, which is 10 years.

For the purpose of the study, the project incorporates the cost associated with the replacement of diesel equipment. However, replacement will certainly occur if power equipment or equipment powered with fuels generating fewer CO2eq emissions becomes available in the next 10 years.

As mentioned in section 3.5.1, after extensive research, a forklift, buses (2) and pickups (9) are available in electric versions and will be acquired. However, the telescopic forklifts and the platform truck are only available in a smaller version than required by GLCI. The electric version of the other equipment (for snow removal, garbage management and emergency units) has not been found on the market but their development is being monitored for possible integration. It should be noted that GLCI would prefer powering its entire mining complex using hydroelectricity, but right now, HydroQuébec cannot guarantee a full supply.

The energy supply plan depends on the power provided by Hydro-Québec and will evolve concurrently. For the purpose of the studies, GLCI has to ensure a year-round supply of power for all its activities.

GLCI remains on the lookout for any technological progress in energy to reduce its dependence on fossil fuels. As a producer and developer of lithium products used in the development of batteries for electric vehicles, GLCI wishes to position itself as a forerunner in this field and to implement these new technologies when they become available. Therefore, GLCI will certainly look for available aid programs and equipment that consumes the least amount of diesel possible when the time comes to purchase its equipment.

4.10.2 WASTE WATER DISCHARGE

The worker' camp will be serviced by a domestic wastewater treatment system with an expected capacity supplying 280 people during the construction phase and 180 people during the operation phase. The treated water requirements are estimated at 56 m³ per day and 30 m³ per day, respectively for the construction and operation phases.

A rotating biological reactor (Ecoprocess MBBR technology from Premier tech) has been chosen for waste water treatment. Considering the nature of the native soils and the proximity to wetlands, it is unlikely that a leaching field will be possible. Therefore the discharge of treated wastewater to a receiving watercourse must be considered.

To that end, the supplier of the Ecoprocess MBBR technology will also supply a tertiary treatment train to meet the disinfection and phosphorus removal objectives required for discharges to a receiving watercourse. This tertiary treatment would be integrated to the proposed unit (equalization tank and Ecoflo units) and it would replace the proposed leaching field. A discharge pipe with an outfall will also be prepared to channel treated wastewater toward the receiving watercourse. A service building (3 m x 4 m) will be required to house the disinfection units (UV lamp) at the outlet of the Ecoflo units and the dosing chambers for phosphorus removal. The treated wastewater will be discharged to the CE4 watercourse.

The domestic wastewater treatment system selected has the ability to treat sanitary water using a biological reactor and will serve for both construction and operations. The treated water will be discharged to CE4 due to the nature of the native soil and the proximity of wetlands. The unit selected can treat the flow during construction (i.e. 56,000 l/d, based on a peak construction labour force of 280 individuals). The flow during the operation phase is lower, at 30,000 l/d, based on an average labour force of 180 individuals. The flow falls below the maximum capacity of the treatment unit.

4.10.3 RESIDUAL MATERIALS

As a rule, GLCI will work to minimize the waste production. However, it will need to be managed on-site. As such as warehouse of residual matter will be built. It will be split into various sectors where different types of residual materials will be stored separately. The warehouse be large enough to allow for a fork-lift to enter through a garage type door to load the material onto trucks. The residual materials will be trucked to an outside facility as managed by a third-party contractor. This party will need to have the required permits and agreements in place with authorised landfill / recycling sites. **GLCI is in contact with Ungava Recycling Inc. of Chibougamau, which currently manages RM from mining sites in the region, namely Éléonore (partially), Nemaska and Renard. The recycling company manages recyclable materials, construction waste, RHM, non-hazardous RM and compostable materials. This contractor searches for sites where it is possible to obtain short, medium or long-term contracts at competitive rates. They even provide on-site services for adequate materials sorting.**

At the moment, recyclable materials, as well as non-hazardous residual materials, could be managed at Chibougamau. Amos could receive putrescible materials while Matagami and Hydro-Québec deny residual materials from other sites. Hazardous residual materials would be managed by one of the contractors servicing the region (Véolia, Sanivac, Amnor and Groupe Gilbert). No residual material loads may leave the site without validation of the transport and disposal permits. Upon signing of a contract with GLCI, Ungava Recycling Inc. would take the required measures to assure GLCI that the appropriate disposal of recyclable and non-recyclable residual materials is conducted. As soon as the contract is signed, a copy (blank, i.e. without cost) will be sent to the MELCC's Representative assigned to the case.

Table 4-25 shows the recommended management approach by RM category.

Table 4-25 Management method, duration and capacity of residual materials storage

Category	Description	Estimated Annual Quantity (Metric Tonne) – Construction		Estimated Annual Quantity (Metric Tonne) – Operation		Storage Capacity (Metric Tonne)	Storage Site (Site No.)	Type of Storage at the Site	Recommended Management Method[1]
			Subtotal		Subtotal				
Recyclable materials	Paper/cardboard	Undetermined	290	165	400	100	25	Packaged, dry storage	Recycling
	Plastic	Undetermined		130					Recycling or disposal
	Glass	Undetermined		9					
	Metal	Undetermined		95					Recycling
	Hardware	Undetermined		0.5					
	Batteries	Undetermined		0.5					
Food waste	Compostable material	167	170	90	92	40		Sealed container	Reuse
	Cooking grease	3		2					Disposal
Construction, renovation and demolition debris	Wood, concrete	Undetermined	35	Undetermined	20	10		In a stack outside	Disposal
	Other (i.e., tires etc.)	Undetermined		Undetermined					Recycling
Final waste	Voluminous waste, polystyrene foam, packaging, composite objects, etc.	Undetermined	220	Undetermined	480	120		On the ground, dry place On a sealed surface if there is oil/grease	Disposal
Household hazardous waste	Antifreeze, solvents, aerosols, cylinders, paint, fluorescent tubes, lanterns, etc.	Undetermined	8	Undetermined	16	4	24	Separate place with WHMIS-compliant ventilation and a sealed floor	Disposal
Used oils, greases, oily water	Coming from various machine shops	0.8	0.8	Undetermined	4	1		Double-floor containers in a ventilated space provided with a containment tank, with sealed floor	
Residual hazardous materials	Containers of additives used to prepare concrete and other products used in construction	Undetermined	0.6	Undetermined	3	1			
	Empty containers of chemical products used to treat ore and for the WTP	Undetermined		Undetermined				Separate, ventilated space, with sealed flooring	
	TOTAL		725		1015				

Note 1: No material will be eliminated, reused or recycled on site.

Whether they are for residual materials or for hazardous waste, the measures that are put in place are intended to avoid any discharge or environmental contamination. These measures are compliant with current regulations. Laws and regulations related to the management of residual materials are under provincial jurisdiction under the EQA on hazardous materials (chapter Q-2, r.32 ss. 31, 46, 70.19, 115.27, 115.34 and 124.1) and non-hazardous materials (chapter Q-2, r. 35.1 s. 53.4). As the information above indicates, non-hazardous and hazardous residual materials have different management and storage methods. Hazardous materials will be stored on sealed surfaces and non-hazardous materials that may emit contaminants will be stored in sealed containers. Both warehouses will be dry, protected from the elements and well ventilated. The security of the premises will be ensured.

The estimated quantities of domestic residual material by category are listed in Table 4-**26**. On-site management and temporary storage of domestic residual material will consist of:

— Used tires: A storage area (on the ground) for used tires will be delimited. Recyc-Québec provides a free on-call service of tire collection (without rims and of standard size) across the Nord-du-Québec region.

— Scrap metal and hardware: A storage area (on the ground) for recyclable scrap metal will be delimited. If the volume of copper, aluminum, batteries (lead) and hardware is significant, a distinct area may be considered to obtain a better resale value. Special attention will be placed to waste which can generate leachate (such as oil, grease, various fluids) and contaminate the environment.

— Cafeteria waste: Waste is directly placed in a container by the cafeteria and cleaning staff without further handling until disposal in a **composter that will be installed on the mine sit**e.

— Recyclable materials: Cardboard and papers are wrapped then stored in a dry location for recycling. For plastic and glass, the most convenient and cost-efficient management method must be assessed, either recycling or disposal as ultimate waste.

— Ultimate waste: The waste shall be stored in suitable containers as to prevent dispersal and soil contamination until disposal in an authorized site. This category includes: bulky waste, polystyrene foam, packaging, sanitary tissue, composite objects, non-recyclable plastic, rubber, ash and other various domestic containers.

Table 4-26 Estimated quantity of residual materials

Category	Description	Tonnage (t)	
		Construction (15 months)	Operation (per year)
Recyclable materials	Paper/cardboard	119.6	165
	Plastic	94.3	130
	Glass	6.5	9
	Metal	68.9	95
	Hardware	0.4	0.5
	Batteries	0.4	0.5
Food waste	Compostable material	167	90
	Cooking grease	3	2
Construction, renovation and demolition debris	Wood, concrete	35	20
	Others	0.6	0
Ultimate waste	Voluminous waste, polystyrene foam, packaging, composite objects, etc.	220	480
Total		**715.6**	**992.0**

Source: WSP, **2018a.**

To minimize the RM production, GLCI has chosen to compost the putrescible materials. A composter was added to the project. Such equipment will significantly reduce RM leaving the site. Indeed, the composter requires, in addition to the nitrogen supplied by food scraps, a carbon supply, which can easily be provided by soiled cardboard.

The initial plan was to send the putrescible materials to Amos. The installation of an on-site composter will prevent this trip by truck and the on-site storage of food waste.

In 18 days, the proposed industrial composter produces compost which could be stored over the overburden stockpile for use during the restoration phase. The composter generates CO2 and would produce approximately 2 m³ of compost a week, which represents 100 m³ per year. The compost could also help stabilize soft materials in the overburden stockpile (peat and clay). GLCI will ensure that it complies with the Quebec Residual Materials Management Policy derived from the EQA by giving priority to management methods for all residual materials produced on site that will have the least impact on the environment. GLCI will see that the selected management methods follow the 4R-D order of priority. As part of the implementation of its management system, GLCI will establish a program and procedures to ensure compliance with the 4R-D principle.

4.10.4 RESIDUAL HAZARDOUS MATERIALS

The HMR applies to the storage of residual hazardous materials. The following measures will therefore be taken:

- **the storage site will be constructed and maintained so as to be accessible to emergency teams at all times;**
- **exterior access paths to the storage site will be provided and usable;**
- **storage building doors will be operational at all times;**
- **the building will be laid out so that the doors and passageways are free at all times.**

RHM may be arranged in islands depending on the compatibility of the materials. The following aspects will also be attended to:

- **the number of islands must equal the number of incompatible groups;**
- **separation distances or walls between the islands;**
- **dimensions of passageways for accessing the islands and their compliance so that material-handling vehicles may pass through;**
- **use of containers for incompatible liquid materials with separate holding tanks for each liquid material.**

To set up islands, the following will also be taken into consideration:

- **the breadth and height of the islands in order to facilitate identifying materials, viewing containers and evaluating quantities;**
- **height to ensure worker safety and prevention and the stability of the stacks (to prevent collapsing);**
- **clearances for handling, height of building roofs, and the operation of sprinklers and detection systems (fire, gas or other) or any other system or equipment inside the building.**

As for the residual material, the hazardous waste will be managed in the residual matter warehouse. The quantities of hazardous waste for each category are listed in Table 4-**27**. On-site management and temporary storage of hazardous waste will consist of:

- Hazardous household waste: The waste is stored in a specific and well-ventilated area until transport to a transfer centre or an Ecocentre.

— Residual hazardous materials containers: The management of such materials is regulated; their proper storage must prevent any accidental spill in the environment. Residual hazardous materials **will be** stored **one or many** double-floored containers **known as a "marine container". The container will be subjected to regular inspections and managed as required under provincial regulation. The container may hold used hazardous products, unwashed containers of hazardous products, waste oil and grease, rags soiled by hazardous materials, and contaminated soil. The container will be regularly emptied and a storage record will be updated after each new addition or removal of materials.**

— **Products will be placed in containers (barrels or semi-bulk cubic metre bags), which do not react with the disposed materials. Content of the containers will be identified with the date when storage began. Sections reserved for each content type will be identified on the interior walls of the container.**

— **Other than the difference between solid and liquid materials, the residual hazardous materials generated by the mining operations should not be incompatible. For example, liquids will mainly be oils or antifreeze agents; they will not be mixed since their disposal is more expensive if they are. Solvents are almost never found in RHM since they evaporate and mechanics replenish the container, but almost never empty it, unless there is a significant contamination.**

— **Aerosols, as well as fluorescents, will be collected in specific barrels. Paints will be dried before being sent to waste. If large quantities of paint must be disposed of, they will be offered to the community. Procedures (most likely via a Residual Material Management Program) will be established for the appropriate management of hazardous and non-hazardous residual materials. New hazardous materials will be managed in compliance with the National Fire Code of Canada (NFC) and the National Building Code of Canada (NBC) rules (a section of the warehouse will be reserved for these materials).**

— Some types of hazardous household waste must be stored apart to avoid chemical reaction or to minimize hazardous situation (explosion, fire, toxic gas, etc.) with respect to the Workplace Hazardous Materials Information System (WHMIS), and risk assessment.

Table 4-27 Estimated annual quantity of residual hazardous materials

Category	Description	Tonnage (t) Construction	Tonnage (t) Operation
Hazardous household waste	Antifreeze, solvents, aerosols, cylinders, paint, fluorescent tubes, lanterns, etc.	8	16
Waste oil, grease and oily water	Various from mechanical workshop	0.8	4
Residual hazardous materials	Containers of additives used to prepare concrete and other products used in construction	0.6	0
	Empty chemical vessels for processing and WTP, if necessary	0	3
Total		**9.4**	**23**

*Source: WSP, **2018a**.*

The following residual materials are excluded from the hazardous waste quantities provided:

— Sanitary sludge: The sanitary sludge will be emptied every year by a specialized pump truck service.

— Contaminated soils: Typically, soils for decontamination contain contaminants associated with refined petroleum products (diesel, fuel, mineral oil and grease, etc.). They will be managed as required by Québec regulations.

— Biomedical waste: The on-site medical department will have a separate medical waste system.

4.11 OTHER INFRASTRUCTURE

In addition to the mining, processing, and water management infrastructure, the project will require various other components.

4.11.1 SITE BUILDINGS

Wherever practical, containerized and flat-pack type buildings will be used; flat packs will be imported in containers and assembled on site.

Most buildings (service and process) will be constructed using self-supporting insulated type buildings. Containers will be used as storage and offices. The concentrator building and the HVAC systems will be prioritized to support the construction effort through the winter.

Design of the site buildings is part of a global project cost reduction approach. Power supply being a limiting factor, the design and choice of building materials were made by giving priority to energy-saving solutions. However, no specific eco-design principle was applied. Energy efficiency and reduction of RMs are an integral part of GLCI's environmental policy (https://gxy.com/wp-content/uploads/2020/11/Environmental-Policy.pdf) and are applicable to all employees and contracting parties: "develop products and services and operate facilities in such a manner that prevents pollution, improve efficiency, reduce energy use, use renewable resources and minimize waste through recycling wherever possible".

GLCI will prioritize the purchase of local products and services as part of its approach for the optimization of economic benefits for the region and surrounding communities and as to promote the local social acceptance of the project. The terms and conditions will be mainly defined in the Impact Benefit Agreement negotiated with the Eastmain Community.

4.11.2 SITE ACCESS ROAD

The proposed **12** m wide site access road (Map 4-1) will be **50** m long and composed (from surface to base) of:

- **450** mm of road base typically 0-56 mm crushed stone, compacted;
- Up to 1.5 m subgrade compacted structural fill.

Topsoil will be stripped and any unsuitable material such as compressible soils will be removed. The ditch system will divert clean water in the environment and direct contact water toward the main water management infrastructure (see Section 4.9.3).

For security reasons, the Billy Diamond Highway will be widened with the addition of turning lanes into and out of the site at the point of contact between the Billy Diamond Highway and the site access road.

MTQ standards (signage, traffic control, drainage, visibility, etc.) will be complied with in the right of way of the Billy Diamond Highway. On the project site, access roads will not necessarily follow MTQ standards (foundation, surface, etc.) since they will be private roads. A traffic plan (considering signage, speed limits, protective berms/guard rails, etc.) will, however, have to be prepared at the detailed design stage. Attention will be given to the intersection with the Billy Diamond Highway.

The SDBJ owns the Billy-Diamond Highway. GLCI will have to discuss the improvements to be made with the SDBJ and have them approve the plans. Nothing has yet been decided regarding the roles of each party, particularly concerning the supervision of the work. However, GLCI will certainly pay for the work.

4.11.3 SERVICE ACCESS ROADS

The site will feature **a single** service **road leading to the north water management pond and the explosives magazine**.

The proposed roads will be composed (from surface to base) of:

— **450** mm of road base typically composed of 0-**56** mm crushed stone, compacted;
— Up to 1.5 m subgrade compacted structural fill.

Topsoil will be stripped and unsuitable material such as compressible soils will be removed from the footprint. The ditch system will divert clean water into the environment and direct contact water toward the water management infrastructure.

The project footprint presented in the previous sections includes the encroachment area of the project site roads. From the edge of the road surface, 8 m on either side of the road surface has been added to consider the width at the base of the backfill. Table 7-5 (Chapter 7) details the mitigation measures related to the development of the roads on the site. Road routes have been developed to avoid unnecessary encroachment on watercourses by minimizing the number of watercourse crossings. Culvert construction will be completed in compliance with the standards and periods shown in Table 7-5 (Chapter 7).

4.11.4 ACCOMMODATION

The proposed workers camp can house up to 280 workers in construction and **180** workers in operations. Accommodations include the following:

— Dormitories consisting of wings connected with hallways (two of which are temporary for the construction phase only);
— Kitchen and cafeteria;
— Communal room (with sofas, etc.);
— **A gym;**
— Laundry services;
— Emergency generators;
— Potable water treatment system;
— Cold storage in sea containers.

Modular-type buildings will be installed on wood piling or cribbage and connected to each another with hallways. The accommodation camp will by heated with heating furnaces located at various locations. The electricity demand will be higher in summer due to air-conditioning units and the total demand is estimated to 432 kWh. During winter, heating requirements are estimated to approximately 110.3 million BTU (116.4 GJ). Based on this estimation, the propane consumption is estimated to 4,500 litres per day. The propane will be in the industrial area (Map 4-2). **Various options are being discussed with suppliers to minimize the energy demand and environmental footprint of these buildings.**

Propane tanks and generators will be installed on concrete slabs and will be grounded following regulations and industry standards. The propane tanks and generators will be fenced, and security systems (e.g. closed-circuit cameras) will be installed.

4.11.5 MINE SERVICES AREA

The mine services area is composed of:

- MINE WORKSHOP, ADMINISTRATION, AND VEHICLES WASH-DOWN (ONE BUILDING);
- MECHANICAL WAREHOUSE;
- LIGHT VEHICLE PARKING;
- DIesel fill and storage.

The insulated building will be a steel structure covered with metal cladding supported by a concrete slab and footings where required. Overhead travelling crane gantries will be installed in some of the working bays for heavy lifting.

All the water collected from washing activities will be directed to a water-oil separator before exiting the water management system. That system will be maintained and emptied regularly with a vacuum truck operated by a certified disposal company.

4.11.6 FUEL STORAGE

The fuel storage area located in the mine services area will consist of:

- **two double-walled 150 kilolitre diesel tanks;**
- **a double-walled 11 kilolitre diesel exhaust fluid (DEF) tank;**
- **a tank filling area;**
- **a heavy vehicle service station.**

The final design of the petroleum equipment and tanks has not yet been determined. Petroleum equipment and reservoirs shall all be designed as to prevent and contain any potential spillage. The equipment is regulated by the Building Act and subject to a RBQ (Régie du bâtiment du Québec) permit. Figure 4-17 shows the general layout of the fuel farm. It should be noted that compared to the 2018 project, there is no longer a gasoline and diesel tank to supply light vehicles because they will be electric.

An application for authorization will be submitted to the Régie du bâtiment to use tanks for the quantities required, which would exceed the authorized limit of 50,000 L. The fuel storage and distribution facilities will comply with provisions under the Building Code and be managed in compliance with the Safety Code.

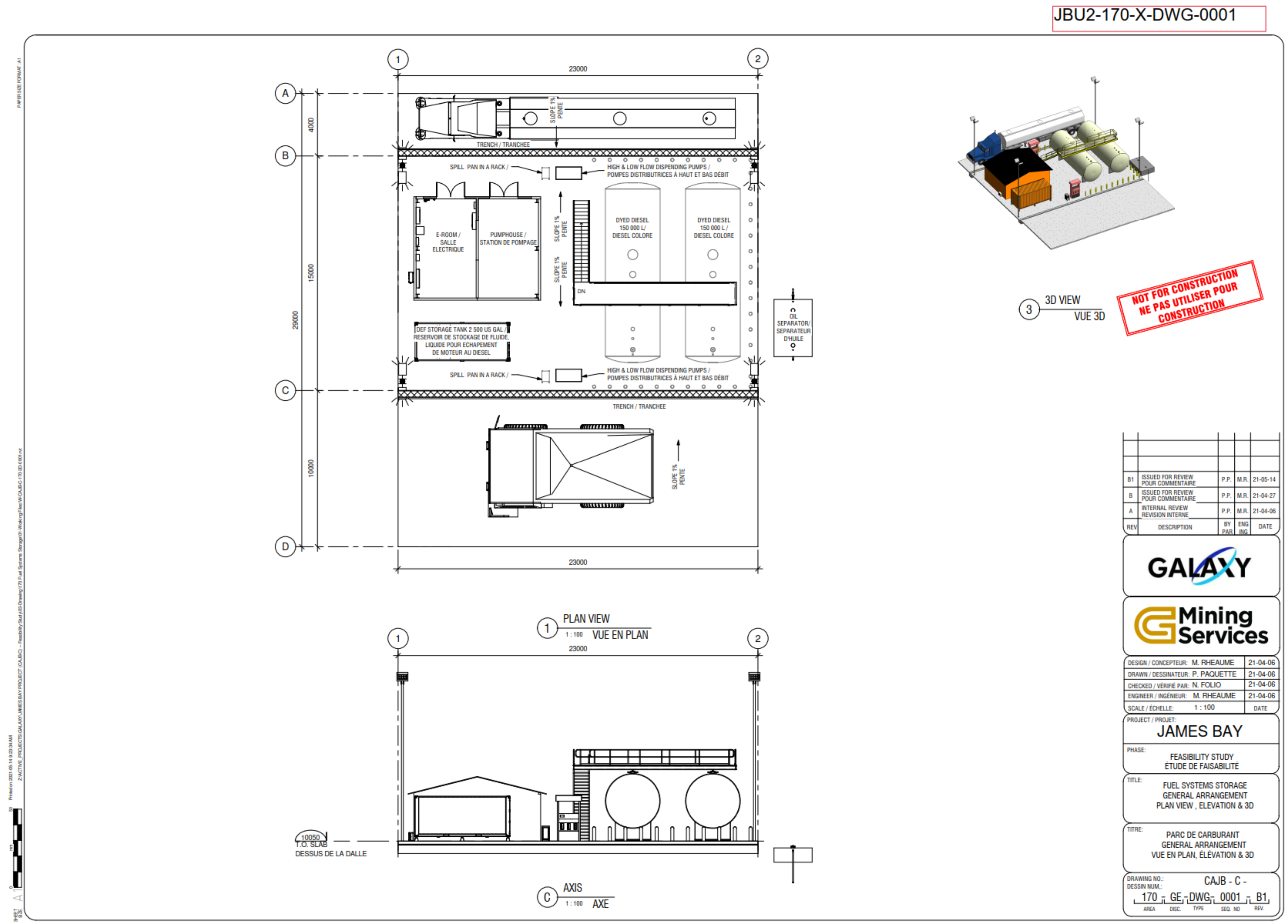


Figure 4-17 Fuel farm layout

Each service station will be equipped with spill grates that will collect potential spills and direct them to a water-oil separator.

The main tanks will not supply standby generators with fuel. The standby generators will be refuelled by mobile tankers that comply with regulations (e.g. small tankers for on-site use).

4.11.7 POWER LINE

Average electricity demand is estimated at 3.33 MW for the industrial area and 2.95 MW for the workers' camp, for an average demand of 6.3 MW and a peak demand of 7.7 MW during winter. Hydro-Québec is responsible for the commissioning of the 69 kV transmission line from the 69 kV power line (L 614) located 10 km south the project site. This will be the main power supply for the project. This option does, however, have some limitations; even with major upgrades to Hydro-Québec Némiscau's substation, the total available capacity will be limited to just over 7.6 MW. This is the reason why an alternative (i.e. propane) is required for heating the buildings. In addition, intermittent use of generated power to meet the peak demands will be required. The current design will use emergency diesel generators to meet this demand.

A pre-project agreement was signed in 2018 and Hydro-Québec is moving the studies forward. GLCI and Hydro-Québec meet on a regular basis to discuss progress of the studies but there is no negotiation underway.

At present, discussions that were held with Hydro-Québec have mainly revolved around the technical fastening with respect to connection details to GLCI's substation and work deadlines for both parties, namely construction of the line in a timely manner for the electrical supply of the mine site substation.

The objective of the preliminary study currently underway at Hydro-Québec is to evaluate all aspects of the power line project, including power availability, costs, construction and operation schedule and long-term maintenance of the line. In the course of the preliminary study, Hydro-Québec has stated, at various follow-up meetings, that electricity is available and the final study report, which is expected in fall 2021, should confirm this statement.

Hydro-Québec is fully responsible for the design of the line route, as well as the construction and operation of the future power line. To meet the demand, Hydro-Québec will build an approximately 10 km long 69 kV power line. The line route studied by Hydro-Québec follows an existing 450 kV power line for almost 70% of its route.

In light of the preliminary results of the environmental and technical studies conducted to date by Hydro-Québec, several location criteria were considered to develop the projected line route, which include the following:

- **Take advantage of the existing 450-kV DC power line to juxtapose part of the projected line, thereby limiting deforestation and using existing access roads;**
- **Avoid radii of exclusion around the mining pit;**
- **Avoid areas valued by Crees, and hunting, trapping and fishing areas;**
- **Limit impact on wetlands.**

In 2019, Hydro-Québec met with the RE2 trapline tallyman and the Eastmain Band Council to present the studied line route and to gather their concerns.

Once the environmental and technical studies have sufficiently progressed, Hydro-Québec will be in position to assess the project impact on human and natural environments, and the landscape, and identify appropriate mitigation measures.

Although no application for an authorization certificate is to be submitted to the Minister under section 160 of the Environment Quality Act, and since 69 kV transmission lines are exempted from the environmental and social impact assessment and review procedure, Hydro-Québec will obtain all required sectoral authorizations and permits from the relevant authorities to build the power line.

After verification and discussions with Hydro-Québec, it was confirmed that there were no opportunities to increase the available power beyond what was discussed in 2018. Furthermore, engineering firms are still working on reducing the project's energy demand. At present, no significant change that would allow a decrease in demand was noted. GLCI remains on the lookout for any reduction opportunity for the various project phases.

4.11.8 HIGH AND MEDIUM VOLTAGE SUBSTATION

Aside from the typical lighting transformers (dry-type, 600/120-208 V), the project will require seven oil-filled transformers:

- One oil-filled transformer for the main substation: 69/4.16 kV, 10 MVA, oil filled, auto tap changer;
- Six transformers for the plant: 4.16/0.6 kV, 2.5 MVA, included between 1 MVA and 2.5 MVA, dry-type, offload tap changer, mounted inside.

All transformers will use a natural convection air cooling system (AN). The oil type is to be confirmed at a later phase but will most likely be Envirotemp™ FR3™ fluid, a natural ester derived from renewable vegetable oils.

4.11.9 BACK-UP GENERATORS

With the total plant demand already at the limits of the local utility's 69 kV system, power generation costs have been considered and mitigation measures have been studied should demand increase. At the process plant, emergency power will be provided by two standby 1.8 MW, 480 V diesel generators located near the main substation. The workers' camp will be directly connected to the generators by limiting intermediate equipment and allowing immediate power in the case of power outage.

4.11.10 EXPLOSIVES MAGAZINE

The explosive storage requirement was designed based on the mining method and powder factor. The storage infrastructure was designed in compliance of all applicable provincial and federal laws and regulations, and in accordance with the best industry practices. The location of the explosives magazine was selected to comply with minimal stand-off distances (Map 4-1). The quantities of explosives stored are found in Table 4-28.

Table 4-28 Estimated stored quantity of detonators and explosives

Explosive Type	Unit	Quantity	Stock (days)
Detonators	#	27,000	28
Ammonium nitrate	kg	158,961	21
Emulsion	kg	76,537	21

Source: WSP, 2018a

As presented in Section 4.5.2, ANFO and emulsion explosives will be utilized on a 50/50 volume ratio. During the wet months (May to October), bulk emulsion explosives will be utilized, with the drier months (November to April) utilizing ANFO.

The magazine area dimension is estimated at 170 m x 80 m, which includes:

- **A mixing building;**
- **An explosives magazine;**
- **Detonator warehouse;**
- Stand-off distance between different classes of explosive;
- Soil barrier;
- Access road;
- Perimeter fence;
- Buffer clearing of 35 m (for forest fire safety).

The ANFO mix shall be made on site in a plant designed, installed and managed by the explosive manufacturer. All permits shall be issued in the manufacturer's name. The plant shall be zero waste, i.e. all waste will be managed so that nothing is discharged into the environment:

- **Wastewater will be treated in an oil-water separator, filtered and reused in the ammonium nitrate solutions;**
- **No discharge into the air;**
- **Sanitary discharges (toilet and sink) will be stored in a sealed septic tank and disposed of outside the site;**
- **Waste oil and other non-recyclable discharges will be disposed of outside the site by an authorized firm for reclamation or disposal;**
- **The plant is completely sealed. All accidental spills and wastewater are contained in a sealed floor drain;**
- **All raw material storage areas are equipped with a secondary containment system;**
- **All outdoor storage tanks are double-walled and equipped with a primary wall leak detection system.**

Trucks containing ANFO will be cleaned inside the plant. Washwater will be sent to the oil-water separator then filtered and reused. At the storage site, there will be separate tanks for gasoline (fuel) and nitrate. The detonators will be stored at the storage site in a special room kept under controlled access as required by the regulations and will not be transported at the same time as the explosives or they will be transported in separate sealed cases. Mixing will be done only before use, directly in the blast hole and not at the storage site. Packaged emulsions, purchased as is from the manufacturer, will be used on rainy days.

GLCI will comply with Quebec and Canada regulations, and apply for and obtain all required permits and authorization for the storage and use of the planned type of explosives.

4.11.11 OPTICAL FIBER CABLE

The cable will be installed along the existing James Bay road and along the site access road at a depth of approximately 1.2 m. The cable construction will require a 300 mm wide clearing and will require two creek crossings and one road crossing. The optical fibre cable between the km 381 truck stop and the project site will be buried. Excavation of the road for burying of the cable is not planned. Rather, directional drilling will be employed so as not to affect the surrounding environment and the existing infrastructure.

4.12 CONCENTRATE TRANSPORT TO MATAGAMI

The spodumene concentrate will be hauled to the transhipment terminal in Matagami, Québec. There, it will be transferred to trains (Map 1-1). Approximately **10 to 12** truckloads per day will be required to haul the daily concentrate production. Transportation will be done during the day **with minor exceptions**.

Transhipment terminal

The transhipment terminal in Matagami is located at 2200 Industrial Boulevard (along Highway 109 south of Matagami), directly in continuity with the Billy-Diamond Highway. Its exact location is 49°44'05.5"N and 77°41'02.4"W.

It has a 4-kilometre rail network and 250,000 m^2 of space available for storage and transshipment operations. It has a 1,500 m^2 warehouse and 3,400 tons of silo storage capacity. The warehouse is located directly on the railroad track and has a paved handling area. A weigh station has been installed, with a capacity of up to 100 net tonnes and a length of 27.4 m, equipped with an electronic access system. In 2016, the City of Matagami upgraded 1,200 m of track by replacing ties and levelling the tracks. Approximately 700 m of track remains to be upgraded. Figure 4-18 presents the layout of the transhipment terminal.

We estimate the requirement to be approximately 30,000 m2 for this GLCI project. The facilities required for the project are minimal. An exterior dome will be constructed for trucks to unload their cargo. The entire facility will sit on a concrete slab. The dome will be located near the C-56 railroad track on which gondola-type cars will be loaded with a wheeled front-end loader. This operation is conventional, simple and efficient. The only work required for transhipment is the construction of the dome, the official dimensions of which have not yet been determined as the variables of the final scenarios are not yet fully determined.

The partners involved in the transhipment operations are carriers and subcontractors for the actual handling as the City of Matagami's employees will not perform any field operations. The City of Matagami essentially owns and is a manager of the infrastructure.

Note that the transhipment terminal is already in operation and works with many clients such as SDBJ, Newmont-Éléonore, Lafarge-Holcim, Canadian National, Hydro-Québec and the Eeyou Communication Network. This transhipment terminal is the northernmost point in western Quebec to reach the national rail network. For more details and up-to-date images, please visit www.ct-matagami.com.

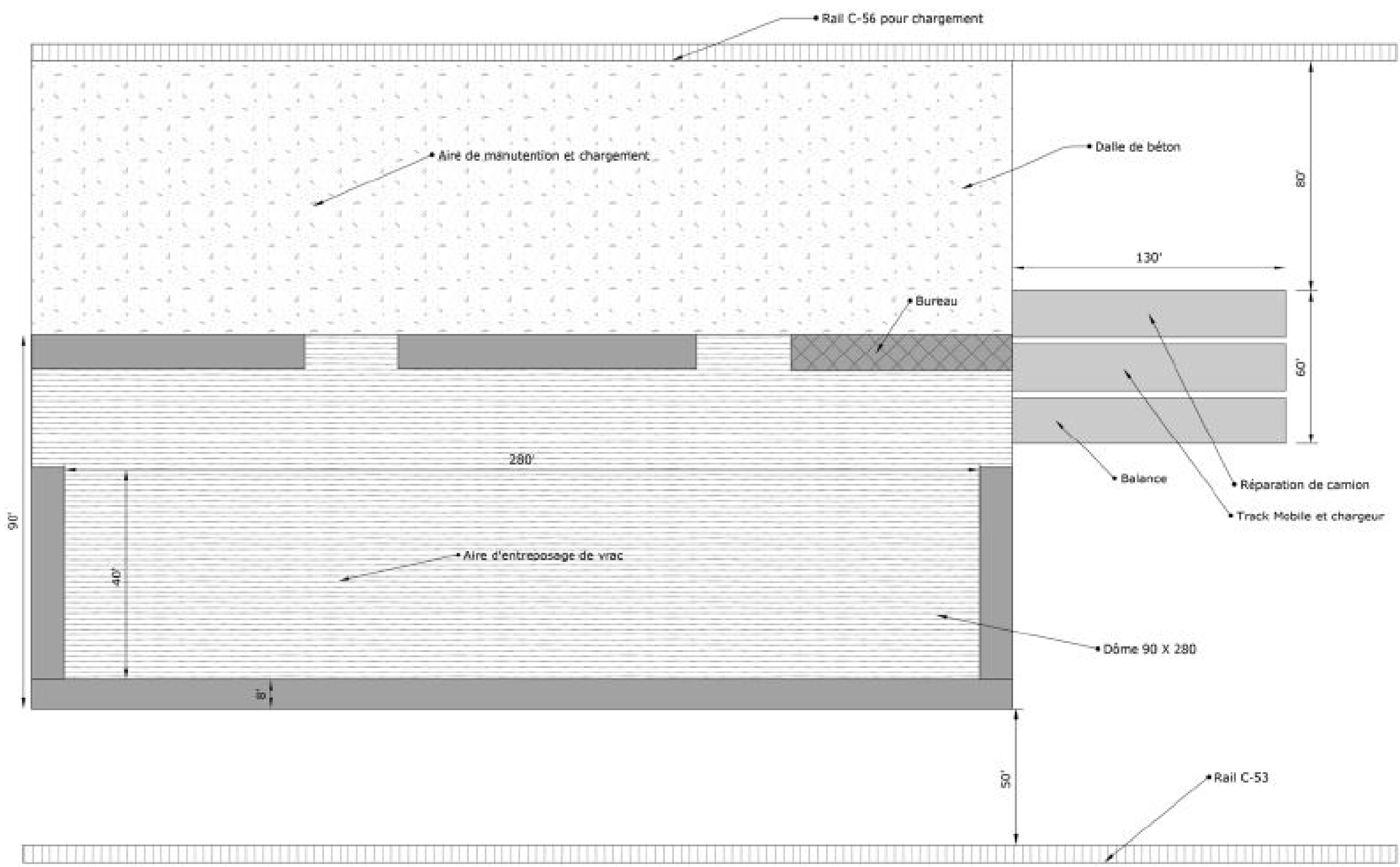


Figure 4-18 Matagami transhipment terminal layout

Source: City of Matagami, 2018.

At the transhipment terminal (managed by a third party), the concentrate will be transported from the rail yard to an undetermined location in southern Québec, to a processing plant or to a port for international shipping.

4.13 MINE RESTORATION

Appendix D presents the prepared conceptual mine closure and restoration plan. The planned state of the site after closure and the mine restoration are presented on Map 4-**12**.

As required by Section 101 of the Mining Act, the full rehabilitation and restoration plan will be prepared at a later stage. This plan will comply with the requirements of the Guidelines for preparing mine closure plans in Québec (MERN, 2017) and the trapline tallyman will be consulted. Note that the restoration plan must be approved by the MERN and the MELCC before the mining lease is issued.

4.13.1 CONTAMINATED SOILS

Following a definitive cessation of activities, GLCI will be required to undertake a characterization study of the property, as this type of activity falls into one of the categories listed in Schedule III of the *Land Protection and Rehabilitation Regulation* (CQLR, Q-2, r.37). Areas likely to have been contaminated mainly by petroleum, hydrocarbons, and metals will be prioritized. In all areas where petroleum product storage tanks and transfer sites were present during the construction and mining operations, the **ROM pad** and all petroleum product transfer sites will be sampled and analyzed to confirm the degree of contamination.

4.13.2 INFRASTRUCTURE AND BUILDINGS

Site rehabilitation will include the dismantling and demolition of all buildings and surface infrastructure, as well as the electrical and support infrastructure. The foundations will be levelled. The concrete slabs will be washed, perforated or crushed, to ensure proper drainage of water, and covered with reserved materials to promote the growth of self-sustaining vegetation. **The water management ponds will be drained,** sludge will be removed and sent to an authorized disposal facility. Eventually, **the water management ponds will be reinstated** as a wetland.

It should be noted that the management of the dismantling materials will be carried out in compliance with regulations, namely the *Regulation respecting the landfilling and incineration of residual materials* (CQLR, c. Q-2, r.19), as well as the *La gestion des matériaux de démantèlement - Guide de bonnes pratiques* (Courtois and coll., 2003).

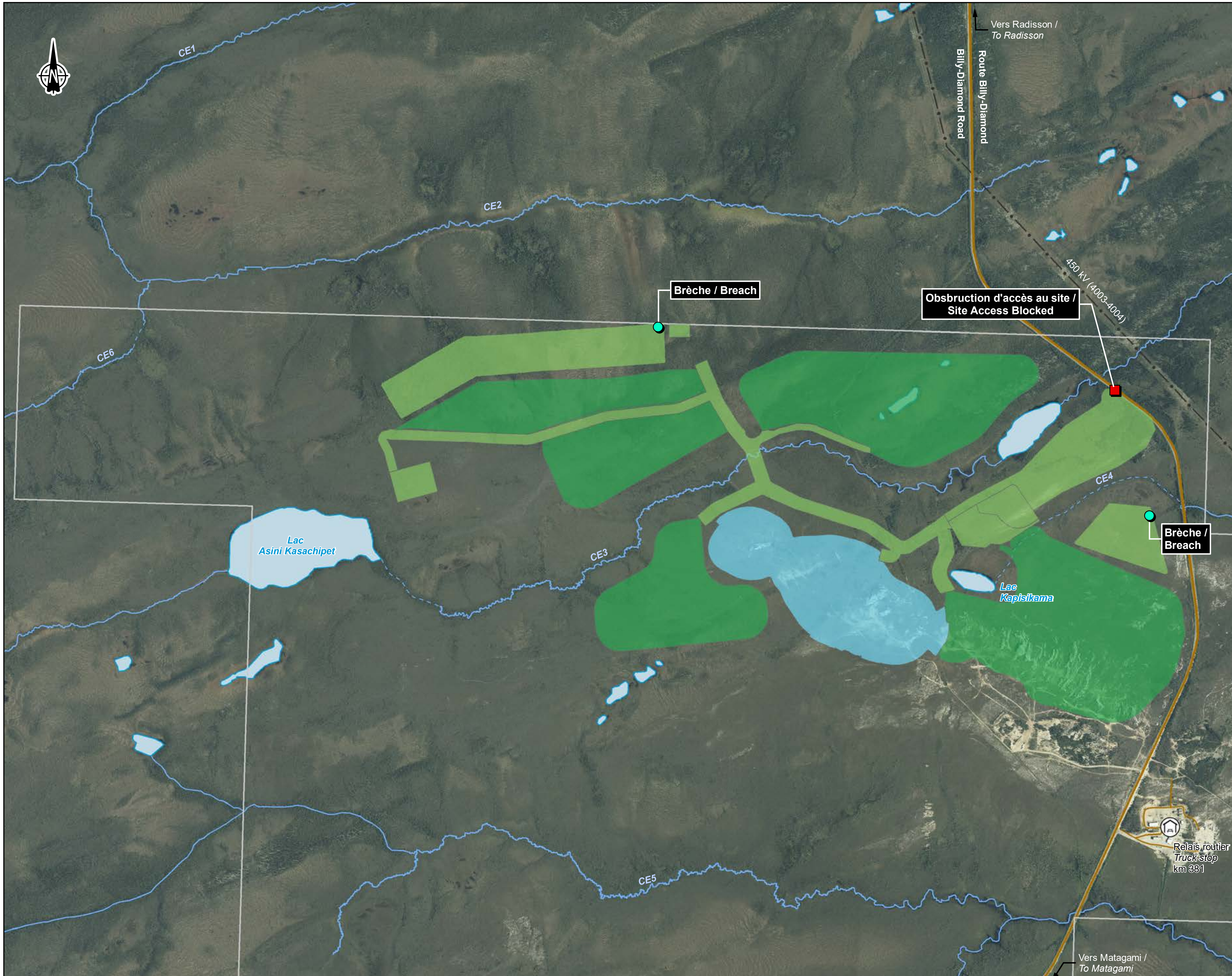
4.13.3 PETROLEUM AND CHEMICAL PRODUCTS, HAZARDOUS WASTE

Upon closure of the mining site, all equipment and heavy machinery will be sold, or drained of any fluids, broken down into parts and sent to an authorized recycling facility. All petroleum tanks and related pipelines will be drained, cleaned and sold, or disposed of in accordance with applicable regulations. No residual hazardous material will be present on the site once mining activities have stopped.

4.13.4 WASTE ROCK STOCKPILES

The waste rock and tailingsstirage facilities will be remodelled to ensure long-term physical stability and integration into the landscape. Bench slopes will be softened down to 2.5H:1V **and the tailings on the stockpiles will be** covered with overburden and topsoil to improve revegetation.

Note that water quality monitoring will be conducted during the operation phase and will determine if the actual leaching reactions last longer than the laboratory simulations (Chapter 10). If they do, then the restoration plan will be modified accordingly during operation. Water quality monitoring will also be maintained during the restoration phase to validate the assumption that the tailings will not leach once new material is no longer deposited. In the post-restoration period, the environmental monitoring will have to demonstrate compliance with the requirements of Section 2.11 of Directive 019 on the abandonment procedure for the post-restoration monitoring program.



Limite de propriété / *Property limit*

Composantes du projet / *Project Component*

Haldes à stériles revégétalisée / *Revegetated waste rock stockpile*

Infrastructures revégétalisées / *Revegetated infrastructure*

Fosse remplie d'eau / *Pit filled with water*

Infrastructures / *Infrastructure*

Route principale / *Main road*

Route d'accès / *Access road*

Ligne de transport d'énergie / *Transmission line*

Relais routier / *Truck stop*

Hydrographie / *Hydrography*

CE3 Numéro de cours d'eau / *Stream number*

Cours d'eau permanent / *Permanent stream*

Cours d'eau à écoulement diffus ou intermittent / *Intermittent ou diffused flow stream*

Plan d'eau / *Waterbody*

GALAXY

Mine de lithium Baie-James / James Bay Lithium Mine

Carte / *Map* 4-12
Aménagement du site minier après la restauration/
Mine Site After Restoration

Sources :
Othoimage : Microsoft Bing (ESRI, 2017)
Données du projet / Project data : Galaxy 2020

0 200 400 m

UTM, fuseau 18, NAD83

Juillet / *July* 2021

Dessin : A. Masson
Approbation : C. Martineau

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4.13.5 **OVERBURDEN AND PEAT** STORAGE FACILITY

If topsoil is excavated for rehabilitation purposes (e.g. revegetation), the excavation geometry will allow water flow toward the existing ditch system. The access roads built during topsoil deposition will be revegetated. If slopes of granular material are exposed, they will be softened to allow revegetation.

4.13.6 ROM PAD

There will by no material remaining on the ROM pad after mining has ceased. The surface will be reprofiled to prevent water puddling at the proposed pumping point and then revegetated.

4.13.7 PIT

As provided for in the mining plan, tailings and waste rock will be deposited in the southeast portion of the pit once the mineral resources of interest have been removed. The remainder of the pit will fill naturally with precipitation and groundwater to an equilibrium level with the water table. An overflow and ditches will be constructed to prevent overflow around the pit that could damage the environment. The flow will be channelled to the CE3 watercourse.

The pit will be surrounded by a 2 m high berm, with a ditch built at its foot. Hazard signs will be installed every 30 m in compliance with Section 104 of the *Regulation respecting mineral substances other than petroleum, natural gas and brine*.

4.13.8 **WATER MANAGEMENT INFRASTRUCTURE**

During the rehabilitation activities, the following modifications of the water management infrastructure will gradually be performed:

- **Construction of a pit overflow;**
- **Breach of the dike of the main water retention basin;**
- **Removal of culverts and surface water flows brought back to pre-project conditions;**
- **Dismantlement of the WTP (after the completion of the post-closure environmental monitoring program).**

4.13.9 REVEGETATION

The industrial and administrative area, WTP area **(if necessary)**, waste rock **stockpiles** and the **unconsolidated deposit and organic matter stockpiles** as well as the roads (surfaces and shoulders) will be revegetated to control erosion and restore the site to a natural condition in accordance with the surrounding environment and close to its original conditions. Prior to revegetation, the surfaces will be scarified. They will then be seeded with native herbaceous plants. Necessary measures to promote plant growth will be taken. The remaining organic material in the topsoil stockpile will also be seeded with indigenous herbaceous plants. Revegetation will allow the area to reach a satisfactory condition. This means that once in place, the plants must be hardy, provide long-term viability, and not require other care to ensure their sustainability.

Temporary shutdown

In the event that mining operations are temporarily suspended, GLCI will notify the government authorities in writing of the date operations ceased and anticipated date of resumption in accordance with the regulation.

In compliance with the section on Measures Applicable in the Event of a Temporary Shutdown of the MERN's Guidelines for Preparing Mine Closure Plans in Quebec, GLCI will implement safety measures if mining operations are temporarily suspended for more than six months. These measures are intended to restrict access to the mine site and the various buildings and other structures, as well as to maintain effluent quality control and ensure the physical and chemical stability of the various accumulation and storage areas.

The following measures will be applied during a temporary cessation of mining activities:

- mine site access will be prohibited. A barrier will be installed at the mine site entrance and ensure its safety;
- a protection berm will be installed around the pit to ensure the safety of land users;
- an effluent monitoring program will be carried out, including sampling and analysis in compliance with the EQA requirements;
- measures (visual inspections and water analyses) will be taken to ensure the physical and chemical stability of the various accumulation areas.

4.14 PROJECT EXECUTION

Figure 4-**19** presents a timeline that covers activities from the submission of the EIA to the end of the post-rehabilitation. The length of time for the main project phases is:

- Construction: **15** months;
- Operations: **18.5** years:
- Rehabilitation: **2 years**;
- Post-rehabilitation: 5 years.

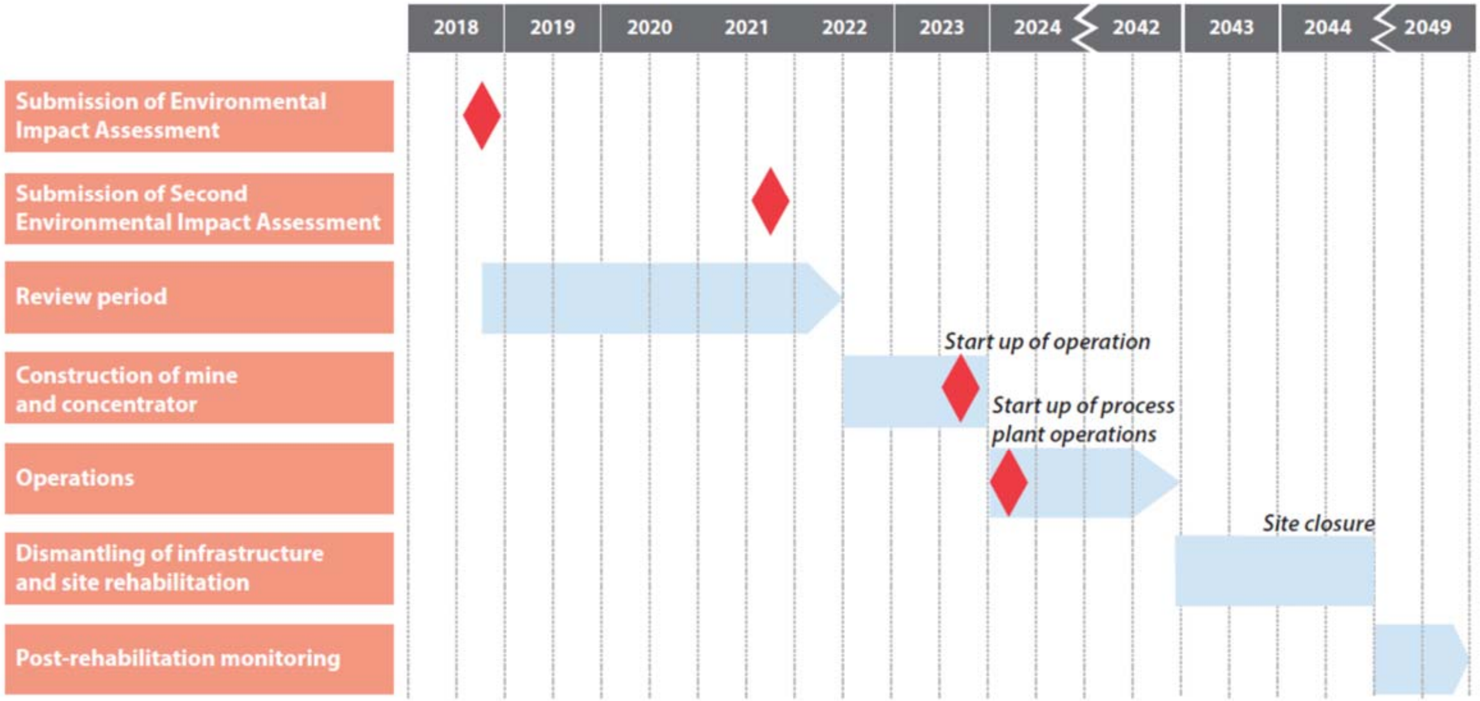

Figure 4-19 Schedule

Most of the workers employed at the mine will work in **10**-hour shifts. They will be on-site 14 days in a row followed by 14 days off. Schedule adjustments may be possible for the Crees that do not require air transport. They will be offered a 7-day in, 7-day off schedule but only for certain positions at the mine. **Management positions as well as the Eastmain community members could have** a four-day work followed by three-day off schedule or a typical five-day work and two-day off schedule (Monday to Friday).

Air travel will be the primary means of transportation for workers. GLCI will organize charter flights from major hubs to the Eastmain airport and will provide a shuttle service to and from the site. The Eastmain airport is located **130** km away from the project site. **During construction and operation phases, the number of chartered flights and shuttles to reach the mine site is currently planned at 3 or 4 per week depending on the number of employees required. The number of chartered flights will depend on the location of the employees and the agreed terms of employment (particularly regarding fly-in fly-out). GLCI would like to hire as many local workers as possible.**

The construction phase will employ 210 workers, **to reach the maximum of 280 workers,** on average during the **15** months required to build the infrastructure. The first activities will be those associated with civil works such as the opening of the site and building of the first roads. Once the roads and worker's camp are in place, activities in the industrial and administrative area will become possible. As such, the various building structures will be assembled. Following the first months of the structure work, mechanical and electrical jobs will start (around month 6). Civil works account for most of the workforce and will be continuous throughout construction.

Figure 4-**20** illustrates the annual number of workers for the various mining operations. **Most of the available jobs will be related to extraction operations. The mine's labour force will peak at 167 in year 14 of operation.**

Table 16.13: Workforce Forecast

Department	Max	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042
Mine Operations	104	59	85	83	87	88	88	92	96	100	100	100	100	100	104	104	104	100	96	92	80
Mine Maintenance	45	18	39	41	41	41	41	41	41	41	45	41	45	41	45	45	41	45	41	40	31
Mine Geology	10	8	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	8	7
Mine Engineering	8	3	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	7	3
Total Workforce	167	88	142	142	146	147	147	151	155	159	163	159	163	159	167	167	163	163	155	147	121

Figure 4-20 Estimated number of workers during operation

Notes: Mine Operations (Opérations minières), Mine Maintenance (Entretien à la mine), Mine Geology (Géologie minière), Mine Engineering (Ingénierie minière)
Source: G Mining Services, 2021

Capital expenditures (CAPEX) for the construction of the project, including processing, mining equipment purchases, infrastructure and other direct and indirect costs are estimated at $325.75 M (Table 4-29).

Table 4-29 presents the cost breakdown. Detailed information is available in Rapport technique – Évaluation Économique préliminaire NI 43-101 (G Mining Services Inc. 2021).

Table 4-29 Estimated capital expenditures

Component	Expenditures (CAD millions)
Infrastructure	34.60
Energy and electricity	46.80
Water	20.31
Ground operations	9.26
Pit mining operations	36.93
Processing plant	64.51
Construction - indirect costs	45.34
General services	31.91
Pre-production, start-up, commissioning	4.07
Contingency	32.03
TOTAL	325.75

Source: G Mining Services, 2021

4.15 OPTIMIZATION OPPORTUNITIES CONSIDERED IN THE PROJECT

4.15.1 AIR TRANSPORT

As currently defined, the project will use the Eastmain airport to transport workers from southern Québec. Located 130 km west of the worker' camp, this airport is not equipped to receive as many travellers throughout the year. Work will be required, including installing de-icing equipment and a source of fuel supply, to improve the flow of departures and landings.

Another option **considered** is to use the Opinaca airport, 55 km east of the project site. This airport has been closed since 2013 and its facilities have been dismantled but since the runway is still usable, materials could be delivered by a Hercules-type carrier.

GLCI had the two options assessed by specialized consulting firm Octant. Both options, whether the use of the Opinaca airport runway or the Eastmain airport, present benefits and disadvantages.

The Opinaca runway is closer to the site, but is currently closed. The property is classified as a vacant land located on Category III lands and on trapline V35 owned by the Eastmain Community. Thus, occupation and construction permits, as well as land use rights would need to be requested. Furthermore, except for the runway, there is no infrastructure on site; everything would need to be built.

The Eastmain airport is farther away from the site; more hours paid to employees and transport by bus must be considered. Risks of accidents and GHG emissions would be higher.

The existing facilities are insufficient for the following reasons:

- **Fuel is not available;**
- **Ground handling equipment is insufficient;**
- **De-icing equipment is unsuitable;**
- **No hangar.**

No impact assessment is required for the work to be conducted (addition of equipment and installation of fuel tank). Despite the longer and more expensive transport of employees via the Eastmain airport, and given the timeline for construction work at Opinaca, temporary facilities should be developed at Eastmain to welcome workers for the first few years. It was therefore decided to go forward with the Eastmain airport option based on the CAPEX, and time.

4.15.2 USE OF LNG TRUCKS TO TRANSPORT CONCENTRATE TO MATAGAMI

As mentioned previously, reducing GHG emissions is an inherent priority for GLCI, a producer of lithium, the preferred source for electric vehicle batteries. At the present time, electric vehicles with the capacity required for the project activities are not available. Although LNG is a source of fossil energy, it emits 30% less GHG than diesel, the conventional energy for road transport.

Discussions were held between GLCI and Energir (Quebec's LNG supplier) in 2018, regarding the possibility of using LNG to fuel haul trucks (also valid for trucks transporting the concentrate to Matagami). Calculations under various scenarios for transporting liquefied natural gas to the mine site were then performed to compare the GHG emissions and costs of the alternatives. Thus, considering the full cycle, including the transportation of LNG (and losses during transportation and storage), the anticipated reduction in GHG emissions is minimal. These solutions will drive capital costs of the project up, without having a significant positive impact on the environment. Additional technological and health and safety risks (accidents) must also be considered. Based on this evaluation, LNG-fuelled trucks are not as beneficial a choice as it might seem at first sight. Section 3.4.2 of this study discusses the details of this approach.

4.15.3 USE OF A CONVEYOR SYSTEM TO TRANSPORT EXTRACTED ROCK ON THE MINE SITE

To reduce GHG and dust emissions, the option of installing a conveyor to transport extracted ore and waste rock the concentrator and waste rock stockpile was considered in 2018. With the project optimization, this option is no longer appropriate given the new stockpile locations, which are now closer to the pit.

4.15.4 OPTIMIZATION OF WASTE ROCK STOCKPILE

The location of the waste rock stockpile was the subject of a structured analysis of alternatives that considered various environmental, social and economic factors. Environmental and social factors were considered more than economic factors. The site selected **in 2018 had** construction constraints that significantly **increased** costs.

To reduce construction and operating costs, technical solutions other than those presented **in the 2018 impact assessment project description were studied. Based on this study, the positioning was optimized by moving the stockpiles closer to the pit to reduce transport distances and by limiting encroachment on less suitable areas such as wetlands.**

4.15.5 USE OF THE CAMP AT THE TRUCK STOP

Given the long work hours and difficult living conditions of workers on remote sites, it was decided to set up a camp on the project site so that they can walk to work, develop a sense of belonging to the company and its values and enjoy organized leisure activities that meet their needs. This permanent camp will be able to house **180** workers. More rooms will be added for the construction period **to house an additional 100 workers**.

Additional workers can evidently be lodged at the truck stop. The truck stop has 40 rooms; another 130 rooms will be required during the construction phase. Setting up additional rooms at the truck stop is possible because the sanitary and energy infrastructure can serve up to 250 people. One possible scenario is to set up 130 additional rooms for the construction period and afterwards keep about 40 for GLCI's use during occasional periods of extra visitors (e.g., industrial visits, additional work or general annual maintenance work).

The main problem with using the truck stop is that it is a public facility and alcohol is permitted whereas the worker' camp on the project site will be dry. GLCI is investigating how to manage the different conditions for employees at the truck stop and at the site.

4.16 SUSTAINABLE DEVELOPMENT PRINCIPLES APPLIED TO THE PROJECT

4.16.1 CONCEPT AND PRINCIPLES

In 2006, Québec adopted the Sustainable Development Act (CQLR, chapter D-8.1.1) in which sustainable development "means development that meets the needs of the present without compromising the ability of future generations to meet their own needs. Sustainable development is based on a long-term approach which takes into account the inextricable nature of the environmental, social and economic dimensions of development activities."

In 2015, the Council of Ministers adopted the Government Sustainable Development Strategy 2015-2020 (MDDELCC, 2015). The 2015-2020 strategy is based on the results of the Government Sustainable Development Strategy 2008-2013 (MDDELCC, 2013) (extended until December 2014) and takes into account the observations and findings of the Rapport sur l'application de la Loi sur le développement durable and the report on the state of sustainable development in Québec for the period from 2006-2012 (MDDEFP, 2013). This strategy presents the government's vision for sustainable development as well as the issues, orientations and objectives that guide the public administration in its sustainable development efforts (MDDELCC, 2018).

In general, all development projects must seek to achieve the government's sustainable development objectives:

5 Maintain environmental integrity to ensure the health and security of human communities and life-sustaining ecosystems;
6 Ensure social equity to enable the complete fulfilment of all men and women, development of communities and respect for diversity;
7 Aim for economic efficiency to create an innovative and prosperous economy that is ecologically and socially responsible.

GLCI is committed to respecting these three sustainable development objectives and will do so by applying its environmental and health and safety policies as presented in Chapter 1.

4.16.2 ACTIONS THAT COMPLY WITH SUSTAINABLE DEVELOPMENT PRINCIPLES

The Québec government sets out 16 sustainable development principles in its legislation on sustainable development (section 6). While the *Sustainable Development Act* does not apply directly to project initiators, special attention was paid to the 16 principles in this Act to ensure they are considered, to the extent possible, at the planning, design and development stages of the project. As a result, many elements respect these principles, as presented below.

Health and quality of life

> *"People, human health and improved quality of life are at the centre of sustainable development concerns. People are entitled to a healthy and productive life in harmony with nature."*

Through the measures outlined below, GLCI will help promote every individual's right to a healthy and productive life, in harmony with nature. The preservation and improvement of the quality of life of the host community were taken into consideration when planning the activities for the EIA, as evidenced by the content of this report. During the project design, innovative mitigation measures were developed for aspects of activities most likely to upset the local population. The following are just a few examples:

- **Design and location of waste rock stockpiles to reduce the distances over which waste rock and tailings are transported, thereby limiting the amount of dust and GHG emissions;**
- Healthy, balanced menus in the cafeteria for mine workers;
- Banning alcohol consumption at the mine site (including the worker camp);
- **Hiring employees trained in human resources to facilitate worker integration;**
- **Hiring of Cree women, particularly in human resources, to balance the project's impact between genders.**

Concerning the project's impact on quality of life, GLCI is committed to implementing mitigation measures to minimize the effect on health and quality of life. As well, an environmental follow-up program for aspects that directly or indirectly affect health and quality of life is proposed during the mine's construction and operation (Chapter 10).

By implementing employment and training programs for local communities and the surrounding First Nations, GLCI will indirectly contribute to improving the local population's quality of life. GLCI also intends to award contracts to qualified local entrepreneurs, which will drive job creation and economic development in the region.

GLCI will comply with the highest national and international health and safety standards to protect its workers and the surrounding community. An occupational health and safety policy and program will be introduced and presented to contractors prior to construction to ensure worker safety on the job site.

Lastly, as required by the *Mining Act* (CQLR, chapter M-13.1), a rehabilitation plan will be implemented at closure and will improve the aesthetic quality of these sites while restoring them to a satisfactory state, which at minimum will entail:

- eliminating unacceptable health risks and ensuring the safety of persons;
- limiting the production and spread of contaminants likely to affect the receiving environment and endeavouring to eliminate any form of long-term maintenance and follow-up;
- restoring the site to a visually acceptable state;
- restoring the infrastructure site to a state compatible with future use.

Social equity and solidarity

> *"Development must be undertaken in a spirit of intra- and inter-generational equity and social ethics and solidarity."*

With this project, the Eeyou Istchee James Bay (EIJB) region will benefit from the presence of a company committed to creating opportunities and supporting initiatives that meet the community's needs and priorities. This support could take the form of community involvement by GLCI and its employees, as well as partnerships, donations and sponsorships for local organizations.

As well, as stated in its policy on harassment and equal opportunity employment, GLCI intends to create a work environment where everyone can develop their talents and be successful.

The project will be developed in a manner that ensures inter-generational equity, with a view to generating benefits that will enhance the lives of future generations. For example, under the procurement strategy, long-term relationships will be established with local businesses to enable them to develop expertise that they will then be able to transfer to new projects or markets. GLCI can therefore serve as a springboard for local suppliers who, once the mine is closed, can continue their activities. Proposals will be analyzed to ensure that the major part of a locally awarded contract is not outsourced to a contractor outside the region.

GLCI has established standards and procedures on discrimination, which must be followed globally. GLCI is currently assessing the possibility of incorporating the Flexible Work Arrangement Standard (Appendix E) currently used in Australia, in order to provide added value to Canadian employees, including women who would benefit from flexible work arrangements.

The inclusion of women in training programs, the hiring of women workers and how to facilitate work-family balance will be more specifically considered and discussed as part of the Impact and Benefit Agreement process. Ongoing consultations will take place throughout the life cycle of the project to assess GLCI's role in advancing women's education, training and professional development in relation to the project.

The following is a non-exhaustive list of initiatives that will be undertaken:

- **Ensure a diverse and qualified hiring team.**
- **Establish hiring targets (screening and interview targets) for women.**
- **Share these hiring targets with employment agencies and encourage collaboration to achieve the targets.**
- **Train recruiters and managers to recognize stereotypes and cognitive biases related to the type of work women can do, and what they can do in non-traditional roles.**
- **Adopt a meritocratic process starting from the CV review and selection phase to the final offers.**

- **Expand the skills and pool of potential candidates by broadening the abilities and experience required for non-traditional roles in order to increase the number of potential candidates, expand the pool of candidates for non-traditional roles and include women from the region.**
- **Provide networking opportunities for women to share information and support each other.**
- **Where possible, offer flexible training in terms of time and location.**
- **Provide development assistance for women focusing on specific skills, such as influencing and networking, as well as specialized on-site training and development sessions.**
- **Positions in the community of Eastmain will be available in addition to positions at the mine, to allow women to stay close to their families.**

Environmental protection

> *"To achieve sustainable development, environmental protection must constitute an integral part of the development process."*

The current form of the project has been deemed to be the least harmful to the environment. Various design and development options were considered to protect the environment as much as possible, specifically, infrastructure development that keeps the facilities in the same watersheds, avoidance of sensitive areas (indigenous and natural) and footprint minimization. **Furthermore, the optimization exercise carried out for the 2021 project helped further reduce the footprint, mainly on wetlands.**

A critical analysis of this project was carried out to determine the effects on the physical, biological and social environments. GLCI and its subject matter experts have identified mitigation measures to reduce these effects. The project's insertion in the receiving environment is thus favoured and the environmental effects are minimized. Compensation measures have been planned for certain effects that could not be mitigated.

As well, the local population was consulted and suggested many ways to improve the project. **After the impact assessment was submitted to the provincial and federal ministerial authorities, new protection measures were included in the project based on the comments obtained during their analysis of the project.** Some government departments also provided validations that helped the proponent make choices consistent with environmental protection.

Once the authorizations are received, implementation of the mitigation measures by specialists will be ensured by a rigorous monitoring program during construction. All the measures will first have been incorporated into the specifications that will be given to the contractors. Lastly, the proponent will adhere to the environmental follow-up program approved by the authorities and found in the EIA.

Using the recommendations of many varied stakeholders, different forms of environmental protection have been and will be integrated into each project phase, from project development to operation.

Economic efficiency

> *"The economy of Québec and its regions must be effective, geared toward innovation and economic prosperity that is conducive to social progress and respectful of the environment."*

Thanks to transportation electrification, the lithium industry continues to grow. Rising demand for lithium means the project will be profitable and optimized.

This project will revitalize the regional economy by creating jobs and economic opportunities for local entrepreneurs and attracting huge investments. GLCI's investment in this project to date illustrates the major impact it can have in the short, medium and long term.

The operating techniques and equipment used will directly affect the complexity of the jobs that will be offered. Employees with specialized training and diverse technical skills will be sought out (mechanical, electrical, electronic, IT). Many employees will need to acquire new skills to work for the company. This is a significant aspect of the project's contribution to Québec's economic development as it offers a unique opportunity to develop local expertise.

Participation and commitment

> *"The participation and commitment of citizens and citizens' groups are needed to define a concerted vision of development and to ensure its environmental, social and economic sustainability."*

Since GLCI considers social acceptability a fundamental condition, active citizen participation is essential to the project's development. In this regard, GLCI has put in place proactive voluntary participation mechanisms, allowing all interested stakeholders to express their views on the project and send GLCI their recommendations. Among these mechanisms, the pre-consultation process and the numerous individual meetings that preceded the project allowed GLCI to meet with the citizens and groups concerned. At the meeting, GLCI presented the project in detail, answered questions, addressed concerns and made adjustments to the project.

GLCI's vision of citizen participation and engagement will translate into a project that meets the expectations of the local population.

Access to knowledge

> *"Measures favourable to education, access to information and research must be encouraged in order to stimulate innovation, raise awareness and ensure effective participation of the public in the implementation of sustainable development."*

Public consultations and information sessions to communicate information on various aspects of the project have been and will continue to be held. An effort has been made to make the communication tools easy to understand (e.g., posters and simplified information sheets). A project website and email address have also been made available to collect questions and comments from the public, as presented in Chapter 5. The website is continuously updated to ensure that people have access to the latest information.

GLCI is in discussions with the Council of the Cree Nation of Eastmain with a view to developing training programs that will allow workers from the community to access jobs at the mine. The first activity, an introduction to mining (Mining 101), was held in July 2018.

Subsidiarity

> *"Powers and responsibilities must be delegated to the appropriate level of authority. Decision-making centres should be adequately distributed and as close as possible to the citizens and communities concerned."*

Public consultation and participation meetings were held as part of the project planning and the EIA and will continue.

GLCI intends to form a committee to maintain open dialogue with stakeholders and the public. Moreover, GLCI wishes to obtain ISO:14001 accreditation to ensure the implementation of appropriate environmental management systems for an activity of this size.

Intergovernmental partnership and cooperation

> *"Governments must collaborate to ensure that development is sustainable from an environmental, social and economic standpoint. The external impact of actions in a given territory must be taken into consideration."*

GLCI has had several preliminary meetings with the provincial and federal authorities with a view to aligning the requirements of the various levels of government. The main topics covered were expectations related to the consultations, development of the project infrastructure, the cumulative effects assessment, climate change and GHGs.

Dialogue with the government authorities will continue after the EIA is filed, i.e., throughout the detailed engineering phase, to validate any changes or improvements to the project's current definition.

Prevention

> *"In the presence of a known risk, preventive, mitigating and corrective actions must be taken, with priority given to actions at the source."*

The way mining is carried out is constantly changing. Practices considered acceptable and that were permitted in the past are not necessarily so today. In the case of the project, the practices will at least meet the requirements of REMMMD, D019 and any other applicable regulations.

The proposed project will promote environmental management of the mine by using a centralized approach to water treatment and a gradual rehabilitation of part of the site.

A risk assessment for accidents or natural events has been completed as part of this EIA and preventive actions have been incorporated into industrial developments and processes to reduce, at the source, the environmental risks associated with HAZMAT storage and use, for example:

- the connection to the Hydro-Québec grid due to economic and environmental considerations (versus the use of diesel);
- on-site storage of minimum amounts of hazardous products required for operations;
- the implementation of measures to minimize the environmental consequences in the event of a spill (e.g., double-walled tanks, concrete slabs under all at-risk infrastructures);
- deforestation of a perimeter of 35 metres around at-risk developments to limit the spread of wildfires around the site.

The results of the risk assessment have been incorporated into the Emergency Measures Plan (EMP) to consider the risks associated with the project.

Lastly, an environmental monitoring and follow-up program has been developed and will be implemented at the start of construction to confirm the anticipated effects of the project.

With respect to the prevention of occupational safety risks, the design team's priority was to reduce staff exposure to potential safety risks by eliminating them at the source, which is very different from an approach that identifies and controls risks. Many of the technologies developed by the industry in recent years have been specifically designed to reduce employee exposure to risks (e.g., emissions, dust). This was evident in GLCI's choice of such equipment as drones, which make it possible to visualize watercourses.

Precaution

> *"When there are threats of serious or irreversible damage, lack of full scientific certainty must not be used as a reason for postponing the adoption of effective measures to prevent environmental degradation."*

Inherent project risks were reported to GLCI throughout the design phase and corrective measures were implemented. The goal was to reduce all risks to an acceptable level.

Some sector studies conducted as part of the EIA are based on projected scenarios in the operation phase. This is the case for, among others, the studies on noise, vibrations, air quality and hydrogeology, for which modelling was required. In all cases, conservative assumptions were used that represented the worst theoretical case to ensure compliance with existing standards.

Preventively, samples of various media were collected and analyzed for metal content. This baseline condition will make it possible to compare the initial condition with the condition after the project if environmental risks were to be identified later. This includes the quality of surface water, groundwater, soil, sediment and plants likely to be consumed by the Crees.

Protection of cultural heritage

> *"The cultural heritage, made up of property, sites, landscapes, traditions and knowledge, reflects the identity of a society. It passes on the values of a society from generation to generation and the preservation of this heritage fosters the sustainability of development. Cultural heritage components must be identified, protected and enhanced, taking their intrinsic rarity and fragility into account."*

As part of the impact study, some complementary work pertaining to the cultural heritage was carried out:

- interviews with tallymen and their families to document land use;
- a review of the literature on traditional knowledge, particularly as it relates to medicinal plants;
- visual simulations integrating viewpoints valued by users of the territory;
- a study on the archaeological potential and an inventory of heritage elements.

In this regard, GLCI undertakes to carry out a complementary archaeological study of sites with archaeological potential near the project infrastructure to ensure the heritage is preserved. **The inventory work will be completed in July 2021.**

Biodiversity preservation

> *"Biological diversity offers incalculable advantages and must be preserved for the benefit of present and future generations. The protection of species, ecosystems and the natural processes that maintain life is essential if quality of human life is to be maintained."*

Thanks to the wildlife and plant inventories carried out during the sector studies, any impact on valued species was, to the extent possible, avoided and when it could not be avoided, mitigation measures were added. Also, the timing of construction, specifically land clearing, has been adjusted to limit the effect on sensitive species on the territory as well as on the bird nesting period.

Respect for ecosystem support capacity

> *"Human activities must be respectful of the support capacity of ecosystems and ensure the perenniality of ecosystems."*

Some components of the project have been planned with a view to limiting GHG emissions. For example, shuttles will be used to transport workers from the Eastmain Cree community to the camp, substantially reducing the number of vehicles on the road and the associated GHG production. **The acquisition of electric auxiliary vehicles (forklifts, buses, pick-up trucks) will also help reduce GHG emissions. There are also plans to install electric vehicle charging stations in the community of Eastmain. The exact location of these stations will be determined in collaboration with the community of Eastmain.**

The size of the trucks to be used on the site has been increased, thus reducing the total number of trucks on site. The waste rock stockpiles were also repositioned during project optimization to reduce transportation distances, thereby reducing GHG production.

Concerning the aquatic environment, the location of the project infrastructure was determined based on the boundaries of the watersheds. Most of the redirected waters will remain within the boundaries of their current watersheds, except for pit dewatering. In addition, **effluent** monitoring is planned to ensure compliance with standards.

Other mining projects near the site were considered in the project design. GLCI has initiated contact with these companies to discuss their lessons learned and adjust its project accordingly.

Finally, it should be remembered that the objective of the project is to extract lithium, which is mainly used in the production of batteries. Although GHG emissions are considered in mining production, the production of batteries for the sale of electric vehicles will have a major effect on the atmospheric carrying capacity.

Responsible production and consumption

> *"Production and consumption patterns must be changed in order to make production and consumption more viable and more socially and environmentally responsible, in particular through an eco-efficient approach that avoids waste and optimizes the use of resources."*

Throughout the design stage, GLCI chose to optimize its project by implementing measures to reduce resource consumption. GLCI recognizes that the mining industry has left mine sites rehabilitated to the standards of the time, which are not the same as those of today. Consequently, major efforts have been made to carefully plan a cost-effective waste rock and tailings management regime that meets today's environmental regulatory requirements and minimizes the visual impact for communities. Thus, the **combined waste rock and tailings stockpiles will** reduce the project's footprint and limit environmental risks.

The optimization of resource use through innovative production techniques has been extensively documented in chapters 3 and 4. As an example, **the water** will be recycled in the process to limit fresh water supply. Concerning rehabilitation of the sites where the infrastructure will be dismantled, the grounds will be decontaminated if necessary and then covered with overburden.

Polluter pays

> *"Those who generate pollution or whose actions otherwise degrade the environment must bear their share of the cost of measures to prevent, reduce, control and mitigate environmental damage."*

All costs for pollution prevention equipment will be borne by the project and impacts that will not be fully mitigated may be subject to compensation measures. In addition, during the construction phase, contractors will be required to comply with the environmental clauses, failing which they will have to assume the costs to rectify the situation.

GLCI does not expect to be subject to the Québec cap-and-trade system (SPEDE). It would not have to bear any costs related to GHG production. However, it will eventually have to pay the annual fees provided for contaminant emissions, in accordance with the Guide explicatif - Droits annuels exigibles des titulaires d'une attestation d'assainissement en milieu industriel (MDDELCC, 2016).

Internalization of costs

> *"The value of goods and services must reflect all the costs they generate for society during their whole life cycle, from their design to their final consumption and their disposal."*

GLCI has no control over the value of lithium on the market. However, operating expenses certainly cover the costs associated with conformance to environmental requirements and with payroll taxes in force in Québec and in Canada (for example but without limitation, the Québec Pension Plan, Employment Insurance, CNESST, etc.).

Since 2013, the *Regulation respecting mineral substances other than petroleum, natural gas and brine Mining Act* imposes an obligation to provide a financial guarantee covering 100% of the site rehabilitation cost. The cost of restoring the site has been included in the project's financial arrangement.

Synergy with other projects

Synergy with other mining projects is very difficult for various reasons. While GLCI is willing to consider coordinated training efforts in the future, this is more difficult in the short term since other projects in the region have different timelines and project schedules because they are in different phases of development than GLCI. As for waste management, it will likely be entrusted to a contractor from the James Bay region. This contractor will coordinate different types of waste collection and ensure proper disposal. There are no opportunities for transportation coordination as there is too much distance between the mining projects. Opportunities have not been considered for ore processing as other mining projects are in competition with GLCI.